# **1. PROJECT INFORMATION**

4181-00
UTL – Surviving the Gauntlet
1 October 2010 – 30 Sept 2014
\$3,765,811
1 December 2012 to 1 April 2013
19 April 2013
Jamal Moss

\*Although there may be only one lead author of the report, all PIs and co-PIs of the project, as identified in the approved statement of work and listed below, are responsible for the content of the Semiannual Progress report in terms of completeness and accuracy.

## Principal Investigator(s), Co-Principal Investigators and Recipient Organization(s):

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# 2. PROJECT OVERVIEW

# a. Briefly (4-5 sentences) describe the core purpose of your project, and the underlying need for this research.

The overall goal of our research is identifying and quantifying the major ecosystem processes that regulate recruitment strength of key groundfish species in the Gulf of Alaska (GOA). We concentrate on a functional group of five predatory fish species that are commercially important and account for most of the predatory fish biomass in the GOA. We focus on recruitment success because large swings in the abundance of these species have occurred despite precautionary fishing levels. Their early life begins with an offshore pelagic phase followed by a nearshore settlement phase. Spatial distribution, food preference, and habitat suitability of these two life history phases are poorly known. Fieldwork will define a critical environmental window for these five focal species by examining the gauntlet they endure while crossing from offshore spawning to nearshore settlement areas. We will contrast two regions: the central GOA with a broad shelf dominated by high oceanographic variability and large demersal fish biomass and the

eastern GOA (SEAK) with a narrower shelf, lower demersal biomass, and higher species diversity. Retrospective analysis of biological and environmental variability combined with multispecies stock assessment models will determine the relative influence of environmental parameters and identify processes influencing recruitment. Regional differences will be linked to dietary preference of top level predators to infer causal mechanisms for population trends and influence of climate change on ecosystem structure and diversity.

## b. State the specific GOAIERP hypothesis or hypotheses that your project is addressing.

*The Gauntlet*: The primary determinant of year-class strength for marine groundfishes in the GOA is early life survival. This is regulated in space and time by climate-driven variability in a biophysical gauntlet comprising offshore and nearshore habitat quality, larval and juvenile transport, and settlement into suitable demersal habitat.

GOAIERP hypotheses are posted in SharePoint at: <u>https://agora.afsc.noaa.gov/sites/gisr</u>

# c. List the specific objective(s) of your research project.

- 1.) Quantify, by region, the temporal variability in potential climatic, oceanographic, or biological drivers influencing the early life survival of key groundfish species. Differences between the eastern and central GOA will be examined through retrospective analyses of available spatial datasets. Please refer to the retrospective component progress report for more details.
- 2.) Determine by region the abundance, distribution, and condition of key groundfish species during their offshore to nearshore pelagic phase through at-sea sampling with concurrent observations of the biophysical environment (i.e. oceanography, prey, competitor, and predator fields). Please refer to the lower trophic level (LTL) and the middle trophic level (MTL) component progress reports for more details on nearshore sampling and the concurrent offshore observations of oceanography, competitor, and prey fields.
- 3.) Create benthic habitat suitability maps by region through analysis of available bathymetry and substrate data (e.g. slope, grain-size) to characterize the nearshore demersal habitat.
- 4.) Develop growth curves and consumption rates through laboratory work, which will parameterize simple bioenergetics models that will estimate potential fish growth for rockfish.
- 5.) Analyze dietary preference and foraging behavior of seabirds and relate diet to prey availability. Please refer to the MTL component progress report for more details on the estimation of total biomass removals by seabirds.

# **3. PROGRESS SUMMARY**

## a. Provide a table showing the timeline and milestones for the current reporting period only.

What	Who	Start and end dates	Status
2012 predator diet processing	Fournier	March 2013 – June 2013	In progress

2012 juvenile rockfish diet	Fournier	December 2012 –	Complete
processing		March 2013	
2011 and 2012 juvenile ATF	Mullen	March 2013 – June	In progress
sample diet processing		2013	
Georegistering and digitizing of	Shotwell,	December 2011 –	In progress
central GOA bathymetry and	Zimmermann	April 2013	
sediment data and begin			
process for southeast Alaska			
region			
2013 UTL survey planning	Moss	December 2012 – June	In progress
		2013	
2013 UTL survey coordination	Fournier	December 2012 – June	In progress
		2013	
Proximate analysis for age-0	Heintz	December 2012 –	Complete
target species collected in 2011		February 2013	
Pollock physiology lab study	Heintz,	December 2012 –	Complete
	Sreenivasan	January 2013	
P. cod physiology lab study	Heintz,	April 2013 – May	In progress
	Sreenivasan	2013	
Rockfish physiology lab study	Heintz,	May 2013 – June 2013	Planned
	Sreenivasan		
Rockfish RNA/DNA lab study	Heintz,	June 2013 –	Planned
	Sreenivasan	September 2013	
Rockfish RNA/DNA field	Heintz,	December 2012 –	Complete
survey sample processing	Sreenivasan	February 2013	
Prepare rockfish samples for	Fournier	December 2012 –	Complete
genetics analyses		February 2013	
FTSP diet samples and	Slater	October – 2013	In Progress (1/2
puffin & auklet diet analyses			complete)
are complete			
-			
Along track densities of marine	Slater	November – 2013	In Progress
mammal and seabird			
observations from 2011			
Provide 2011 seabird	Slater	November – 2013	Complete
reproductive success data			_
Rhinoceros auklet foraging area	Slater	April – 2013	Complete
study data collection			

## **b.** Describe report period progress.

#### Retrospective Analysis (1):

Please refer to retrospective component progress report.

#### Fisheries Oceanographic Surveys (2):

Age-0 marine fish were much more abundant during the summer of 2012 relative to 2011. However, age-0 sablefish were rarely encountered. UTL fisheries oceanographic survey data (fish sampling and cruise activity logs) collected during summer 2012 were checked, proofed, and posted to the GOA Project *Workspace* in December. Diet samples collected from age-0 rockfish in 2012 have been processed and

samples collected from age-0 ATF, Pacific cod, and pollock are being processed this spring, which are expected to be complete by summer 2013. Larval rockfish collected in bongo nets were received from NOAA's ECO-FOCI group and combined with age-0 rockfish collected in surface trawls for identification through genetic analysis (UAF). Age-0 rockfish collected during the GLOBEC Program (2001-2004) and preserved at -80°F have not yet been prepared for diet and proximate analysis. However, these samples will be processed if time allows. Salmon were the most abundant predator in surface waters during summer 2012 and diet samples for adult Chinook, pink, and coho are currently being processed.

The report titled: "Surviving the Biophysical Gauntlet: YOY Rockfish in the Eastern Gulf of Alaska, 2010 to 2013" is in the preliminary stages of being developed with 2010 and 2011 data summarized and 2012 fish currently being analyzed. This study observes inter-annual variability in bottom –up, top-down, and competition influences on YOY rockfish abundance, distribution, and energy allocation. The report will be authored by W. Fournier, R. Heintz, and J. Moss; and will utilize data from the 2010, 2011 and 2012 UTL field surveys, energetic data generated by the RECA Nutritional Ecology Lab, and diet data from the FEDZ laboratory.

## Habitat Suitability (3):

We completed a draft digitization of the smooth sheet features, such as rocky reefs, kelp beds, rocks and islets, which might provide important habitat information, in the CGOA study area. Work is in progress to digitize these same features between the CGOA and EGOA areas. We have made plans to complete this work in the EGOA this summer. In general, we are equating these features with rock or rocky habitat, so that it can be included along with the sediments, providing a more detailed groundfish settlement habitat map.

Our bathymetry and sediment data manuscript, which describes several potentially useful measures for describing and comparing five of the MTL sites, will hopefully be accepted in the first GOA IERP DSRII special issue. A supporting manuscript, describing in great detail the GIS methods for such an analysis, was written and submitted for internal review for eventual publication as a NOAA Tech. Memo.

We have also recently accepted a post-doc, Jodi Pirtle, for the marine habitat mapping NRC opportunity that we posted this last fall. Jodi attended the recent Seattle PI meeting and was available for discussing ideas for integration and collaboration with several other components. She will begin her post-doc in May in Juneau, Alaska.

#### Seabirds and Marine Mammals (4):

One observer was present on each of the 2012 cruise legs aboard the F/V *Northwest Explorer* to record sightings of seabirds and marine mammals. Cruises along transects occurred farther offshore in 2012 than in 2011. Wildlife sightings were reflective of this as densities were generally lower than those observed in shallower waters. These observations are being used to generate estimates of seabird and marine mammal densities along transects.

#### Seabird Colony (5):

Colony-based work occurred on St. Lazaria (eastern gulf) in 2012 but not on East Amatuli Island (western gulf) due to a lack of funding. Data collected at St. Lazaria Island covered the full complement of monitoring parameters for storm-petrels (planktivores) and auklets (piscivores). In addition, data on rhinoceros auklet foraging range was obtained by deploying 22 temperature-depth recording (TDR) dataloggers between 30 June and 12 August. Ten of these loggers were retrieved with data. In addition, six global positioning system (GPS) tags were deployed. Citizen observers recorded size and location of rhinoceros auklet flocks in the Sitka Sound area during late July and August.

#### Physiology (6):

A growth and feeding experiment for juvenile walleye pollock was conducted over four temperature treatments (4°, 8°, 12°, and 16°C) over four feeding ration levels (high, medium, low, and starvation). Maximum consumption levels were also estimated at each temperature during these 14-day experiments using *Euphausiids* as prey. These experiments are currently being performed on juvenile Pacific cod. Rockfish will be the third and final species to be tested, and experimental trials for cod are scheduled to begin immediately after Pacific cod are complete (~4 weeks). Data from temperature and ration dependent feeding trials will parameterize a maximal consumption rate model specific to the suite of experimental temperatures along with. RNA/DNA ratios will be measured from muscle tissue samples at the end of each trial and be used to determine instantaneous growth rates that correspond with temperature-specific trials. They will also be used to develop a RNA/DNA based growth model for juvenile Pacific cod and rockfish.

Pristane concentrations have been estimated for the age 3+ yellowtail rockfish that were used in the initial growth study. RNA/DNA analysis on these specimens is ongoing. Muscle plug samples from pollock used in the growth study were analyzed for RNA/DNA ratios. Samples from theses specimens are being homogenized in order to be used in a pristane analysis. The pristane assay uses whole body homogenate and will eventually be contrasted with RNA/DNA ratio data. This particular comparison will allow for a more comprehensive estimation and analysis of growth rate, assimilation efficiency, and consumption level across species and ration level.

#### c. Describe preliminary results.

#### Fisheries Oceanographic Surveys (2):

The highest fish biomass levels during summer 2012 were located on the shelf seaward of Cross Sound and Chichagof Island in the eastern study region (Figure 1) and over the shelf between Harris Bay and Stevenson Entrance in the western study region (Figure 2). Age-0 rockfish and Pollock were abundant in both study regions with the largest densities of rockfish encountered to date in slope and offshore habitats off Kodiak Island (Figure 2). Age-0 arrowtooth founder were abundant in the eastern region, but not in the western region.

Preliminary results indicate that age-0 rockfish were larger and higher in both energetic density and lipid content during summer in 2011 relative to 2010 (Figure 3, 4, and 5). Primary prey items identified in stomach content analysis indicate that rockfish mostly consumed *Eupahusiids* in 2010 compared to *Calanoid* copepods in 2011 (Figure 6). Stomach content analysis of juvenile chum and pink salmon revealed a high frequency of prey overlap with age-0 rockfish. Juvenile coho preyed upon age-0 rockfish in 2010. Age-0 rockfish, pink salmon, and chum salmon prey overlap decreased in 2011 relative to 2010. Adult pink salmon diets were not quantified in 2010 but onboard observations indicate a high potential for predation. 2011 adult salmon stomachs were retained from the survey and analyzed in the lab, but age-0 rockfish were not a significant prey item. 2012 adult salmon diets are currently being processed and preliminary results indicate a high proportion of age-0 marine fish in their diet.

Habitat Suitability (3):

No preliminary results to report at this time.

### Seabirds and Marine Mammals (4):

Recorded observations are being used to generate estimates of seabird and marine mammal densities along transects, however, no preliminary data on marine mammal and seabird distribution is presently available. Sightings of what appeared to be tsunami debris from the March 2011 earthquake in Japan were also noted.

# Seabird Colony (5):

Monitoring data were collected to evaluate population trends, annual productivity, and the timing of breeding events, chick growth, and chick diet composition. Preliminary analyses of rhinoceros auklet activities are as follows:

- Burrow occupancy rates on long-term study plots (i.e., number of burrows active out of total number on plots) was 62.7%
- Annual reproductive success (number of active burrows in early August/number of active burrows in early July) was approximately 85%
- Breeding occurred 1-2 weeks later than usual and was more asynchronous than typical
- Chicks fledged slightly heavier (< 5 grams) than in 2011

More pronounced breeding asynchrony than typical resulted in challenges in capturing adults for telemetry work as well as collecting data on stomach contents of adults. Nevertheless, 19 adults were non-lethally sampled for stomach contents and 34 adults were sampled for blood stable isotope analysis. Data on rhinoceros auklet foraging range were obtained by deploying 22 temperature-depth recording (TDR) dataloggers between 30 June and 12 August which will be used to describe the foraging behavior.

No diet samples were collected from seabirds in western Gulf as part of GOAIERP due to lack of Alaska Maritime National Wildlife Refuge funding. However, tufted puffin diet data were summarized from the time period 1995-2011 and submitted to the team. Ninety-three diet samples (defined as individual billloads of prey) were collected from adult rhinoceros auklets in 2012. Figure 7 shows the relative biomass of the predominant prey identified from 1994-2012. Fork-tailed storm-petrel diet samples were collected at the St. Lazaria colony in 2012 and are in the Auke Bay lab queue to be analyzed.

# Physiology (6):

Preliminary data suggest juvenile pollock are capable of consuming up to 13% and juvenile Pacific cod up to 20% of their body weight when acclimated to 4°C water. A preliminary analysis of RNA/DNA ratios for pollock suggests that their highest rates of food consumption and growth efficiency occur when acclimated to 8°C water. The growth study for Pacific cod is currently in progress, and maximum rates of consumption and growth efficiency will be reported in the fall.

# d. Describe integration activity.

#### Fisheries Oceanographic Surveys (2):

UTL investigators put forth considerable effort toward preparing topic session talks for the GOA Project PI meeting. Priorities for sample processing and sharing data with the modeling team were discussed at the PI meeting. Results for preliminary data analysis were shared and manuscripts will be developed in collaboration with PIs from other trophic components during spring and summer. UTL investigators will continue to work collaboratively with other trophic level investigators over the coming months to ensure cross cutting themes are addressed and integration is preserved in analyses. The UTL field sampling team is also working with other trophic-level groups on planning and scheduling the 2013 field sampling effort.

The EGOA age-0 rockfish analysis has a high level of integration among the UTL and LTL groups. Efforts have been made to integrate the UTL database with the one currently being used by the ichthyoplankton group within the LTL component. UTL PIs have been interacting with members in the Modeling component in order to provide data that can be used to estimate levels of predation and competition in age-0 fish though predator diets. All of the information collected on UTL surveys is being shared with all member groups in the GOA Project.

# Habitat Suitability (3):

Mark Zimmermann made an hour-long habitat presentation at the modeler's group meeting in late December as a representative of the benthic habitat group. There was a lot of discussion and questions and answers during the presentation, such that the modeler's hopefully gained a better understanding of the habitat data sets being prepared for GOA IERP.

Mark also made the Habitat group presentation at the annual GOA IERP meeting in March. Highlights included demonstrating the relationship between shoreline exposure and sediments in the Barren Islands (integration between habitat data sets) and demonstrating the spatial relationship between hydroacoustically determined schools of zooplankton and fish (provided by Alex De Robertis) and the 3D bathymetry of Port Dick (integration between habitat and MTL data sets).

At the annual meeting we came up with a plan for a limited amount of groundtruthing to be added to the MTL 2013 field work. Mark created a list of 25 habitat items, such as islets, sills, and sediment types, to be investigated at 4 MTL sites in the CGOA area: Kiliuda Bay, Izhut Bay, Port Dick and Aialik Bay (the Barren Islands do not have small skiff field work, impeding collection of groundtruthing data).

## Seabirds and Marine Mammals (4):

Density estimates of marine wildlife observed on transects (i.e., between sampling stations) during UTL fisheries oceanographic surveys in 2012 are being derived (using an R-based script) for incorporation within the GOA Project *Workspace*. Also, through this integrative process, distribution and abundance of all species can be temporo-spatially linked with chemical and physical properties of the marine environment recorded during UTL cruises.

## Seabird Colony (5):

A subsample of rhinoceros auklet diets collected in 2011 was sent to the Auke Bay lab for lipid content analysis and dietary preference determination. This analysis was completed in September.

<u>Physiology (6):</u> None to report at this time.

#### e. Describe any concerns you may have about your project's progress.

We have two primary concerns. The first concern is the AFSC's inability to provide a platform from which LTL work can be completed in the eastern study region during fall 2013. A request to use Cobb replacement to provide for an oceanographic vessel to perform this work was submitted to AFSC leadership in December 2012. However there are not sufficient funds available this year to do so. Our second concern is not having a 120 kHz GPT box for the UTL survey vessel. However, we are currently working closely with the MTL group to resolve this issue.

#### f. Poster and oral presentations at scientific conferences or seminars

1. Oral presentation(s): (GOA Project Annual PI Meeting, March 2012) Topic session presentations

- a. Topic Session 1: Retrospective analyses overview (Mueter, Waite, Shotwell)
- b. Topic Session 3: Fish distribution and abundance (Moss, Fournier)
- c. Topic Session 4: Habitat research (Zimmermann, Shotwell)
- d. Topic Session 5: Trophic relationships (Fournier, Moss)
- e. Topic Session 6: Physiological ecology (Heintz, Fournier)

2. Poster presentation: (AMSS, January 2013) Surviving the Biophysical Gauntlet: YOY Rockfish in the Eastern Gulf of Alaska, 2010 and 2011 by Wyatt Fournier

3. Poster presentation: (AMSS, January 2013) Benefits of living life on the edge: "Enhanced growth and foraging opportunities for juvenile salmon inhabiting the margins of the Sitka Eddy" by Jamal Moss

4. Poster presentation: (AMSS, January 2013) A Tale of Two Feathers: Resource Allocation and Corticosterone in Seabird Nestlings by A. Will, A. Patterson, and A. S. Kitaysky.

#### g. Education and outreach

Nothing to report for this period

## 4. PROGRESS STATUS

We have made satisfactory progress in completing all tasks scheduled for the current reporting period and are on task to complete the laboratory processing of 2012 samples by summer 2013. Feeding and growth rate experiments on pollock, Pacific cod, and rockfish are currently underway and expected to be complete by summer 2013. Feeding and growth experiments are about a year behind schedule due to difficulties associated with live fish collection. Sablefish were originally a species targeted for wet lab work, but were rarely encountered in the field and no specimens were obtained. Survey data from 2012 is currently being shared with the group and 2013 field season preparation and coordination is proceeding as planned.

# 5. FUTURE WORKPLAN and DATA DELIVERY

<u>workpiun</u>			
What	Who	Start and end dates	Other key dates
NOAA/UTL summer and fall	Moss, Fournier	July – October 2013	
field surveys			
Age-0 ATF diet and energetic	Moss	May – November 2013	
analysis			
Adult diet salmon processing	Fournier	April – May 2013	
Finalize surface of region-wide	Zimmermann	December 1 –	
bathymetry product for GOA		completion of product	
Complete digitizing and	Reid	December 1 –	
proofing of western and eastern		completion of product	
GOA sediment data and begin			
process for gap region			
Begin literature review and	Shotwell, Pirtle	April 1 – December 31	
species specific base model		2013	
development			
Age-0 P. cod lab experiments	Sreenivasan,	April – May 2013	
	Heintz		

#### Workplan

Age-0 rockfish lab experiments	Sreenivasan,	May – June 2013	
	Heintz		
Continue RNA/DNA analysis	Sreenivasan,	June – November 2013	
	Heintz		
Post UTL field survey data on	Moss	December 2013	
Workspace			
Rockfish genetics processing	Heifetz	May – December 2013	
Age-0 P. cod and Pollock diet	Heintz	May – June 2013	
and energetics			
Colony-based productivity &	Slater	September 2013	
diet sampling at East Amatuli &			
St. Lazaria			
At-sea observations for marine	Slater	December 2013	
mammal & seabird numbers			
and distributions data collection			
Rhinoceros auklet foraging area	Slater	December 2013	
study (including use of TDR)			
data collection			

#### Data delivery

GOAIERP Data Delivery Table		
Data type for delivery	Delivery Month & Year	Person sending data, with email address
2013 field survey data	December 2013	Jamal Moss jamal.moss@noaa.gov
Adult salmon diet data (2012)	June 2013	Wyatt Fournier wyatt.fournier@noaa.gov
	June 2013	Wyatt Fournier wyatt.fournier@noaa.gov
Tufted puffin diet data	April 2013	Arthur Kettle arthur_kettle@fws.gov
Fork-tailed storm-petrel diet data (partial, remainder pending)	September 2013	Leslie Slater leslie_slater@fws.gov
Seabird/marine mammal observational data from 2012	October 2013	Leslie Slater leslie_slater@fws.gov
Species Specific Habitat Suitability (SSHA) maps	January 2014	Kalei.Shotwell@noaa.gov

- 1) 2012 field survey data was posted to the SharePoint FTP site in December 2012. Specific survey data delivered are:
  - Haul location, timing, weather, and net mensuration
  - Fish species abundance by haul (counts and total weight)
  - Individual lengths and weights for all fish sampled
  - Event log with time and location (GPS) of all sample activities

2) Wyatt Fournier will disseminate adult salmon diet data.

• Prey composition by prey group weight for adult salmon

- 3) Leslie Slater will disseminate shipboard seabird and marine mammal observational data and seabird colony diet and tag data.
  - Transect line counts (with locations) of seabirds and marine mammals
  - Diet and tag data from colonies













# Figure 3.

Length frequency of age-0 rockfish captured in the eastern study regions during 2010 and 2011.

# Figure 4.

Length vs. energy content of age-0 rockfish captured in the eastern study regions during 2010 and 2011.

Figure 5. Relative CPUE (30-minute surface tow) for age-0 rockfish in 2010 and 2011.

Figure 6. Percent prey composition of rockfish diets in 2010 vs. 2011.