Alaska Salmon Shark Assessment Project

Project Number:	02396
Restoration Category:	Research
Proposer:	Dr. Stan Rice and Lee Hulbert NMFS, Auke Bay Laboratory ABL Program Manager, Dr. Stan Rice
Lead Trustee Agency:	NOAA
Cooperating Agencies:	Alaska Department of Fish and Game
Alaska Sea Life Center:	no
Duration:	Closeout of 2 year project
Cost FY 02:	$29.4K
Cost FY 03:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific salmon, Pacific herring, rockfish

ABSTRACT

This project will fund a closeout year of data analysis and manuscript preparation for this two-year study of salmon sharks in Prince William Sound. There will not be a field work component to the project in FY 02. Funding will cover analysis and final write-up of (a) Data transmitted from satellite tags deployed on salmon sharks that will be scheduled to transmit during winter and spring of 2002, and (b) Data transmitted from satellite tags deployed on salmon sharks that will transmit when the sharks frequent surface waters during summer, (c) Stomach samples collected during 2001 field sampling and pre-arranged stomach sample collections from the Copper River gillnet fleet and the Prince William Sound salmon seine fleet during the 2001 commercial fishing season. The funding will also cover FY 02 Argos time, NOAA Joint Tariff Agreement costs for satellite tag data recovery, and contracted data analysis. The final report will describe salmon shark movements, habitat utilization, regional fidelity, and diet composition from data collected during the project.

INTRODUCTION

The salmon shark, *Lamna ditropis,* is one of the predominant shark species in coastal Gulf of Alaska (GOA), yet very little is known of their movements, regional fidelity, or diet composition. The ecological role of salmon sharks in PWS will depend upon seasonal patterns of these parameters. Since FY 00 we have been investigating salmon shark diet through stomach collections and analyses, and salmon shark movements and fidelity to Prince William Sound (PWS) through use of two types of satellite transmitters. This research is yielding previously unknown information on salmon shark prey preference, prey switching, and seasonal habitat utilization in PWS and the GOA. Important stomach contents and satellite tag data describing these behaviors will be recovered in FY 02. Funding is needed to collect and synthesize this data for final manuscript preparation.

Data transmitted from satellite tags deployed in FY00 prove that the tagging works, and are yielding previously inaccessible information that are necessary to study salmon shark movements and ecology. In contrast, conventional tag-and-recapture efforts are not yielding much information because there are no shark fisheries for tag recoveries, and as indicators of movement and behavior have limited resolution. To date, of the 223 salmon sharks tagged with spaghetti tags in 1999 and 2000, only one has been recaptured. Utilization of satellite telemetry technologies provide state-of-the-art methods to acquire otherwise unattainable data on the movements, seasonal residency, regional fidelity, and ecology of these apex fish predators in PWS and GOA ecosystems.

Seasonally diverse salmon shark diet data are needed to assess the ecological role of salmon sharks in PWS and GOA ecosystems. Cooperation has been established with commercial and sport fishermen and various agencies to acquire seasonally and regionally diverse salmon shark stomach samples in the GOA. These efforts are ongoing and will continue through FY 01 and into FY 02.

Synthesis of historical salmon shark distribution and abundance data in the north Pacific from literature and bycatch databases was completed in FY 01. **This work documents increasing salmon shark abundance in the GOA because of their importance as predators not only to Pacific salmon, but also to other economically and ecologically important species in the region. We reviewed potential influences leading to a sudden increase in salmon shark abundance in the Northeast Pacific beginning in the mid 1990s, including; the 1992 moratoria on all large-scale pelagic driftnet fishing on the high seas;** salmon shark bycatch demographics and distribution records in the North Pacific, and; trophic regime shifts and increasing Pacific salmon production occurring in the GOA beginning in the 1980s. We suggest that a convergence of factors are resulting in the increasing importance of salmon sharks as predators in the changing ecology of the GOA.

Understanding the ecology and impact of sharks on the predator/prey dynamics of PWS requires research on TWO shark species; salmon sharks (*Lamna ditropis*) and Pacific sleeper sharks (*Somniosus pacificus*). The evidence of increasing numbers occurs for both species. These species have different biologies, although little is known about the diet and migration of either

species. Salmon sharks are caught in salmon fisheries; sleeper sharks are not. Sleeper sharks are caught often in long line gear; salmon sharks are not. Parallel but independent will be sleeper shark studies conducted by the NMFS using Stellar Sea Lion funds beginning in March 2001. Although the present evidence is meager, there is growing evidence of predation by sleeper sharks on marine mammals. This EVOS study will focus on salmon sharks, and at this time, is projected to be the last and only directed study on salmon sharks.

Progress to date

In FY 00 satellite tags, data archival tags, and spaghetti tags were deployed on salmon sharks. During the FY 00 field season we also collected side-looking and down-looking hydroacoustic data along stratified random line transects and aerial survey counts in Port Gravina.

In FY 01 we completed a draft manuscript of historical salmon shark distribution and abundance data synthesized from literature and analysis of bycatch databases from North Pacific fisheries. This work was performed to investigate evidence of changing salmon shark population trends. During FY 01 field work, nine PAT (pop-up archival transmitting) satellite tags and three SPOT2 (smart position-only transmitting) tags will be deployed on salmon sharks. Three PAT tags will be programmed to pop-up on each of three dates: October 1, 2001; February 1, 2002; and July 1, 2002. The tags provide large-scale geographic movement data, time spent at depth, time spent at temperature, and seasonal PWS and GOA residency information. SPOT2 tags are bolted to the sharks dorsal fin and transmit high resolution movement data to ARGOS satellites when the tag breaks the waters surface. The SPOT tags are providing information on salmon shark regional fidelity, seasonal PWS residency, and large and small scale spatial and temporal movements. Salmon shark stomachs will also be collected during the July 2001 field season, and from contributions from pre-arranged sources in FY 01 and FY 02.

In FY 02 we will retrieve and analyze satellite tag data, finish salmon shark stomach contents analyses, and synthesize a final report from satellite tag and salmon shark diet data collected in FY 00, FY 01, and FY 02. The will be no field season component in FY 02.

NEED FOR THE PROJECT

A. Statement of the Problem

The ecological role of sharks in PWS and their affects on the recovery of spill-injured resources in the region will vary with temporal and spatial patterns of movement. Salmon shark seasonal residency patterns, movements, and diet in PWS and the GOA have not been described.

Large numbers of sharks coupled with high food consumption to support above ambient body temperatures indicates that shark predation may be dominant and directly limit other key species (salmon, herring, rockfish, sablefish). Salmon shark body temperature averages 26.5^0C (80^0F) (Goldman 1999 unpublished data) and may be the highest of any shark. Because of this and the cold waters they inhabit in the GOA, salmon sharks likely possess a high metabolism and high daily ration. Eighteen salmon shark stomachs collected in late July and early August, during peak pink salmon returns, contained as many sablefish as salmon and also contained herring and rockfish

(Hulbert 1999 unpublished data). In regions of high abundance, salmon sharks have the potential to affect the recovery of oil spill injured species, including Pacific herring, Pacific salmon, and rockfish.

Salmon sharks inhabiting Alaskan waters have low fecundity, long life, and slow maturation. Once sharks reach a dominance level in the community they are likely to continue that dominance for a long time. Observations suggest salmon sharks may be a dominant predator in PWS now and for some time into the future, but we do not understand the significance of this role to other species and the ecosystem.

B. Rationale

This research will provide a valuable contribution to the understanding of shark ecology in the GOA and PWS and will document predator/prey interactions in the region. This information is needed to further the understanding of the ecological role of sharks in PWS and their effects on the recovery of spill injured resources in the region.

Pop-up archival transmitting (PAT) tags, and smart position-only transmitting (SPOT2) tags were successfully demonstrated by the project in FY00 and FY01 for monitoring the movements and diving behavior of salmon sharks. Data from satellite tags and opportunistic aerial observations will continue to be collected and analyzed in FY01 and FY02 to describe salmon shark movements, migrations, regional fidelity, and critical feeding areas.

Shark stomachs will be collected during directed sampling efforts, pre-arranged cooperation from commercial and sport fishermen, and from NMFS and ADF&G biologists. Efforts to collect and analyze seasonally diverse diet samples will be emphasized in an effort to describe prey switching when spawning aggregations of Pacific salmon are not present.

The project will also synthesize historical salmon shark distribution and abundance in the north Pacific from published literature and analysis of bycatch databases. This work is needed to investigate whether evidence of salmon shark population trends are revealed.

C. Location

Prince William Sound and Gulf of Alaska

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

A traditional and local knowledge component has been incorporated in this study. People from Cordova, Chenega, and Tatitlik have been and will continue to be asked to contribute their knowledge of shark temporal abundance and distribution. Community members may also be hired to recover PAT tags if they “pop-up” in PWS.

PROJECT DESIGN

A. Objectives

FY 01: Deploy satellite tags, collect seasonally diverse salmon shark stomach samples for diet analyses, and analyze historical salmon shark bycatch dat in the North Pacific Ocean.

FY 02: Retrieve and analyze satellite tag data, finish stomach analyses, and synthesize a final report. The final report will include salmon shark movements, movements, regional and seasonal fidelity to PWS and the GOA, and historical bycatch and population trends.

B. Methods

Data will be analyzed and manuscripts prepared by the investigators who were primarily responsible for the research.

C. Cooperating Agencies and Volunteers

Alaska Department of Fish and Game port samplers will collect salmon shark stomachs and tissue samples.

University of Alaska Fairbanks (Evelyn Brown) will provide opportunistic PWS aerial salmon shark observations.

Cordova Air will provide opportunistic PWS aerial salmon shark observations.

SCHEDULE

A. Measurable Project Tasks (Milestones) for FY 02 (October 1, 2001-September 30, 2002)

August- November 2001	Organize and analyze stomach data, and SPOT2 satellite tag data (position only tags) when available
December 2001- July 2002	Retrieve, analyze, and synthesize satellite tag data as available; analyze salmon shark stomach contents from contributions to the project from pre-arranged sources
August- September 2002	Analyze stomachs and satellite tag data, complete reports/manuscripts

C. Completion Date

September, 2002	Final Report (Date of final report allows for analysis of satellite tag data transmissions from SPOT tags which are likely to transmit during summer months when the sharks are active in surface waters and PAT tags which will be programmed to transmit during winter and spring, 2002.)

D. Budget Summary

Budget Category:	***FY02***
Personnel	$15.0
Travel	$ 1.4
Contractual	$10.0
Commodities	$ 0.0
Equipment	$ 0.0
Subtotal	$26.4
General Administration	$ 3.0
Project Total	$29.4

PUBLICATIONS AND REPORTS

A final report detailing results and accomplishments of the research will be accompanied by: A draft salmon shark seasonal diet manuscript; a draft salmon shark spatial and temporal movement manuscript; and report detailing the results of salmon shark historical distribution and abundance synthesis.

NORMAL AGENCY MANAGEMENT

NOAA/NMFS has statutory stewardship for most living marine resources; however, if the oil spill had not occurred, NOAA would not be conducting this project. NOAA/NMFS proposes to make a significant contribution (as stated in the proposed budget) to the operation of this project, making it truly cooperative.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The information gathered in this study may be useful to understanding the lack of recovery of some non-recovering species (harbor seals, Pacific herring).

PRINCIPAL INVESTIGATOR

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OTHER KEY PERSONNEL

Lee Hulbert, NMFS, Auke Bay Laboratory

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002						
Personnel	$28.2	$15.0						
Travel	$2.2	$0.8						
Contractual	$22.2	$10.0						
Commodities	$26.6	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$79.2	$25.8	Estimated FY 2003					
General Administration	$5.8	$3.0						
Project Total	$85.0	$28.8	$0.0					
Full-time Equivalents (FTE)	0.5	0.25						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Comments: This close-ourt year of the will analyze data produce a final report on investigations of salmon shark seasonal residency, movements, and trophic interactions in the eastern Gulf of Alaska (GOA) and Prince William Sound (PWS). State-of-the-art satellite tag data will be used to describe salmon shark movements and migrations, diet, and critical feeding areas and depths.

NOAA Contribution: Lee Hulbert 1 mo @ 5K, Dr. Stan Rice 1 mo @13K for a total NOAA contribution of 18K.

FY02

Prepared:7/9/01

Project Number: 02396-CLO
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Personnel Costs:		GS/Range/	Months	Monthly		
Name	Position Description	Step	Budgeted	Costs	Overtime	
L. Hulbert		GS9	3	5		
	Subtotal		3.0	5.0	0.0	
					Personnel Total	

Travel Costs:	Ticket	Round	Total	Daily	
Description	Price	Trips	Days	Per Diem	
	0				
RT Juneau to Anchorage (Lee Hulbert, EVOS workshop)	0.4	1	2	0.2	
				Travel Total	

FY02

Prepared:4/12/01

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Contractual Costs:	
Description	
Contract to analyze data Argos time and Joint Tariff Agreement	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	
Commodities Costs:	
Description	
Commodities Total	

FY02

Prepared:4/12/01

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

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

Existing Equipment Usage:	Number of Units	
Description		

FY02

Prepared:4/12/01

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA