R7 I&M BRANCH PROPOSAL

1. Station: Kodiak NWR	**2. Org Code (FBMS)**: FF07RKDK00	**3. Amount Requested**: $6,000
4. Project Title: Document Salmon Catch Rate of Brown Bear to Augment Current Modeling Effort		
5a. Project Officer: William Leacock	**5b. Phone**: 907-487-0246	**5c. email**: William_Leacock@fws.gov
6. I&M Staff Name: N/A	**7. PRIMR Survey ID**: FF07RKDK00-058	**8. Station Project Ranking**: 1

9. Problem Statement and Objectives. Ongoing work by J. Armstrong, Oregon State University (OSU), has identified two poorly understood variables that strongly influence results of modeling salmon foraging ecology of brown bear: variation in salmon catch rates among habitats, and the effect of bear density on catch rate. Catch rates generally increase with salmon abundance up to an asymptote, above which additional salmon does not increase capture rates. For example, research by Gende and Quinn (2004) showed that catch rates asymptote at relatively low salmon densities (~0.1 salmon/m^2) in streams. Peak salmon density in stream tributaries of Karluk Lake, Kodiak Island, are much higher, averaging 1.93 salmon/m^2 in streams (Deacy unpublished data).

The refuge acquired catch rate data in studies conducted during 1991-1993 and 2003. Recent analyses of these data indicated that they are insufficient for estimation of summary statistics for stream and lake shoal habitats. Power analysis indicated that 180 observations within each habitat are required to detect catch rate difference of two salmon/hr among habitats at an error rate of 0.05. The purpose of this study is to provide an empirical basis for catch rate estimates that can be applied directly to a bear-salmon model under current development at OSU. Moreover, inclusion of catch rate data will address a primary assumption in the model.

The goal of this study is to collect brown bear catch rate and aggregation data to support and improve ongoing modelling effort. Objectives include: (1) quantify variation in sockeye salmon catch rates across aquatic habitats (falls, streams, rivers, lake shoals; Deacy et al. 2016a); and (2) quantify effect of bear density on salmon catch rates.

10. Methods/Scope of Work. Data collection will occur between late June and mid-October 2017. Due to time and resource constraints, we cannot quantify catch rates at all sites in the study area, southwest Kodiak Island. Instead we have selected representative habitat locations we have previously utilized where we are assured that data can be collected. We selected survey periods which coincide with historic peaks of salmon abundance and bear use. The actual survey period will last five-seven days, and will be conducted during the timeframes listed below.

Habitat	**Site**	**Method**	**Survey Period**
Falls	Lower falls of Dog Salmon River	Video	Jun 20 – Aug 15
Streams	Connecticut Creek	Hill camp	Jul 15 – Aug 10
River	Red Lake River	Hill camp	Sep 5 – Sep 20
Beach	South end Karluk Lake	Hill camp	Oct 2 – Oct 17

Hill Camp Protocol

For these surveys we will use a restructured version of the survey methods used in previous Refuge research. A team of observers will be based on a mountain bench overlooking the observation area (i.e., hill camp). We will maximize the amount of data collected and its efficacy by using a paired observation approach. Each hour of observation will begin with a quick scan survey of the observation area to measure bear density. One person will observed bears through spotting scopes and/or bi9noculars, while the other records observations on a data sheet. All bears within 100 meters of the water body (or lake shoal-lakeshore edge) will be recorded. When bear density is high, these scans tend to take a long time. To expedited data collection and focus on current objectives, we will only record the number of bears and their class. We will not record behavioral data during the scan survey. Once the scan survey is complete, each surveyor will use the remainder of the hour conducing solo, 15 minute focal surveys. They will each watch a different bear (or family group), randomly selected among those that are easily observed. Focal surveys will end when either 15 minutes passes or the bear moves out of the survey area. The total number of captured fish and the bear class will be recorded for each focal scan. Surveyors will strive to survey for eight hours per day depending on conditions.

Video Protocol

A video system will be installed at the Lower Falls of Dog Salmon River prior to June 20. The system will be similar to the systems used on the time-lapse photography/video weirs used on streams from 2013-2016 (Deacy et al. 2016b). The camera system will be mounted to a tree just downstream from the falls and will be programmed to record video from 0700 – 1000 and 1800 – 2200, the periods of maximum bear activity. Once the data is collected the video will be reviewed, and data will be recorded using the same protocol as the observer-based surveys.

Data Analysis

For objective one, we will use summary statistics and ANOVA to test for differences in catch rates among habitats. For objective two, we will use least squares regression and AICc to select among several possible relationships between catch rate and bear density.

11. Partnerships and Roles. Proposed fieldwork will be conducted by William Leacock, Kodiak Refuge, as assisted by technicians and volunteers. Leacock specializes in monitoring and research of brown bear and established the partnership with OSU that builds on recent comprehensive research of brown bear-salmon foraging ecology. A copy of the data will be provided to William Deacy and Johnny Armstrong of OSU Fisheries and Wildlife Department. Deacy and Armstrong will organize the data and apply it to the model under current development. This OSU team presently has a contractual obligation with the Service to develop the model with completion scheduled for 2018.

12. Products and Schedule. The main product will be data collected in proposed 2017 fieldwork. This work will be summarized in report to the Inventory and Monitoring Division. These data will be immediately utilized by the OSU team responsible for modeling salmon foraging ecology of brown bear. OSU will issue modeling products in 2018. under separate contractual obligation with the Refuge. Data collection will occur from late June through mid-October.

13. Literature Cited

Deacy W, Leacock W, Armstrong JB, Stanford JA. 2016a. Kodiak brown bears surf the salmon red wave: Direct evidence from GPS collared individuals. Ecology 97:1091-1098.

Deacy WW, Leacock WB, Eby LA, Stanford JA. 2016b. A time-lapse photography method for monitoring salmon (Oncorhynchus spp.) passage and abundance in streams. PeerJ 4:e2120; DOI 10.7717/peerj.2120

Gende S, Quinn T. 2004. The relative importance of prey density and social dominance in determining energy intake by bears feeding on Pacific salmon. Canadian Journal of Zoology 85:75-85.

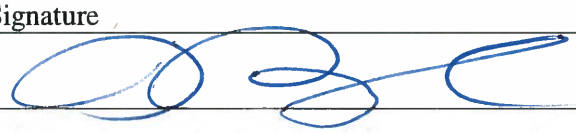
Quinn TP, Wetzel L, Bishop S, Overberg K, Rogers DE. 2001. Influence of breeding habitat on bear predation and age at maturity and secul dimorphism of sockeye salmon populations. Canadian Journal of Zoology 79:1782-1793.

14. Budget

Item	FWS I&M Funds ($)	Other funds & source
Personnel (hours x rate)	0	Refuge staff, salary contribution
Fringe Benefits	0	
Travel*	1,000	
Refuge floatplane (3 trips)	1760	
Chartered floatplane (1 trip)	1760	
Equipment	0	
Supplies (avgas)	780	
Supplies (field food)	700	
Contractual	0	
Other		
Indirect Charges (x% rate x Project Total)	0	
Total	$6,000	

*Detail-Inventory & Monitoring Division staff person to assist with field work

15. Station Project Leader Approval

Signature	Date
	4/21/17