North Pacific Research Board
Gulf Project Semiannual Progress Report: Middle Trophic Level (MTL) Component

1. PROJECT INFORMATION

GOA IERP Project Number:	G82
Title:	Middle Trophic Level: Temporal and spatial axes of variability in the structure of Gulf of Alaska forage fish communities
Overall project duration	October 1, 2010 to January 31, 2015
Overall project funding	$1,858,400
Report period	May 1, 2011 to November 30, 2011
Report submission date	November 30, 2011
Lead Author of Report*	Olav A. Ormseth

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

Lead PI: Dr. Olav A. Ormseth, Alaska Fisheries Science Center, Olav.Ormseth@noaa.gov
Co-PI: Dr. Alex DeRobertis, Alaska Fisheries Science Center, Alex.DeRobertis@noaa.gov
PI: Dr. John K. Horne, University of Washington, jhorne@u.washington.edu
PI: Shiway Wang, Sedna Ecological, lnc., sedna.ecological@gmail.com
PI: Dr. Suzanne Budge, Dalhousie University, suzanne.budge@dal.ca

2. PROJECT OVERVIEW

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

Forage fish link primary and secondary producers to upper trophic level (UTL) predators. The forage fish community includes small, fast-growing species such as capelin and sand lance, as well as juvenile stages of groundfishes (e.g. walleye pollock and Pacific cod). The MTL seeks to understand the ecosystem role of forage fishes as well as their predators, prey, and competitors by studying how forage fish communities and the GOA ecosystem varies over time (seasonally and annually) and through space (variation within regions and between regions). Sampling is being conducted in spring, summer, and fall of two years (2011 and 2013). The study area includes two main regions (eastern, comprising the outer coast of southeast Alaska, and western, comprising the east side of Kodiak Island and the southern coast of the Kenai Peninsula). Nearshore surveys are focusing on 5-6 sampling sites within each main region; offshore acoustic surveys throughout each region are being conducted aboard the UTL vessel; and diet and energetics studies are addressing relationships among species and the flow of energy among trophic levels. Oceanographic studies are being conducted aboard the nearshore surveys in collaboration with the LTL component. The MTL project is also contributing to the all-component retrospective analysis effort.

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

The MTL component is addressing all three of the overarching GOA IERP hypotheses:

1) 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.

2) The physical and biological mechanisms that determine annual survival of juvenile groundfishes and forage fishes differ in the eastern and western GOA regions.

3) Interactions among species (including predation and competition) are influenced by the abundance and distribution of individual species and by their habitat requirements, which vary with life stage and season.

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

1) Provide a synoptic view of nearshore/offshore distribution and abundance (past and present) to gain a comprehensive understanding of how GOA forage communities are structured, how this structure changes in response to the environment, and the effects of this variability on prey availability for upper trophic level species.

2) Analyze habitat associations to determine how habitat needs influence the spatial overlap among species and resulting predation and competition.

3) Use analysis of stomach contents, stable isotopes, and fatty acids to infer diets and elucidate relationships among forage community members, lower trophic level prey, and upper trophic level predators.

4) Use proximate analysis to assess nutritional condition of community members and relate condition to spatial and diet overlaps among species.

3. PROGRESS SUMMARY

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

Activity	*Q3 – FY2011*	*Q4 – FY2011*
Collection of historical data	X	X
Nearshore survey and sample collection	X	X
Offshore survey and sample collection	X	X
Acoustic data processing		X

b. Describe report period progress.

Objectives 1 & 2

Research activities: nearshore surveys, offshore acoustics surveys, retrospective analysis

Progress:

- All planned fieldwork for 2011 has been completed.
- Six nearshore surveys were performed (eastern GOA region and western GOA region in spring, summer, and fall) for a total of 93 days at sea. All sites were visited in all seasons except during the fall cruises, when Torch Bay/ Graves Harbor (EGOA) and Aialik Bay (WGOA) could not be reached due to weather.
- Acoustic data were collected aboard all 4 legs of the UTL offshore survey. Forty midwater tows were conducted to provide groundtruthing of acoustic sign. During the fall cruises, some transects/ station lines were not completed due to weather.
- A large number of fish samples (forage fishes, GOAIERP focal species YOY, and potential competitors/ predators) were collected during the nearshore and offshore surveys and saved for the diet and energetics analysis.
- Oceanographic data including chlorophyll, nutrients, CTD casts, and plankton tows were collected at all sites visited during the nearshore surveys and at the offshore survey stations.
- Along with investigators from other components, we are currently collecting and organizing historical data for the retrospective analyses. Greater detail is available in the separate progress report submitted by the retrospective component.
- Pre-processing of acoustic data from the nearshore and offshore surveys has commenced.

Objective 3

Research activities: analysis of stomach contents and tissues

Progress:

- No tasks related to this objective were planned for this reporting period, as the research activities are dependent on samples gathered in the field. We gathered a large number of samples (forage fishes, focal species YOY, and potential competitors/predators) in all seasons. These have been stored either frozen or in formaldehyde. During December 2011, these samples will be shipped to PIs Wang and Budge and analysis of the samples will occur throughout calendar year 2012.

Objective 4

Research activities: proximate analysis of fish tissues

Progress:

- No tasks related to this objective were planned for this reporting period, as the research activities are dependent on samples gathered in the field. We gathered a large number of samples (forage fishes, focal species YOY, and potential competitors/predators) in all seasons. These have been stored frozen. During December 2011, these samples will be shipped to UTL PI Heintz and collaborator Vollenweider and analysis of the samples will occur throughout calendar year 2012.

c. Describe preliminary results.

Nearshore surveys, spring – summer- fall 2011, eastern and western regions: Six nearshore surveys were conducted during 2011. We have not yet had time to collate or analyze any biological or oceanographic data. We include here some general impressions that may serve as preliminary results:

1) Pacific herring appear to be the most abundant and ubiquitous forage fish species in our study areas. We encountered herring at most of the sites and in all seasons. We encountered all life stages, from eggs and YOY to spawning adults.
2) We did not find many large aggregations of other forage fishes in the nearshore areas. We encountered Pacific sand lance, sandfish, capelin, and eulachon but these occurred either dispersed or in small schools.
3) In the spring we captured chum and pink salmon fry throughout both of our study areas. It seems likely that these are an important forage resource in the spring.
4) During the summer cruises we encountered large numbers of young-of-the-year (YOY) saffron cod, Pacific cod, and walleye pollock. These fishes occurred together in eel-grass habitats, while kelp habitats had either Pacific cod or a Pacific cod/pollock mix. Other species (such as unidentified rockfish YOY) sometimes co-occurred in kelp habitats.
5) When we revisited the same sampling sites in the fall, walleye pollock were almost completely absent from catches, and the size of the saffron cod/Pacific cod catches was substantially lower than in the summer.
6) We did not observe the large aggregations of larval capelin that we saw in fall 2010. Also, seabirds seemed at a much lower density than in 2010.
7) In deeper waters (> 100 m), we often observed a krill layer. We were unable to sample fish backscatter at these depths but the echosign was consistent with walleye pollock.
8) In summer and fall, nearshore water temperatures appeared to be consistently several degrees colder in the CGOA than in the EGOA.

Offshore survey, summer – fall 2011, SE and Central Gulf of Alaska: All four legs of the UTL cruise from July 1 through October 15 were staffed by one or two acoustic biologists. Observations during the two SE cruise legs included: fewer rockfish and more herring observed over the shelf in the fall, subsurface salmon schools were absent in the fall; the myctophid layer over the slope transitioned from an upper dense and lower patchy, less dense layers in summer to a shallower, patchy upper layer and a continuous, lower layer in the fall. In Spencer's Gully during the summer, continuous small, dense aggregations of walleye pollock and assorted forage species were observed during summer. During fall, aggregations were absent and targets were concentrated near bottom with increased density at gully edges. In the Central Gulf during the fall, herring abundance increased and was frequently observed and caught in surface trawls at stations closer to shore. Capelin, Pacific ocean perch, walleye pollock, and dogfish were common in both seasons. A notable catch of age-0 walleye pollock occurred at station 205d, due east of Kennedy Entrance. The corresponding characteristic patterns of age-0 walleye pollock were not observed during the summer cruise leg.

d. Describe integration activity.

Nearshore surveys: The nearshore fieldwork is heavily integrated with the UTL and especially LTL components. On board the surveys, we focused on UTL focal species and conducted a full suite of oceanographic studies.

Offshore acoustic surveys: Discussions were held with project PIs on a variety of topics. Contributions were made to the UTL survey design at all PI meetings and follow up emails. Coordination between nearshore and offshore MTL sampling was discussed among LTL and MTL scientists. Finalizing staffing and in-port dates for the survey vessel was coordinated with Jamal Moss. MTL, UTL, and LTL scientists integrated and assisted with all sampling activities throughout the offshore survey legs.

Retrospective analysis: We are an integral part of the retrospective team that has formed to coordinate the analyses.

Modeling: We have worked with the modelers to develop sampling plans for gathering data (particularly food habits data) for use in the models.

General: We have been actively involved in developing overall GOA IERP hypotheses and objectives, sampling plans, and other activities. This includes participation in all PI meetings, phone calls, and GABI meetings.

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

Nearshore surveys: We were unable to sample 2 sites in the fall due to weather. While this is unavoidable, it does hinder our ability to perform seasonal comparisons at these sites. One of the sites, Aialik Bay, corresponds geographically to UTL offshore stations that were also missed in the fall due to weather delays. As a result, the impacts to the two components are at least relegated to the same spatial area. Groundtruthing the acoustic backscatter remains our largest challenge in the nearshore. As we analyze the data this year, improving our groundtruthing will be a top priority for the 2013 field year. We have already discussed several possibilities and we anticipate that we will be able to improve our abilities in this regard, although we will likely not be able to adequately groundtruth all echosign.

Offshore acoustic surveys: As described in the May report, a 120 kHz transducer was not available for us on the UTL cruises. The lack of a second frequency constrains the ability to acoustically discriminate among groups of backscattering organisms (e.g. krill and fish). A continuing concern is the lack of sampling intensity for groundtruthing echosign on the UTL cruises. Only 40 midwater tows were conducted during the four legs of the survey. This low sampling intensity limits the species partitioning of the acoustic record below the range of the surface trawls. A combination of acoustic noise and a ~ 200m depth limit on midwater trawls also constrains the resolution of data analyses. Noise removal during data processing will extend the analytic data range to a minimum of 500 m. It is proposed that a high species resolution analysis be conducted from 15 to 200 m depth and a general acoustic backscatter as an index of biomass be calculated from 200 to 500 m depth. Estimates of species-specific pelagic fish and macro invertebrate densities will be limited by the amount of midwater trawl catch data and the consistency of acoustic backscatter patterns.

f. Poster and oral presentations at scientific conferences or seminars

Ormseth presented a talk at the annual American Fisheries Society meeting in Seattle in September 2011 entitled "Forage fish studies as part of the GOA IERP". He also gave an extensive GOIERP update talk to the combined Plan Teams of the North Pacific Fishery Management Council in August 2011.

g. Education and outreach

A potential outreach program is being discussed with the Seattle Academy (PI Horne). Specific activities have not been planned but we are exploring the level of interest in the school's science program and investigating possible linkages between science classes and GOA IERP scientists. We plan on identifying specific topics and activities during the next reporting period.

4. PROGRESS STATUS

Overall our progress has been good. The equipment problems encountered during the April 2011 survey have largely been solved. Groundtruthing the echosign remains the largest challenge for the nearshore surveys. The offshore acoustics project fulfilled the sampling objectives developed by project PIs. We continue to be particularly satisfied with the collaboration between the LTL component and our nearshore surveys and the integration of sampling on the UTL offshore cruise. We are also developing some collaborations with non-GOAIERP investigators to maximize the usefulness of the data and samples gathered during the fieldwork (e.g. a joint effort with the AFSC's Age & Growth Program using otolith microchemistry to study stock structure in the Pacific cod YOY captured during the nearshore surveys).

5. FUTURE WORKPLAN and DATA DELIVERY

Workplan

Note: We have included workplan dates that only include the next reporting period (i.e. no date is later than 5/1/2012); some activities (e.g. fatty acid analysis) will extend into the following reporting period

What	*Who*	*Start and end dates*
nearshore fish data analysis	Ormseth	12/1-5/1
nearshore acoustic data processing and analysis	Ormseth/DeRobertis	12/1-5/1
Preparation of fish samples	Ormseth	12/1 -1/1
Stable isotope and fatty acid analysis	Budge/Wang	1/1-5/1
offshore acoustic data processing and analysis	Horne/ McGowan/Barbee/Nomura	12/1 – 5/1
retrospective data collection and analysis	Ormseth	9/30-12/31
archive 2011 offshore acoustic data	McGowan	June 2012

Data delivery.

Note: We have not yet figured out who will have the responsibility for stewardship of the oceanographic data for the MTL nearshore surveys. Lead PI Ormseth is listed as the point contact for all of these data sources as he is in the best position to facilitate data delivery.

GOAIERP Data Delivery Table		
Data type for delivery	Delivery Month & Year	Person sending data, with email address
Nearshore survey fish catch data	3/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore acoustics integrated backscatter	7/12	Olav Ormseth (olav.ormseth@noaa.gov)
Offshore acoustics integrated backscatter	6/12	Dave McGowan (mcgowand@uw.edu)
Nearshore CTD data	3/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore zooplankton data	12/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore chlorophyll data	3/12	Olav Ormseth (olav.ormseth@noaa.gov)
Nearshore nutrients data	3/12	Olav Ormseth (olav.ormseth@noaa.gov)