

**Regional Information Report No. 2A11-01**

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**A Program for Improving Fisheries Management and  
Research in Central Region – Project Blue Book  
FY 2012**

by

**Lowell F. Fair**

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October 2011

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics</b>	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	$H_A$
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	$e$
hectare	ha	at	@	catch per unit effort	CPUE
kilogram	kg	compass directions:		coefficient of variation	CV
kilometer	km	east	E	common test statistics	(F, t, $\chi^2$ , etc.)
liter	L	north	N	confidence interval	CI
meter	m	south	S	correlation coefficient	
milliliter	mL	west	W	(multiple)	R
millimeter	mm	copyright	©	correlation coefficient (simple)	r
		corporate suffixes:		covariance	cov
<b>Weights and measures (English)</b>		Company	Co.	degree (angular)	$^\circ$
cubic feet per second	ft <sup>3</sup> /s	Corporation	Corp.	degrees of freedom	df
foot	ft	Incorporated	Inc.	expected value	$E$
gallon	gal	Limited	Ltd.	greater than	>
inch	in	District of Columbia	D.C.	greater than or equal to	$\geq$
mile	mi	et alii (and others)	et al.	harvest per unit effort	HPUE
nautical mile	nmi	et cetera (and so forth)	etc.	less than	<
ounce	oz	exempli gratia	e.g.	less than or equal to	$\leq$
pound	lb	(for example)		logarithm (natural)	ln
quart	qt	Federal Information Code	FIC	logarithm (base 10)	log
yard	yd	id est (that is)	i.e.	logarithm (specify base)	log <sub>2</sub> , etc.
		latitude or longitude	lat. or long.	minute (angular)	'
<b>Time and temperature</b>		monetary symbols (U.S.)	\$, ¢	not significant	NS
day	d	months (tables and figures): first three letters	Jan,...,Dec	null hypothesis	$H_0$
degrees Celsius	°C	registered trademark	®	percent	%
degrees Fahrenheit	°F	trademark	™	probability	P
degrees kelvin	K	United States (adjective)	U.S.	probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
hour	h	United States of America (noun)	USA	probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
minute	min	U.S.C.	United States Code	second (angular)	"
second	s	U.S. state	use two-letter abbreviations (e.g., AK, WA)	standard deviation	SD
<b>Physics and chemistry</b>				standard error	SE
all atomic symbols				variance	
alternating current	AC			population	Var
ampere	A			sample	var
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

***REGIONAL INFORMATION REPORT NO. 2A11-01***

**A PROGRAM FOR IMPROVING FISHERIES MANAGEMENT AND  
RESEARCH IN CENTRAL REGION – PROJECT BLUE BOOK FY 2012**

by

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The Regional Information Report Series was established in 1987 and was redefined in 2006 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at <http://www.adfg.alaska.gov/sf/publications/>.

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# TABLE OF CONTENTS

	Page
LIST OF TABLES.....	ii
ABSTRACT .....	1
OVERVIEW.....	1
Bristol Bay Fisheries Overview .....	2
Bristol Bay Fisheries Management .....	3
Proposed Projects .....	4
Nushagak River Sonar Extension .....	5
Kvichak River Sockeye Smolt Enumeration .....	5
District Catch Sampling Improvements .....	5
Naknek River Sockeye Smolt Mark–Recapture .....	6
Alagnak River Sockeye Smolt Mark–Recapture .....	6
Togiak River Sockeye Escapement Using Sonar.....	6
Escapement Monitoring Using Video.....	7
Research and Management Internship .....	7
Togiak Herring Biomass Estimation.....	8
COOK INLET .....	8
Introduction .....	8
Cook Inlet Fisheries Overview .....	8
Cook Inlet Fisheries Management .....	9
Proposed Projects .....	9
Susitna Sockeye Genetic Mark–Recapture .....	10
Kenai Sockeye Smolt Abundance.....	10
Offshore Test Fishery Improvement.....	11
Kasilof Smolt Abundance.....	11
ASL Data Entry .....	12
Kenai and Skilak Lake Studies .....	12
UCI Mark–Recapture Salmon Population Estimate .....	12
Escapement Monitoring Using Video.....	13
Kachemak Bay Large-mesh Trawl Survey .....	13
Kamishak Bay Large-mesh Trawl Survey .....	14
Management and Research Assistance .....	15
Research and Management Internship .....	15
Herring Aerial Surveys .....	16
Herring AWL Sampling.....	16
PRINCE WILLIAM SOUND.....	17
Introduction .....	17
Prince William Sound Fisheries Overview .....	17
Prince William Sound Fisheries Management.....	18
Proposed Projects .....	19
Pink Salmon Straying .....	19
Chum Salmon Straying .....	20
Otolith Marking Wild Pink Salmon Fry .....	20
Pink Salmon Juvenile Outmigration .....	20
Pink Salmon Otolith Recovery .....	21
Chum Salmon Otolith Recovery.....	21
Copper River and Main Bay Otolith Recovery.....	21
Copper and Bering River Sockeye Salmon Remote Video.....	22

## TABLE OF CONTENTS (Continued)

	<b>Page</b>
Eshamy River Sockeye Salmon Remote Video .....	22
Aerial Survey Ground Truthing .....	23
Expanded Pink Salmon Adult Sampling.....	23
Additional Aerial Surveys .....	23
Research and Management Internship .....	24
Prince William Sound Large-mesh Trawl Survey .....	24
Sablefish Tag and Recapture Survey .....	25
Herring Aerial Surveys .....	25
Hydroacoustics Herring Survey .....	26
Herring Disease Studies .....	26
Herring Energetic Content .....	27
Herring Spawn Deposition Surveys.....	27
Juvenile Herring Aerial Surveys .....	27

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1. Summary of prioritized Bristol Bay projects and estimated costs (in thousands of dollars). .....	4
2. Summary of prioritized Cook Inlet projects and estimated costs (in thousands of dollars). .....	10
3. Summary of prioritized Prince William Sound projects and estimated costs (in thousands of dollars). .....	19
4. Summary of Central Region projects (prioritized by area) and estimated costs in thousands of dollars.....	28
5. Proposed FY 12 Central Region fisheries projects and estimated cost (thousands of dollars), listed in descending order of priority. ....	29

## ABSTRACT

This document covers all aspects of Central Region commercial fisheries, including salmon, herring, groundfish, and invertebrates (shellfish) from Bristol Bay, Cook Inlet, and Prince William Sound (PWS). Each of the 3 main geographic areas of Central Region has a single list of projects inclusive of all species. The overall goal of these projects is to provide critical information that will result in sustainable commercial fishing opportunities for Alaskan fishermen through responsible management.

Key words Central Region, Bristol Bay, Cook Inlet, Prince William Sound, salmon, herring, groundfish and shell fish, Blue Book.

## OVERVIEW

This document covers all aspects of Central Region commercial fisheries, including Pacific salmon (*Oncorhynchus* spp.), Pacific herring (*Clupea pallasii*), groundfish (eg. *Sebastes* spp.), and invertebrates (shellfish) from Bristol Bay, Cook Inlet, and Prince William Sound (PWS). Each of the 3 main geographic areas of Central Region has a single list of projects inclusive of all species. The proposed projects in this document represent important projects that are either not conducted, or those that are funded through either unstable Test Fish receipts or temporary sources (i.e., not General Fund). The overall goal of these projects is to provide critical information that will result in sustainable commercial fishing opportunities for Alaskan fishermen through responsible management. Programs funded by Test Fish receipts require the State of Alaska, Department of Fish and Game (ADF&G) to catch and sell salmon to pay for projects. This diverts staff time away from critical management and research functions, and reduces user allowable harvests.

The proposed projects cover a wide range of research and management needs. To provide a sense of importance, project lists are ordered by priority and area. In ranking these projects, consideration was given first to projects that improve management of commercial fisheries by providing inseason tools or collecting data that provides a better understanding of stock-specific productivity. In general, projects for larger, more valuable fisheries take precedence over less valuable fisheries.

The internship projects located in each area of the region addresses the difficulty of recruiting and hiring highly qualified and experienced fishery biologists. Under these projects, ADF&G supports research related to commercial fisheries that develops prospective employees through improved qualifications and experience.

Salmon fisheries in Central Region are the most commercially valuable species, and as such, are heavily funded in management and research. Salmon projects considered for inclusion in this document do at least one of the following: (1) help ensure the achievement of sustainable escapement goals, essential for healthy, productive runs that provide long-term opportunities for commercial fishermen to harvest available surpluses; (2) improve our ability to estimate spawning abundances for commercially viable species; (3) advance aspects of catch sampling and/or stock identification in mixed stock fisheries; (4) increase our understanding of freshwater productivity, a critical component to accurately forecasting returns and assessing escapement goals; or (5) advance our understanding of hatchery runs such that hatchery fish do not negatively impact wild salmon stocks.

Central Region herring fisheries have occurred in each of the 3 regional geographic areas. Since 2000, Togiak District has had the only viable commercial fishery in the region. Other areas in

the region having previously had viable herring fisheries include 4 of the 5 Lower Cook Inlet (LCI) management districts (Eastern, Kamichak Bay, Outer, Southern) and the PWS fishery, last fished in 1999. There is a very small herring fishery in Upper Subdistrict of Upper Cook Inlet (UCI) that occurs each year. In general, herring programs in each area have diminished from what they were 10 to 20 years ago. Given this change, there is a strong need for basic research projects to help with better understanding abundance, spawning distribution, and age, sex, and size composition, each of which is necessary to estimate annual abundance and biomass. As such, herring projects included in the blue book directly relate to stock assessment. For example, herring do not begin recruiting to commercial fisheries in Central Region until about age 3, and to reliably estimate their abundance it is necessary to sample later (beyond what is currently funded) in the run since they typically arrive at the spawning grounds after older fish. Herring management is fairly uniform throughout Central Region where the strategy is to forecast the population size from a combination of age composition, catch information, and aerial surveys. Generally, the preseason forecast establishes harvest levels, demonstrating the importance of maintaining program stability in providing accurate population assessments.

Groundfish and invertebrates provide important commercial fisheries in PWS and LCI. The specific species of interest and associated fishing activities occur within waters subject to the jurisdiction of the State of Alaska. Typically, these marine species are difficult and costly to study. Some of the proposed projects evaluate various sampling methods to improve assessment precision. The proposed projects provided herein will gather biological and life history information for various groundfish and invertebrate species having commercial importance (e.g., crab (e.g., *Chionoecetes* spp.), shrimp (e.g., *Pandalus* spp.), scallops (e.g., *Patinopecten caurinus*), pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*) and rockfishes).

## **BRISTOL BAY**

### **INTRODUCTION**

#### **Bristol Bay Fisheries Overview**

The 5 species of Pacific salmon found in Bristol Bay are the focus of major commercial, subsistence, and sport fisheries. The sockeye salmon (*O. nerka*) fishery is the largest and most valuable commercial fishery of its kind in the world.

Approximately 2,900 Limited Entry permit holders and 40 processing companies annually participate in the commercial salmon fishery. Most permit holders hire additional crewmembers, and processing plants employ many permanent and seasonal workers. Approximately 70% of the permit holders are Alaska residents, and about half of those live within the Bristol Bay region. The Bristol Bay commercial salmon fishery is an important element of the local and Alaska economy with an exvessel value ranging from about \$32 million to \$116 million over the past 10 years. However, low fish prices have affected the fishery in recent years, reaching a low of \$0.42 in 2001, but slowly climbing to \$0.68 in 2008.

Sockeye salmon in Bristol Bay fell to a low commercial harvest of 743 thousand and a low total run of 3.5 million in the early 1970s. In an effort to restore salmon runs, the State of Alaska invested an increasing amount of General Fund dollars to improve management, expand research, and provide a more comprehensive plan. By the late 1970s, salmon runs increased because of favorable environmental conditions, curtailment of high seas fishing, and ADF&G's

enhanced research and management capability. The largest Bristol Bay sockeye salmon run occurred in 1995, yielding a commercial harvest of 44 million. Since then, runs and harvests have been highly variable. The smaller harvests of 1997, 1998, and 2002 (10–12 million) resulted in disaster declarations. Fortunately, harvests from 2004 to 2008 have been stronger, averaging 27 million. Other commercially important salmon species include Chinook (*O. tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), and even-year pink (*O. gorbuscha*) salmon.

Pacific herring have been documented throughout Bristol Bay, but the major concentration spawns in the Togiak area each spring and is the focus of sac roe and spawn-on-kelp fisheries. In Togiak District, herring are commercially harvested for sac roe using gillnets and purse seines while spawn on rockweed kelp is harvested by hand. Total exvessel value has been as high as \$16.7 million in the mid 1990s, averaging \$3.3 million over the past 10 years with harvests typically around 20,000 tons. Participation peaked around 300 seiners and 460 gillnetters, plus about 300 spawn-on-kelp permit holders, which is the only component of the fishery that is currently limited. Recent participation is much smaller than historical highs, with the number of seiners around 30 and the number of gillnetters around 60. Although the Togiak sac roe fishery has experienced a recent reduction in exvessel value and effort, the annual harvest level of 15,000 to 20,000 tons makes it the largest herring fishery in the U.S.

### **Bristol Bay Fisheries Management**

Management of the commercial salmon fishery in Bristol Bay is focused on discrete stocks with harvests directed at terminal areas around the mouths of major river systems. Each stock is managed to achieve a spawning escapement goal based on sustained yield. Escapement goals are achieved by regulating fishing time and area by emergency order (EO) and/or adjusting weekly fishing schedules.

Sockeye salmon runs in Bristol Bay are primarily produced from 9 major river systems: Alagnak, Egegik, Igushik, Kvichak, Naknek, Nushagak, Togiak, Ugashik, and Wood. A number of smaller rivers, such as the Kulukak and Snake, produce smaller runs. Sockeye salmon returning to each major river system are managed to achieve escapement goals designed to produce sustainable yields. To best facilitate discrete stock management, commercial fishing is limited to 5 relatively small fishing districts near the mouths of the major river systems: Egegik, Naknek-Kvichak, Nushagak, Togiak, and Ugashik. Districts with multiple major spawning systems have been further divided into sections to better focus fishing effort on discrete stocks. Runs to each major river system are managed independently based primarily on information about escapement, catch, and timing.

Many of the projects currently in place provide direct information to estimate exploitation rates, create pre-season run forecasts, and develop escapement goals. Forecasts are used by the processors to make decisions about staffing, supply requirements, and the number of contracted tenders. Similarly, fishermen use forecasts to make decisions about staffing, supply requirements, and where to fish. Forecasts are developed using information on age, abundance (adult, smolt), and genetic stock composition of catch.

As adult sockeye salmon enter Bristol Bay, some are sampled in gillnets at stations spaced along a transect running offshore of Port Moller. This project gives a sense of total run size, and by sampling fish for age, length, and genetic markers, it provides information about stock-specific returns to the commercial fishing districts and major river systems.

As sockeye salmon arrive in individual districts, commercial catches, district test fisheries, and aerial surveys help assess run size and timing. Once sockeye salmon move through the fishing districts and into rivers, abundance may be monitored by inriver test fisheries (Kvichak, Egegik, and Ugashik rivers) and/or aerial surveys. A final estimate of spawning abundance is determined once they reach assessment projects that use sonar (Nushagak River) or towers (all other major rivers). Sampling programs provide estimates of sex, age, and length. Aerial surveys are used to monitor the distribution of spawners in some of the major systems as well as index spawning escapement into systems without towers or sonar projects.

Inriver test fishing projects are important inseason management tools for Egegik, Kvichak, and Ugashik rivers as they provide timely escapement indices 1–3 days before counts are obtained at the towers. This information helps ensure escapement goals are met while optimizing sustainable harvests.

The Bristol Bay Herring Management Plan (BBHMP; 5 AAC 27.865) sets a maximum 20% exploitation rate for the Togiak District stock. The BBHMP states the sac roe fishery’s primary objective is to prosecute an orderly, manageable fishery while striving for the highest level of product quality with minimal waste.

## PROPOSED PROJECTS

The following section lists projects critical to evaluating and improving Bristol Bay fishery management (Tables 1 and 4).

Table 1.–Summary of prioritized Bristol Bay projects and estimated costs (in thousands of dollars).

	Estimated First Year Cost	Estimated Continuation Cost	Duration
Nushagak River Sonar Extension	\$80.0	\$80.0	Long Term
Kvichak River Sockeye Smolt Enumeration	\$40.0	\$40.0	Long Term
District Catch Sampling Improvements	\$50.0	\$50.0	Long Term
Naknek River Sockeye Smolt Mark–Recapture	\$120.0	\$100.0	Long Term
Alagnak River Sockeye Smolt Mark–Recapture	\$120.0	\$100.0	Long Term
Togiak River Sockeye Escapement Using Sonar	\$150.0	\$60.0	Long Term
Escapement Monitoring Using Video	\$60.0	\$40.0	Long Term
Research & Management Internship	\$60.0	\$60.0	Long Term
Togiak Herring Biomass Estimation	\$40.0	\$40.0	Long Term

## **Nushagak River Sonar Extension**

Location: Nushagak River.

Primary Objective: Obtain estimates of abundance, age, size, and sex of coho and pink salmon entering the Nushagak River.

Description/Purpose: Currently, DIDSON is used to estimate sockeye, chum, and Chinook salmon escapement in the Nushagak River. Existing funds only operate the project from early June to about July 20, prior to the arrival of most coho and pink salmon. The funding for this project would allow us to estimate coho and pink salmon until August 20. In addition to counting coho and pink salmon using DIDSON, gillnets will be drifted regularly to apportion sonar counts to species. The operation of this project is important because there has been renewed interest in commercially harvesting coho and pink salmon in Nushagak District. Presently, there is no inseason assessment for either species beyond commercial harvest numbers.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$80.0

## **Kvichak River Sockeye Smolt Enumeration**

Location: Kvichak River.

Primary Objective: Obtain estimates about Kvichak River sockeye salmon smolt abundance, age, and size.

Description/Purpose: Currently, in cooperation with the Bristol Bay Science & Research Institute, sockeye salmon smolt abundance is estimated as they migrate seaward from the Kvichak River using a newly designed, experimental up-looking sonar system. After 2 years, the new sonar system appears promising. Age and size information is collected from smolt with fyke nets and/or inclined plane traps. Smolt numbers and biological information provide critical data to evaluate freshwater production, develop escapement goals, and forecast adult returns. At present, there is no dedicated ADF&G funding source for this project. If successful, project expansion will include the revitalization of Egegik and Ugashik river smolt projects.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$40.0

## **District Catch Sampling Improvements**

Location: Bristol Bay.

Primary Objective: Improve set net and drift catch genetic stock composition by better separating their catch samples.

Description/Purpose: Current wisdom is that stock composition of set net and drift catches are likely to be significantly different; however, current analyses combine the two gear types into a single estimate. To improve resolution, steps will be taken in the existing catch sampling program to separate and analyze set net and drift catches for genetic stock identification.

Additional personnel and genetic samples will be required. The result will be improved catch estimates by stock, leading to more reliable brood tables for estimating stock-specific exploitation rates, escapement goals, future returns, etc.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$50.0

### **Naknek River Sockeye Smolt Mark–Recapture**

Location: Naknek River.

Primary Objective: Obtain estimates about Naknek River sockeye salmon smolt abundance, age, and size.

Description/Purpose: Sockeye salmon smolt will be estimated as they migrate seaward from the Brooks Lake system using inclined plane traps and mark–recapture techniques. Age and size information will be collected from sockeye salmon smolt captured near the counting site. Concurrently, fish traps will capture fish coming out of Naknek Lake. Samples from Naknek River fish will be genetically identified to spawning population, including the Brooks Lake proportion, which will then be expanded to estimate the total Naknek River smolt abundance. Smolt numbers and biological information provide data to evaluate freshwater production, develop escapement goals, and forecast adult returns.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$120.0 (\$100.0 for first year due to equipment purchase).

### **Alagnak River Sockeye Smolt Mark–Recapture**

Location: Alagnak River.

Primary Objective: Obtain estimates about Alagnak River sockeye salmon smolt abundance, age, and size.

Description/Purpose: Sockeye salmon smolt will be estimated as they migrate seaward from the Nonvianuk Lake system using inclined plane traps and mark–recapture techniques. Age and size information will be collected from sockeye salmon smolt captured near the counting site. Concurrently, fish traps will capture fish coming out of the Alagnak River below its confluence with the Nonvianuk River. Samples from Alagnak River fish will be genetically identified to spawning population, including the Nonvianuk Lake proportion, which will then be expanded to estimate the total Alagnak River smolt abundance. Smolt numbers and biological information provide data to evaluate freshwater production, develop escapement goals, and forecast adult returns.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$120.0 (\$100.0 for first year due to equipment purchase).

### **Togiak River Sockeye Escapement Using Sonar**

Location: Togiak River.

Primary Objective: Obtain estimates of the abundance, age, size, and sex of sockeye and other salmon entering Togiak River.

Description/Purpose: Sockeye and other salmon will be counted using DIDSON as they migrate up the Togiak River. Age, size, and sex information will be collected from all salmon species. Escapement and biological information provide data for inseason management and escapement goal development. Currently, Togiak Lake sockeye salmon escapement is estimated with counting towers. Unfortunately, sockeye salmon travel time from the fishing district to the tower site is too long (~ 7–10 days) for timely inseason management. Sockeye and other salmon entering the drainage below the counting tower are currently estimated from fixed-wing aircraft with estimates that are much less accurate and precise.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$60.0 (purchase of sonar equipment and camp gear will increase the first year cost to about \$150.0).

## **Escapement Monitoring Using Video**

Location: Bristol Bay.

Primary Objective: Improve estimates of the abundance of salmon entering selected Bristol Bay systems to spawn.

Description/Purpose: The use of video cameras to count Pacific salmon in Bristol Bay will be evaluated. In Bristol Bay, there are a large number of small river systems for which there is no sockeye salmon escapement estimation. Additionally, relatively little escapement information is collected for other salmon species. Reliable abundance data allows managers to evaluate salmon populations that might be important in further refining management strategies. Where applicable, a video project could decrease the current cost of escapement monitoring or increase the number of monitored systems. An additional benefit is that video equipment provides a visual record of salmon passage for future review and analysis. Escapement projects provide data needed to evaluate management strategies, better understand stock productivity, and develop escapement goals.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$40.0 (purchase of video equipment and camp gear will increase the first year cost to about \$60.0).

## **Research and Management Internship**

Location: Anchorage, Dillingham and/or King Salmon.

Primary Objective: Provide funding for up to 2 college fisheries students focusing on research or management projects that improve Bristol Bay fisheries management.

Description/Purpose: This project will provide salary and project support for 2 college students majoring in fisheries or a closely related field. Working with area and regional staff, these students will plan and carry out independent research projects that aid in management of Bristol Bay commercial fisheries. Students will work half time during the school year and full time

during the field season. At completion, students will be qualified to move into permanent positions in ADF&G.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$60.0

## **Togiak Herring Biomass Estimation**

Location: Togiak District.

Primary Objective: Estimate spring herring biomass and distribution.

Description/Purpose: For this project, ADF&G will utilize a helicopter to provide daily spring herring biomass estimates and area distribution for managing the commercial sac roe and kelp fisheries. This project will extend the current inseason aerial survey dates to better capture the later returning, younger age component, important for estimating total run biomass and forecasting future runs.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$40.0

# **COOK INLET**

## **INTRODUCTION**

### **Cook Inlet Fisheries Overview**

The Cook Inlet Management Area includes both UCI and LCI, and supports drift gill net, set gill net, and purse seine salmon fisheries. At various times since statehood, commercial fisheries for herring, groundfish, and invertebrates have also occurred.

About 570 drift gillnet, 740 set gillnet, and 80 purse seine permit holders harvest all 5 species of Pacific salmon with sockeye salmon the most numerous and most valuable. Alaska residents make up roughly 80% of the approximate 1,400 total permit holders. The Kenai Peninsula Borough estimates that the fishing industry is responsible for 20% of the Kenai Peninsula jobs. The 10-year average exvessel value of the fishery is about \$18 million.

Salmon fisheries in UCI target mainly sockeye salmon with secondary catches of chum and coho salmon. Sockeye salmon runs in UCI are supported primarily by production from 4 major river systems; Kenai, Kasilof, Susitna, and Crescent. Hatchery production is minor in UCI, accounting for less than 5% of the total salmon run.

Salmon fisheries in LCI target mainly pink and chum salmon. Natural runs for these species have improved in recent years, while prices have remained severely depressed. Hatcheries operated by Cook Inlet Aquaculture Association have contributed significantly to the sockeye and pink salmon harvest in LCI, with sockeye salmon from lake stocking projects becoming the single most valuable component of the catch.

Herring fisheries in UCI reopened in 1998 after a 5 year closure. About 15 fishermen typically fish Upper Subdistrict where 4–20 tons per year have been harvested since 1998. These fish are

used primarily for bait in sport charter fisheries. A commercial fishery for smelt was reopened by the BOF in 2005. The total harvest may not exceed 100 tons.

In LCI between 1985 and 1998, up to 74 purse seine permits have harvested as much as 6,100 tons of herring valued at \$9.3 million. However, due to a decline in abundance, the LCI herring fishery has been closed since 1999 except for 2002, whereby fishermen harvested 2 tons from Tuxedni Bay.

Cook Inlet has also historically supported a groundfish fishery. Under state regulation, groundfish are defined as all marine finfish except halibut, smelts, herring, and salmon. In 2004, the groundfish harvest totaled 3.1 million pounds and generated an estimated exvessel value of \$1.1 million. The 2004 total harvest was the highest in more than 3 years but below fishery yields in the mid to late 1990s. Pacific cod has annually comprised the greatest economic yield from Cook Inlet commercial groundfish harvests since 1990.

ADF&G manages the commercial and personal use fisheries for Dungeness crab, shrimp, weathervane scallops, hardshell clams, blue mussels, and miscellaneous invertebrates such as octopus, green urchin, and sea cucumber. Commercial, sport, and personal use fishing seasons for shrimp fisheries were closed by regulation beginning in 1997 due to low abundance. Similar regulations closed commercial fisheries for green urchin, sea cucumber, Dungeness crab, and the directed fishery for octopus.

### **Cook Inlet Fisheries Management**

UCI salmon management primarily utilizes a combination of catch sampling, test fishing, and escapement monitoring by sonar and weirs in the major sockeye salmon producing rivers to assess surplus harvest consistent with the UCI Salmon Management Plan and other applicable management plans.

LCI salmon management uses a combination of aerial and ground surveys, weirs, and video equipment to assess escapements and run strength, hatchery contribution, and run timing. The management strategy maximizes harvests of surplus salmon in stock-specific terminal harvest areas while simultaneously meeting escapement goals and minimizing harvests of non-target stocks.

Gillnets are the only legal gear allowed in the UCI herring fisheries, with set gillnets the primary gear type. Gill nets are considerably less efficient at capturing herring than purse seines. Moreover, there are conservative guideline harvest levels in place that only provide for a low-level commercial fishery. Currently, herring harvested in UCI go to personal use or bait. The herring fishery closures in PWS and Kamishak Bay have caused UCI bait herring values to rise.

Groundfish and invertebrate management strategies are widely diverse, depending on species and location. Likewise, the gear used to harvest these species covers a wide range of means and methods.

### **PROPOSED PROJECTS**

The following section lists projects critical to evaluating and improving Cook Inlet fishery management (Tables 2 and 4).

Table 2.–Summary of prioritized Cook Inlet projects and estimated costs (in thousands of dollars).

	Estimated First Year Cost	Estimated Continuation Cost	Duration
Yentna Sockeye Genetic Mark–Recapture	\$20.0	\$20.0	Long Term
Kenai Sockeye Smolt Abundance	\$60.0	\$60.0	Long Term
Offshore Test Fishery Improvement	\$175.0	\$150.0	3-4 Years
Kasilof Sockeye Smolt Abundance	\$30.0	\$30.0	Long Term
ASL Data Entry	\$30.0		1 Year
Kenai and Skilak Lake Studies	\$75.0	\$75.0	Long Term
UCI Mark–Recapture Salmon Population Estimate	\$993.0	\$993.0	5 Years
Escapement Monitoring Using Video	\$80.0	\$60.0	Long Term
Kachemak Bay Large-mesh Trawl Survey	\$50.0	\$50.0	Long Term
Kamishak Bay Large-mesh Trawl Survey	\$74.0	\$74.0	Long Term
Trawl Gear Efficiency	\$45.0	\$45.0	Long Term
Management and Research Assistance	\$50.0	\$50.0	Long Term
Research & Management Internship	\$60.0	\$60.0	Long Term
Herring Aerial Surveys	\$25.0	\$25.0	Long Term
Herring AWL Sampling	\$35.0	\$35.0	Long Term

### **Susitna Sockeye Genetic Mark–Recapture**

Location: Susitna River.

Primary Objective: Estimate the escapement of sockeye salmon into the Yentna River postseason using a genetic-based mark–recapture method.

Description/Purpose: This project will use a genetic-based mark–recapture method to estimate sockeye salmon escapement into the Yentna River, a major tributary of the Susitna River. Tissue samples will be collected from approximately 400 sockeye salmon captured in fish wheels operated along both banks at the ADF&G Yentna River sonar site between approximately July 7 and August 15. The ADF&G Gene Conservation Laboratory in Anchorage genetically analyze the samples to estimate the proportion destined for Judd and Chelatna lakes. The total Yentna River sockeye salmon escapement will be estimated using Judd and Chelatna lake sockeye salmon weir counts (existing ADF&G project) and stock proportions estimated from fish wheel samples.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$20.0

### **Kenai Sockeye Smolt Abundance**

Location: Kenai River.

Primary Objective: Estimate Kenai River sockeye salmon smolt abundance.

Description/Purpose: This project will use mark–recapture methods to estimate the population size of sockeye salmon smolt emigrating from the Kenai River. A high-speed mid-water trawl will be deployed near the Kenai Keys on the Kenai River from early May through late June.

Sockeye salmon smolt will be marked each week using a dye solution and recaptures of dyed smolt will be used to estimate smolt population size. Scale samples will be collected to estimate age composition. Project results will be used to validate a bioenergetics model of the overwinter mortality of juvenile sockeye salmon rearing in Skilak Lake. Coupled with fall hydroacoustic estimates of the sockeye salmon population rearing in Skilak Lake, project results will be used to estimate overwinter mortality. A validated overwinter mortality model will be used to help estimate a biological escapement goal for Kenai River sockeye salmon and to forecast future returns.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$60.0

### **Offshore Test Fishery Improvement**

Location: Offshore of Anchor Point.

Primary Objective: Assess the run strength of Cook Inlet sockeye salmon as they pass Anchor Point, the southern boundary.

Description/Purpose: This project will provide a second vessel for the Offshore Test Fishery project, increasing the spatial and temporal resolution of sockeye salmon abundance indices and genetic stock composition estimates. The project will also test whether sockeye salmon maturity indices measured at the test fishery transect and in the Kenai River are correlated with run timing. This project will (1) improve inseason UCI sockeye salmon forecast accuracy by increasing abundance spatial and temporal resolution (greater sample size); (2) improve stock-specific inseason forecast accuracy for the major UCI sockeye salmon stocks (Kenai, Kasilof, and Susitna) by increasing genetic stock composition spatial and temporal resolution; (3) potentially improve stock-specific harvest management if consistent run entry patterns are identified; and (4) potentially improve inseason run forecast accuracy by relating maturity indices to run timing.

Duration: To be a valuable project, it should operate 3–4 years.

Estimated Annual Cost: \$150.0 (purchase of equipment will increase the first year cost to about \$175.0).

### **Kasilof Smolt Abundance**

Location: Kasilof River.

Primary Objective: Estimate Kasilof River sockeye salmon smolt abundance.

Description/Purpose: The project will operate an inclined-plane trap and employ mark–recapture methodology at Kasilof River mile 6.3 from mid May through the end of June. We will conduct weekly dye-marking experiments to estimate sockeye salmon smolt abundance. The project will measure fork length and wet weight from approximately 200 sockeye salmon smolt captured each week. Additionally, we will collect scales for age determination. Recently, smolt abundance estimates by age (brood year) have provided reliable forecast estimates and ancillary support for developing an escapement goal. The Kasilof River smolt project has operated since the early 1980s by either Cook Inlet Aquaculture Association or ADF&G. Unfortunately, dedicated funding for this project is no longer available.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$30.0

### **ASL Data Entry**

Location: Soldotna.

Primary Objective: Enter salmon age, sex, and size (ASL) data from hard copy to electronic format for UCI and LCI stocks.

Description/Purpose: This project will utilize a Fish and Wildlife Technician to enter hard copy age, sex, and size data into electronic format for various UCI and LCI salmon stocks. The vast majority of Cook Inlet salmon ASL is currently residing in electronic format, but a substantial portion remains in hard copy format only. This project will allow for all Cook Inlet salmon ASL data (catch and escapement) to be safely stored in electronic format where it can be easily accessed and summarized.

Duration: Funding is only necessary for one year.

Estimated Annual Cost: \$30.0

### **Kenai and Skilak Lake Studies**

Location: Kenai River drainage.

Primary Objective: Monitor Kenai and Skilak lake juvenile sockeye salmon abundance and condition.

Description/Purpose: The semi-glacial Kenai and Skilak lakes contribute greatly to UCI sockeye salmon production. Glacial lake turbidity greatly affects salmon production because light penetration is positively correlated with primary production. ADF&G has documented variable turbidity, zooplankton abundance, and returns per spawner in the Kenai River system since the mid 1980s. The proposed project will relate observed returns per spawner to juvenile over-winter mortality. We will also explore relationships between water chemistry, zooplankton, and other factors to escapement and fry abundance. Project results will improve our understanding of freshwater survival and aid in preseason forecasts and escapement goal development.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$75.0

### **UCI Mark–Recapture Salmon Population Estimate**

Location: UCI.

Primary Objectives: Estimate UCI sockeye, pink, chum, and coho salmon total run, escapement, and escapement distribution using mark–recapture techniques.

Description/Purpose: ADF&G will contract two purse seine vessels to fish a series of stations across Cook Inlet at the latitude of Anchor Point. We will mark a random sample of individuals from each species with passive integrated transponder (PIT) and radiotelemetry tags throughout

the run from early July to mid August. The total run and escapement of each species will be estimated from tag recoveries in the commercial fishery and at several weirs (Deshka and Little Susitna rivers, and Fish, Cottonwood, and Wasilla creeks, and possibly others). Escapement distribution will be estimated from weekly aerial surveys of the entire shoreline and major streams flowing into UCI to locate radiotagged fish entering freshwater. We do not have estimates of inlet-wide escapement distribution for sockeye, pink, and chum salmon, and we have only a single estimate for coho salmon. We only have total run estimates for pink, chum, and coho salmon for a single year, and our total run estimates for sockeye salmon are based on untested assumptions about escapements into unmonitored streams. Project results will give us important management information about the distribution of inlet-wide salmon production, commercial harvest rates, and recreational harvest rates by stream.

Duration: 5 years.

Estimated Annual Cost: \$993.0

### **Escapement Monitoring Using Video**

Location: Packers Creek, UCI; Aialik Lake, Chenik, Desire, and Mikfik creeks, LCI.

Primary Objective: Develop, implement, and refine video recording technology to monitor small remote river system escapement.

Description/Purpose: Recently, ADF&G has embarked on a process of developing video technology as a replacement for weirs or aerial surveys as a means of estimating salmon escapements in small rivers. Aerial surveys are expensive, impacted severely by bad weather, and subject to observer variability and difficulty of repeatability. Weirs are relatively expensive to operate. Use of video cameras to record escapement will solve many of these problems and save ADF&G a significant amount of money. The use of this technology will not be limited exclusively to Cook Inlet but could easily be broadened to include other areas of the state. Currently, Chenik, Delight, Desire, and Mikfik creeks are funded with Alaska Sustainable Salmon Funds (AKSSF), but these funds are short term. We would like to add Aialik Lake to the list of funded projects.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$55.0 to operate the 4 LCI sites and about \$5.0 to operate the UCI site (purchase of equipment will increase the first year cost to about \$80.0)

### **Kachemak Bay Large-mesh Trawl Survey**

Location: LCI - Kachemak Bay

Primary Objective:

Estimate: (a) Tanner crab absolute abundance in the standard survey area; (b) Dungeness and red king crab relative abundance in Southern District of the Cook Inlet Management Area; and (c) relative catch rates and abundance/biomass of groundfish (pollock, Pacific cod, rockfishes, skates, sharks, sablefish, flounder, and sole) and important commercial invertebrate species such as weathervane scallops.

Description/Purpose: The R/V Solstice will be used to fish a series of standard stations with a 400-mesh Eastern otter trawl net. Upon completion of each successful tow, total catch will be weighed and all large abiotic objects (e.g. rocks, stumps, crab pots) removed from the catch, weighed, and discarded. All Pacific halibut, target groundfish and target invertebrates will be removed, counted, and weighed in aggregate by species. Target groundfish include Pacific cod, walleye pollock, sablefish, skates, sharks, giant wrymouth and rockfishes. Rockfish species will be further sampled for individual weight, length, sex, maturity, and age. A selection of flatfish species (flounder & sole) will also be further sampled for individual weight, length and sex. Target invertebrates include Tanner crab, red king crab, Dungeness crab, weathervane scallop, and octopus. All Tanner, king and Dungeness crab will be separated by sex, weighed and measured (carapace width for Tanner and Dungeness and carapace length for king crab). Tanner crab will be further sampled by measuring chelae height to examine the proportion of mature and terminal molt crab. Estimates of abundance or biomass will be calculated by an area swept method and expanded to a standardized area, and used to set harvest limits for the noncommercial fisheries in the Bay. This project is currently funded to operate every year, but does not rely on General Funds.

Duration: Eight days every year. Survey dates: mid- to late June. To be a valuable project, funding should be long term and stable.

Estimated Cost: \$50.0

## **Kamishak Bay Large-mesh Trawl Survey**

Location: LCI - Kamishak Bay

Primary Objective:

Estimate: (a) Tanner crab absolute abundance in the standard survey area; (b) Dungeness and red king crab relative abundance; and (c) relative catch rates and abundance/biomass of groundfish (pollock, Pacific cod, rockfishes, skates, sharks, sablefish, flounder, and sole) and important commercial invertebrate species such as weathervane scallops.

Description/Purpose: The R/V Pandalus or R/V Solstice will fish a series of stations with a 400-mesh Eastern otter trawl net. Upon completion of each successful tow, total catch will be weighed and all large abiotic objects removed from the catch, weighed, and discarded. All Pacific halibut, target groundfish and target invertebrates will be removed, counted, and weighed in aggregate by species. Target groundfish include Pacific cod, walleye pollock, sablefish, skates, sharks, giant wrymouth and rockfishes. Rockfish species will be further sampled for individual weight, length, sex, maturity, and age. A selection of flatfish species (flounder & sole) will also be further sampled for individual weight, length and sex. Target invertebrates include Tanner crab, red king crab, Dungeness crab, weathervane scallop, and octopus. All Tanner, king and Dungeness crab will be separated by sex, weighed and measured (carapace width for Tanner and Dungeness and carapace length for king crab). Tanner crab will be further sampled by measuring chelae height to examine the proportion of mature and terminal molt crab. Population estimates of abundance or biomass will be calculated by an area swept method and expanded to a standardized area. This project is currently funded to operate every other year, but does not rely on General Funds.

Duration: 12 days every other year (biennial survey). Survey dates: late May to mid-June. To be a valuable project, funding should be long term and stable.

Estimated Cost: \$74.0

### **Trawl Gear Efficiency**

Location: LCI.

Primary Objectives: Estimate the gear efficiency of prerecruit and postrecruit Tanner crab (and other crab and groundfish species) using a 400-mesh Eastern otter trawl designed to estimate biomass and evaluate factors influencing catchability.

Description/Purpose: This project will evaluate the gear efficiency of our 400-mesh Eastern otter trawl net in catching Tanner crab to improve estimates of crab and groundfish abundance and/or biomass during annual surveys. Central Region Tanner crab commercial fisheries are presently closed, however signs of recent recovery of populations in lower Cook Inlet and Prince William Sound have allowed non-commercial harvest to reopen in these areas. All Tanner crab encountered by the trawl net are assumed to be captured when estimating abundance, which while erring on the conservative side for the crab stocks is an unrealistic view of the efficiency of the trawl gear. Through the successful completion of this project, the department will estimate the capture efficiency of Tanner crab from ongoing bottom trawl surveys. In addition, new and upgraded trawl monitoring equipment (net mensuration equipment) will improve trawl performance by providing timely feedback during field surveys, and assist in understanding the factors affecting gear efficiency.

Duration: 5 years.

Estimated Cost: \$45.0

### **Management and Research Assistance**

Location: Homer.

Primary Objective: Provide funding for a Fishery Biologist I to help manage and research salmon, groundfish, and shellfish fisheries in Lower Cook Inlet.

Description: This project will provide approximately 9 months of salary for one Fishery Biologist I to assist with assessing and managing Lower Cook Inlet salmon, groundfish, and shellfish fisheries. Working under general supervision from management and research area staff, the position will plan and carry out independent research and management projects that provide necessary information for managing Lower Cook Inlet commercial fisheries. Skills and experience gained from this work will make them well suited for assistant area research or management biologist positions in the Commercial Fisheries Division.

Duration: To be of value this project needs to be long term with a stable funding source.

Estimated Annual Cost: \$50.0

### **Research and Management Internship**

Location: Soldotna and/or Homer.

Primary Objective: Provide funding for up to 2 college fisheries students focusing on research or management projects that improve Cook Inlet fisheries management.

Description/Purpose: This project will provide salary and project support for 2 college students majoring in fisheries or a closely related field. Working with area and regional staff, these students will plan and carry out independent research projects that aid in management of Cook Inlet commercial fisheries. Students will work half time during the school year and full time during the field season. At completion, students will be qualified to move into permanent positions in ADF&G.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$60.0

## **Herring Aerial Surveys**

Location: Kamishak Bay.

Primary Objective: Estimate the biomass and spawning distribution (and timing) of spring herring.

Description/Purpose: This project will utilize a fixed-wing aircraft to provide real-time estimates through frequent aerial surveys of spring herring biomass and spawning distribution for managing the commercial fishery. Aerial survey results will be used with AWL data to assess and forecast herring biomass, set harvest guidelines, and manage the sac roe fishery. This project is currently under-funded with CFEC monies.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$25.0

## **Herring AWL Sampling**

Location: Kamishak Bay, LCI.

Primary Objective: Obtain Kamishak Bay herring samples throughout the herring migration, including those that are typically missed post fishery.

Description/Purpose: A purse seine vessel will be chartered each May to catch Kamishak Bay late-arrival herring that typically includes the younger age classes. When the commercial fishery is closed, an additional charter will sample herring during the traditional fishery time period. Samples will be collected for age, weight, size, and sex determination. With size, age, and sex composition data, we will be able to better forecast and understand herring population dynamics. This project is currently under-funded with CFEC monies.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$35.0

# PRINCE WILLIAM SOUND

## INTRODUCTION

### Prince William Sound Fisheries Overview

The PWS area, which includes the Copper and Bering Rivers, supports a wide array of commercial fisheries, including those for salmon, herring, groundfish, and shellfish. For salmon, there are large gillnet and purse seine fisheries. Approximately 270 purse seine, 30 set gillnet, and 540 drift gillnet permit holders harvest all 5 Pacific salmon species. In recent years, pink salmon have been the most numerous and sockeye salmon the most valuable. Of the roughly 840 total permit holders, about 76% are Alaska residents. Total exvessel value of the fishery ranges between \$27 and \$78 million annually, averaging about \$35 million over the past 10 years. Among PWS residents in areas such as Cordova and Whittier, commercial fishing and processing represent the primary employment opportunities.

Recently, salmon fisheries inside PWS targeting pink and chum salmon have suffered from low prices. PWS hatcheries operated by Prince William Sound Aquaculture Corporation (PWSAC) and the Valdez Fisheries Development Association (VFDA) contribute significantly to the area's pink and chum salmon harvests. Even though recent harvests have been above average, low prices have caused the fishery to be uneconomical for many purse seine vessels. Lately, Copper River sockeye salmon runs have been healthy, with commercial prices matching some of the highest statewide.

PWS has not experienced a commercial herring fishery since 1998. When active, the annual guideline harvest quota was divided among 5 fisheries. In its final year, there were about 100 purse seine, 25 gillnet, and 130 pound permit holders. Additionally, up to 300 wild spawn-on-kelp participants harvested herring flesh and roe. Approximately 10 permit holders participated in the food and bait fishery. The food and bait and wild spawn-on-kelp fisheries were not limited entry so participation varied with market conditions. Harvests ranged from 0 to over 25,000 tons with annual exvessel values sometimes exceeding \$12 million.

PWS contains 7 salmon hatcheries, 5 of which produce primarily pink (total active capacity of 677 million eggs) and chum salmon (total active capacity of 111 million eggs), as well as lesser numbers of sockeye (10 million eggs), and coho salmon (4 million eggs). Two of the 7 hatcheries occur on the Gulkana River in the Copper River drainage and have a total capacity of 35 million eggs. These hatcheries produce significant numbers of adult fish, providing an important income source for fishermen. To ensure these hatchery programs are adequately monitored, we need to know how many return and how they interact with wild stocks.

Commercial invertebrate fisheries include sidestripe shrimp and weathervane scallops. The low abundance of spot shrimp and Dungeness crab are responsible for the current commercial fishery closure. Directed fishing for other marine invertebrates, including squid, octopus, sea cucumbers, and sea urchins, are allowed under the conditions of a special ADF&G permit. PWS once supported commercial and non-commercial Tanner crab fisheries, starting in the late 1960s and peaking in 1973 at nearly 14 million pounds. In 1999, the Alaska Board of Fisheries (BOF) adopted a regulatory closure of all Tanner crab fisheries to facilitate rebuilding. Red, blue, and golden king crab in PWS commercial harvests began around 1957. Commercial harvests occurred in the early 1960s, peaked at 296,200 pounds in 1972, and decreased through 1988. Commercial fisheries for red and blue king crab have remained closed since 1984. Similarly,

golden king crab fisheries were sporadically open from 1989–1999. Like Tanner crab, the BOF adopted a regulatory closure in 1999 for all king crab fisheries.

Since 1995 the total PWS groundfish harvest has ranged from about 9.1 million lb in 1995 to 2.5 million lb in 2005, averaging 4.9 million lb. The total 2005 area harvest of 2.5 million lb is below the recent 5-year average of 3.5 million lb, reflecting a reduced harvest for most groundfish harvests. In 2005, pollock and Pacific cod harvests were below GHs even with a 35% reduction to the 2.0 million lb pollock GH. Additionally, the groundfish harvest value was about one-half that of the recent 5-year average. Sablefish generated the highest exvessel value based on a round weight dock price of over \$2/lb, while pollock generated the next highest value (~\$0.15/lb). The combined value of the sablefish and pollock harvest is about three-quarters of a million dollars, roughly 85% of the total groundfish value.

### **Prince William Sound Fisheries Management**

PWS salmon fisheries use aerial surveys, weirs, otolith marking of hatchery fish, and test fisheries to gauge run strength, hatchery contribution, and run timing. The management strategy is to harvest all surplus hatchery fish without overharvesting wild salmon. Overlapping run timing and migration routes make this difficult. Managers utilize Special Harvest Areas and Terminal Harvest Areas near hatcheries to concentrate hatchery harvests. Test fisheries are used in mixed stock areas, such as the Southwestern District, to optimize mixed stock harvest without jeopardizing wild stock escapements. As hatchery fish return to their natal hatcheries, cost recovery and common property fisheries are managed for quality and wild stock escapements.

Salmon fisheries of the Copper/Bering River area are managed on Miles Lake sonar fish passage estimates, upper and lower drainage aerial surveys, and commercial fishery performance. Lower drainage aerial surveys occur postseason to corroborate run strength with other projects. Chinook salmon inriver abundance is estimated postseason using fish wheel catches from the Native Village of Eyak mark–recapture project. Coho salmon management decisions are based on aerial surveys, sex ratios, and catch-per-unit-effort information.

The PWS herring management plan divides the annual guideline harvest quota among 5 fisheries: purse seine, gillnet, pound, spawn on kelp, and food/bait. Spawn deposition surveys are the most accurate means of estimating abundance. The PWS stock has not recovered from several disease related population declines. Herring sac roe fishery management is characterized by short, intense fishing periods, whereby the allowable harvest may be taken in just 15 to 30 minutes. Harvests coincide with high roe quality to maximize exvessel values. Consequently, managers maintain close contact with the industry about roe content and fly frequent aerial surveys to assess biomass and distribution.

Groundfish and invertebrate management strategies are widely diverse, varying by species and location. Likewise, the gear used to harvest these species covers a wide range of means and methods. Harvests of Pacific cod, walleye pollock, sablefish, and lingcod are seasonally managed for specific guideline harvest levels (GHL). Rockfish species are managed collectively as bycatch to other directed fisheries. Similarly, the harvest of miscellaneous groundfish species including flatfish, sharks, skates, octopus, and squid, are landed incidental to other directed groundfish fisheries. ADF&G has been granted management authority of lingcod and black rockfish in federal waters of the exclusive economic zone (EEZ) 3 nmi offshore.

## PROPOSED PROJECTS

The following section lists projects critical to evaluating and improving Prince William Sound fishery management (Tables 3 and 4).

Table 3.–Summary of prioritized Prince William Sound projects and estimated costs (in thousands of dollars).

	Estimated First Year Cost	Estimated Continuation Cost	Duration
Pink Salmon Straying	\$75.0	\$75.0	4 Years
Chum Salmon Straying	\$75.0	\$75.0	4 Years
Otolith Marking Wild Pink Salmon Fry	\$150.0	\$150.0	Long Term
Pink Salmon Juvenile Outmigration	\$35.0	\$35.0	Long Term
Pink Salmon Otolith Recovery	\$80.0	\$80.0	Long Term
Chum Salmon Otolith Recovery	\$35.0	\$35.0	Long Term
Copper River and Main Bay Otolith Recovery	\$50.0	\$50.0	Long Term
Copper and Bering River Sockeye Salmon Remote Video	\$60.0	\$60.0	Long Term
Eshamy River Sockeye Salmon Remote Video	\$25.0	\$25.0	Long Term
Aerial Survey Ground Truthing	\$200.0	\$140.0	Long Term
Expanded Pink Salmon Adult Sampling	\$25.0	\$25.0	Long Term
Additional Aerial Surveys	\$25.0	\$25.0	Long Term
Research and Management Internship	\$60.0	\$60.0	Long Term
Sablefish Tag and Recapture Survey	\$100.0	\$100.0	Long Term
Herring Aerial Surveys	\$20.0	\$20.0	Long Term
Hydroacoustics Herring Survey	\$70.0	\$70.0	Long Term
Herring Disease Studies	\$30.0	\$30.0	Long Term
Herring Energetic Content	\$75.0	\$75.0	Long Term
Herring Spawn Deposition Surveys	\$300.0	\$300.0	Long Term
Juvenile Herring Aerial Surveys	\$20.0	\$20.0	Long Term

### Pink Salmon Straying

Location: PWS.

Primary Objective: Determine the spatial and temporal extent of pink salmon straying throughout PWS.

Description/Purpose: ADF&G will estimate the proportion of PWs hatchery pink salmon within substantial pink salmon spawning locations and refine a model of hatchery salmon straying. Ample documentation exists about hatchery pink salmon straying into wild stock streams in the Southwestern District. Studies also show that wild stock pink salmon stray into other wild stock systems. It is important that managers understand the production potential of strayed hatchery pink salmon. Natural straying between wild pink salmon stocks is a normal aspect of pink salmon ecology, occurring since salmon first colonized PWS. Stocking hatchery pink salmon is a relatively new phenomenon. Very few studies have focused on the effects that hatchery strays have on wild stocks. We do not know if wild stock and hatchery stock productivity is similar.

Stream escapements are monitored by aerial survey where it is impossible to identify wild fish from hatchery fish.

Duration: 4 Years.

Estimated Annual Cost: \$75.0

### **Chum Salmon Straying**

Location: PWS.

Primary Objective: Determine the spatial and temporal extent of pink salmon straying throughout PWS.

Description/Purpose: ADF&G will estimate the proportion of PWS hatchery chum salmon within substantial chum salmon spawning locations and refine a model of hatchery salmon straying. Ample documentation exists about hatchery chum salmon straying into wild stock streams in the Southwestern District. Studies also show that wild stock chum salmon stray into other wild stock systems. It is important that managers understand the production potential of strayed hatchery chum salmon. Natural straying between wild chum salmon stocks is a normal aspect of chum salmon ecology, occurring since salmon first colonized PWS. Stocking hatchery chum salmon is a relatively new phenomenon. Very few studies have focused on the effects that hatchery strays have on wild stocks. We do not know if wild stock and hatchery stock productivity is similar. Stream escapements are monitored by aerial survey where it is impossible to identify wild fish from hatchery fish.

Duration: 4 Years.

Estimated Annual Cost: \$75.0

### **Otolith Marking Wild Pink Salmon Fry**

Location: PWS.

Primary Objective: Thermally or chemically mark otoliths from wild PWS pink salmon fry.

Description/Purpose: This project will apply thermal or chemical marks to outmigrating wild pink salmon fry otoliths. ADF&G will examine commercial fishery samples for marks to improve stock-specific wild management. This project will be linked to existing straying studies, giving us hatchery contribution and a better understanding of PWS stock structure. The results will help explain migration routes and travel time, necessary products for a run reconstruction model.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$150.0

### **Pink Salmon Juvenile Outmigration**

Location: PWS.

Primary objective: Examine otoliths for thermal marks and estimate the percentage and number of outmigrating hatchery PWS pink salmon.

Description/Purpose: ADF&G will capture outmigrating pink salmon in the Southwestern District. Project results will help forecast the next year's hatchery and wild pink salmon run compositions. Project findings will improve wild pink salmon forecast accuracy. Improved forecast models will aid wild stock management.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$35.0

### **Pink Salmon Otolith Recovery**

Location: Cordova.

Primary Objective: Continue Cordova otolith laboratory operations.

Description/Purpose: Decoding thermally marked PWS otoliths is necessary to estimate commercial and cost recovery harvest hatchery contributions, important elements in wild stock management. ADF&G currently applies the same technique to hatchery brood stocks. This project will provide the Cordova otolith laboratory with stable personnel funding. We believe that ADF&G should maintain the otolith recovery project to prevent a perception of bias. Current funding is provided by PWSAC.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$80.0

### **Chum Salmon Otolith Recovery**

Location: PWS.

Primary Objective: Examine chum salmon adult otoliths to determine hatchery and wild stock compositions.

Description/Purpose: Hatchery-marked PWS chum salmon have been returning since 2003. As such, we can estimate commercial fishery hatchery and wild stock contributions. Without adequate personnel to collect systematic samples, current contribution estimates are imprecise. Without reliable wild stock return-per-spawner estimates, we cannot reliably generate wild stock forecasts. The Cordova otolith laboratory will be responsible for otolith recovery and examination.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$35.0

### **Copper River and Main Bay Otolith Recovery**

Location: PWS.

Primary Objective: Recover otoliths from sockeye salmon in Copper/Bering Rivers and PWS commercial harvests to estimate hatchery and wild compositions.

Description/Purpose: Gulkana Hatchery sockeye salmon within the Copper River drainage have otoliths marked with strontium chloride while Main Bay Hatchery fish have thermally marked otoliths. Recovering these marks from commercial salmon harvests provides information about abundance, timing, and location of hatchery stocks, critical for the inseason management of mixed-stock gillnet fisheries. The strontium chloride marked otoliths are read using a scanning electron microscope at a lab contracted by Prince William Sound Aquaculture Association. This project is currently operated without a long-term funding source.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$50.0

### **Copper and Bering River Sockeye Salmon Remote Video**

Location: Copper and Bering Rivers.

Primary Objective: Estimate the number of sockeye salmon entering clear water tributaries of the Copper and Bering rivers.

Description/Purpose: ADF&G will remotely operate video recorders above clear water sockeye salmon escapement tributaries of the Copper and Bering rivers. The project will examine time-lapse video recordings of migrating sockeye salmon. The number of adults passing the site will be visually counted. We will use project information to evaluate escapement goals and forecast future returns. The first year will consist largely of equipment purchase, site selection, implementation, and validation with a weir at one site. We will use second and third years to purchase equipment and install other suitable sites. Thereafter, the project will maintain the fixed number of sites.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Cost: \$60.0

### **Eshamy River Sockeye Salmon Remote Video**

Location: PWS.

Primary Objective: Estimate the number of sockeye salmon entering Eshamy Lake.

Description/Purpose: ADF&G will remotely operate video recorders above the Eshamy River to estimate the total sockeye salmon escapement. The project will examine time-lapse video recordings of migrating sockeye salmon. The number of adults passing the site will be visually counted. We will use project information to evaluate escapement goals and forecast future runs. The first year will consist largely of equipment purchase, site selection, implementation and validation with the existing weir project. We will use the second and third years for additional site improvement and validation work. Thereafter, the project will maintain the existing site.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Cost: \$25.0

## **Aerial Survey Ground Truthing**

Location: PWS.

Primary Objective: Estimate the number of spawning pink salmon in select PWS streams.

Description/Purpose: ADF&G will operate a weir at the mouth of 2 streams having diverse characteristics. Each week aerial surveyors will fly each stream and estimate fish abundance. Aerial abundance estimates will be compared with the more accurate weir counts for each surveyor. We will use the ratio of aerial to weir to adjust survey results on other similar streams to provide more accurate abundance estimates.

Preferably, one stream will have multiple species with large escapements while another stream will have smaller escapements with 1–2 species. Using additional streams with varying characteristics will provide higher confidence in error measurements, but at increased costs.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$140.0 (\$200.0 the first year due to purchase of weir materials)

## **Expanded Pink Salmon Adult Sampling**

Location: PWS.

Primary Objective: Estimate the number of returning PWS hatchery and wild pink salmon.

Description/Purpose: The state research vessel *R/V Solstice* is an important part of the PWS salmon fisheries management program. In late July and early August, the *R/V Solstice* conducts a purse seine test fishery in the Southwestern District, sampling adult pink salmon for stock composition (hatchery versus wild). The current program is inadequately funded to generate the precise estimates needed for timely commercial fishery management. This proposed project will add one week of sailing time to the *R/V Solstice*'s schedule and pay an additional crewmember to improve operational safety and efficiency.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Cost: \$25.0

## **Additional Aerial Surveys**

Location: PWS.

Primary Objective: Estimate the number of spawning pink salmon in various PWS streams.

Description/Purpose: ADF&G flies weekly aerial surveys throughout PWS to estimate wild stock salmon escapements for 215 index streams. Additionally, we fly aerial surveys over the Copper River and Bering River Delta streams. A complete set of surveys requires 5 days. Unfortunately, inclement weather, aircraft availability, and shortage of qualified pilots often cause incomplete aerial survey coverage. This proposed project will pay for additional airplane survey time, a qualified pilot, and an ADF&G surveyor, allowing more surveys to be flown during good weather periods. Additional surveys will provide more precise estimates of timing

and abundance. Management decisions are based on the latest information, striving to provide maximum harvest opportunities and adequate escapement.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$25.0

### **Research and Management Internship**

Location: Cordova.

Primary Objective: Provide funding for up to 2 college fisheries students focusing on research or management projects that improve Cook Inlet fisheries management.

Description/Purpose: This project will provide salary and project support for 2 college students majoring in fisheries or a closely related field. Working with area and regional staff, these students will plan and carry out independent research projects that aid in management of Bristol Bay commercial fisheries. Students will work half time during the school year and full time during the field season. At completion, students will be qualified to move into permanent positions in ADF&G.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$60.0

### **Prince William Sound Large-mesh Trawl Survey**

Location: PWS

Primary Objective:

Estimate: (a) Tanner crab absolute abundance in the standard survey area; (b) Dungeness and red king crab relative abundance; and (c) relative catch rates and abundance/biomass of groundfish (pollock, Pacific cod, rockfishes, skates, sharks, sablefish, flounder, and sole) and important commercial invertebrate species such as weathervane scallops.

Description/Purpose: The R/V Pandalus will fish a series of established stations with a 400-mesh Eastern otter trawl net. Upon completion of each successful tow, total catch will be weighed and all large abiotic objects removed from the catch, weighed, and discarded. All Pacific halibut, target groundfish and target invertebrates will be removed, counted, and weighed in aggregate by species. Target groundfish include Pacific cod, walleye pollock, sablefish, skates, sharks, giant wrymouth, and rockfishes. Rockfish species and a selection of flatfish species (e.g., flounder and sole) will be further sampled for individual weight, length, sex, maturity, and age. Target invertebrates include Tanner, red king, and Dungeness crab, weathervane scallop, and octopus. All Tanner, king and Dungeness crab will be separated by sex, weighed, and measured. Biological condition (e.g., shell age, clutch condition) of all crab will be assessed. Tanner crab will be further sampled by measuring chelae height to examine the proportion of mature and terminal molt crab. Population estimates of abundance or biomass will be calculated by an area swept method and expanded to a standardized area.

Duration: 18 days every other year (biennial survey). The approximate survey dates are July. To be a valuable project, funding should be long term and stable.

Estimated Cost: \$40.0

## **Sablefish Tag and Recapture Survey**

Location: Prince William Sound

Primary Objective: Use tag and recapture methodology to examine the degree of mixing between sablefish in PWS and the Gulf of Alaska (GOA).

Description/Purpose: Determining the most effective approach for assessing the population status of PWS sablefish requires knowledge of stock discreteness and the extent of sablefish movements within PWS and between it and outside waters of GOA. If there is frequent movement of sablefish between PWS and the waters of GOA the existing federal stock assessment in GOA and Bering Sea/Aleutian Islands may provide an adequate assessment of the PWS component of the sablefish population. However, with infrequent movement of sablefish between PWS and the outer waters of GOA, PWS-specific assessment may be warranted to adequately determine the status of the PWS population. Documenting the spatial and temporal bounds of sablefish inhabiting PWS during all or part of the year is a requisite to developing an appropriate, efficient method for assessing the status of the stock as part of effective sustainable management. Tagging sablefish with external tags is a relatively simple approach to begin determining movement dynamics.

ADF&G would conduct a longline pot survey to tag sablefish as part of a mark–recapture study to estimate sablefish abundance in PWS. Port sampling and voluntary tag returns of sablefish harvested in the commercial longline fishery (and sport), and subsequent surveys will represent the recapture portion of the study. If mixing rates between PWS and GOA are low, an analysis using various mark–recapture models would determine if data were adequate and met the necessary assumptions to estimate abundance of PWS sablefish. Should this be feasible, estimates could be used to forecast sablefish biomass as a basis for management of the fishery and to set a harvest quota.

Duration: 11 days every year. To be a valuable project, funding needs to be long term and stable.

Estimated Cost: \$100K

## **Herring Aerial Surveys**

Location: PWS.

Primary Objective: Estimate the biomass and spawning distribution (and timing) of spring herring.

Description/Purpose: ADF&G will use this project to utilize a fixed-wing aircraft, providing real-time estimates of spring herring biomass and spawning distribution for managing the commercial fishery. We will use aerial survey results and AWL data to forecast herring biomass, set harvest guidelines, and manage the sac roe fishery. Spawning areas will be identified for potential commercial kelp fisheries. Surveys will estimate annual miles of spawn

for factoring into annual forecasts. This project is currently combined into a single Test Fish fund project with the hydroacoustic survey described below.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$20.0

## **Hydroacoustics Herring Survey**

Location: PWS.

Primary Objective: Estimate PWS pre-spawning herring abundance with greater accuracy than aerial surveys provide.

Description/Purpose: Each spring, ADF&G conducts scientific acoustic surveys near major PWS herring concentrations to estimate mature herring biomass. Survey results are combined with other biological information (age structure, average size, gonad maturity, and sex ratio) to calculate herring spawn biomass. Herring surveys have successfully documented overwinter declines in spawning biomass, supporting management actions that curtail fisheries for depleted stocks. Herring biomass estimates help forecast future returns and set harvest allocations for the winter bait fishery, spring sac roe fisheries, and 2 spawn-on-kelp fisheries. We use aerial surveys to locate major spawning herring concentrations, and provide mature biomass indices consistent with prior years. Aerial surveys also document spawning distribution. This project is currently funded with unstable Test Fish funds.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$70.0

## **Herring Disease Studies**

Location: PWS.

Primary Objective: Monitor PWS herring incidence of viral hemorrhagic septicemia virus (VHSV) and *Ichthyophonus hoferi*, examining their effects on recruitment and population abundance.

Description/Purpose: VHSV and *I. hoferi* have been identified as the likely cause for significant declines in the PWS herring stock. After herring samples are collected, the ADF&G pathology lab will examine tissues for disease. Juvenile herring are most at risk from VHSV and older adults are most at risk from *I. hoferi*. The unforeseen dramatic population crash in 1993 from 130,000 tons to less than 20,000 tons was the first documented crash. EVOS investigations identified VHSV as one of the culprits for the 1993 crash and for a subsequent decline detected in 1999. *I. hoferi* is responsible for additional disease outbreaks that adversely affected abundance. Disease prevalence information will be used to adjust forecasts by altering recruitment survival in the existing age-structured abundance model.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$30.0

## **Herring Energetic Content**

Location: PWS.

Primary Objective: Estimate seasonal fluctuations of herring body tissue energetic content.

Description/Purpose: For this project, ADF&G will measure the seasonal variation in energy content each yearly quarter using bomb calorimetry, wet weight, and dry weight of whole herring. This information will refine survival and recruitment forecast inputs to set commercial fishery harvest allocations. It will also help us understand the role that disease plays in determining population abundance by examining fish condition related to disease outbreaks.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$75.0

## **Herring Spawn Deposition Surveys**

Location: PWS.

Primary Objective: Estimate PWS spawning herring biomass with greater accuracy than aerial surveys provide.

Description/Purpose: ADF&G will use aerial surveys to identify herring spawning beds. SCUBA divers will then estimate the number of eggs deposited on spawning beds combined with other biological information (age structure, average size, fecundity, and sex ratio) to calculate spawning biomass. These estimates will provide greater accuracy than aerial surveys. Annual spawning biomass estimates provide forecast models information used to set harvest allocations for a winter bait fishery, a spring sac roe fishery, and 2 spawn-on-kelp fisheries.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$300.0

## **Juvenile Herring Aerial Surveys**

Location: PWS.

Primary Objective: Estimate the relative abundance of age-0 and age-1 PWS juvenile herring. Others species such as capelin, eulachon, and sand lance will also be assessed.

Description/Purpose: ADF&G will videotape images of juvenile herring, capelin, eulachon, and sand lance schools to estimate species composition, distribution, and abundance. Aerial surveys will be conducted in June and July and videotaped using a hand-held video, GPS-linked camera. We will use juvenile herring information to predict year class recruitment for use in age structured assessment models. Information about other forage species could help set guideline harvest levels for developing commercial fisheries.

Duration: To be a valuable project, funding should be long term and stable.

Estimated Annual Cost: \$20.0

Table 4.–Summary of Central Region projects (prioritized by area) and estimated costs in thousands of dollars.

	Estimated First Year Cost	Estimated Continuation Cost	Duration
<b>Bristol Bay</b>			
Nushagak River Sonar Extension	\$80.0	\$80.0	Long Term
Kvichak River Sockeye Smolt Enumeration	\$40.0	\$40.0	Long Term
District Catch Sampling Improvements	\$50.0	\$50.0	Long Term
Naknek River Sockeye Smolt Mark–Recapture	\$120.0	\$100.0	Long Term
Alagnak River Sockeye Smolt Mark–Recapture	\$120.0	\$100.0	Long Term
Togiak River Sockeye Escapement Using Sonar	\$150.0	\$60.0	Long Term
Escapement Monitoring Using Video	\$60.0	\$40.0	Long Term
Research & Management Internship	\$60.0	\$60.0	Long Term
Togiak Herring Biomass Estimation	\$40.0	\$40.0	Long Term
<b>Cook Inlet</b>			
Susitna Sockeye Genetic Mark–Recapture	\$20.0	\$20.0	Long Term
Kenai Sockeye Smolt Abundance	\$60.0	\$60.0	Long Term
Offshore Test Fishery Improvement	\$175.0	\$150.0	3-4 Years
Kasilof Smolt Abundance	\$30.0	\$30.0	Long Term
ASL Data Entry	\$30.0		1 Year
Kenai and Skilak Lake Studies	\$75.0	\$75.0	Long Term
UCI Mark–Recapture Salmon Population Estimate	\$993.0	\$993.0	5 Years
Escapement Monitoring Using Video	\$80.0	\$60.0	Long Term
Kachemak Bay Large-mesh Trawl Survey	\$50.0	\$50.0	Long Term
Kamishak Bay Large-mesh Trawl Survey	\$74.0	\$74.0	Long Term
Trawl Gear Efficiency	\$45.0	\$45.0	Long Term
Management and Research Assistance	\$50.0	\$50.0	Long Term
Research & Management Internship	\$60.0	\$60.0	Long Term
Herring Aerial Surveys	\$25.0	\$25.0	Long Term
Herring AWL Sampling	\$35.0	\$35.0	Long Term
<b>Prince William Sound</b>			
Pink Salmon Straying	\$75.0	\$75.0	4 Years
Chum Salmon Straying	\$75.0	\$75.0	4 Years
Otolith Marking Wild Pink Salmon Fry	\$150.0	\$150.0	Long Term
Pink Salmon Juvenile Outmigration	\$35.0	\$35.0	Long Term
Pink Salmon Otolith Recovery	\$80.0	\$80.0	Long Term
Chum Salmon Otolith Recovery	\$35.0	\$35.0	Long Term
Copper River and Main Bay Otolith Recovery	\$50.0	\$50.0	Long Term
Copper and Bering River Sockeye Salmon Remote Video	\$60.0	\$60.0	Long Term
Eshamy River Sockeye Salmon Remote Video	\$25.0	\$25.0	Long Term
Aerial Survey Ground Truthing	\$200.0	\$140.0	Long Term
Expanded Pink Salmon Adult Sampling	\$25.0	\$25.0	Long Term
Additional Aerial Surveys	\$25.0	\$25.0	Long Term

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Table 4.–Page 2 of 2.

	Estimated First Year Cost	Estimated Continuation Cost	Duration
Research and Management Internship	\$60.0	\$60.0	Long Term
Sablefish Tag and Recapture Survey	\$100.0	\$100.0	Long Term
Herring Aerial Surveys	\$20.0	\$20.0	Long Term
Hydroacoustics Herring Survey	\$70.0	\$70.0	Long Term
Herring Disease Studies	\$30.0	\$30.0	Long Term
Herring Energetic Content	\$75.0	\$75.0	Long Term
Herring Spawn Deposition Surveys	\$300.0	\$300.0	Long Term
Juvenile Herring Aerial Surveys	\$20.0	\$20.0	Long Term

Table 5.–Proposed FY 12 Central Region fisheries projects and estimated cost (thousands of dollars), listed in descending order of priority.

	Estimated First Year Cost	Estimated Continuation Cost	Duration
Susitna Sockeye Genetic Mark–Recapture	\$20.0	\$20.0	Long Term
Kenai Sockeye Smolt Abundance	\$60.0	\$60.0	Long Term
Pink Salmon Straying	\$75.0	\$75.0	4 Years
Chum Salmon Straying	\$75.0	\$75.0	4 Years
Kvichak River Sockeye Smolt Enumeration	\$40.0	\$40.0	Long Term
Offshore Test Fishery Improvement	\$175.0	\$150.0	3-4 Years
Nushagak River Sonar Extension	\$80.0	\$80.0	Long Term
Kasilof Smolt Abundance	\$30.0	\$30.0	Long Term
District Catch Sampling Improvements	\$50.0	\$50.0	Long Term
ASL Data Entry	\$30.0		1 Year