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GEM PROPOSAL SUMMARY PAGE

(To be filled in by proposer)

Project Title:	Biophysical Observations Aboard Alaska Marine Highway System Ferries
Project Period:	FY04-FY06
Proposer(s):	Edward D. Cokelet, NOAA/PMEL Calvin W. Mordy, Joint Institute for the Study of the Atmosphere and Ocean W. Scott Pegau, Kachemak Bay Research Reserve
Study Location:	Alaska Coastal Current, Prince William Sound

Abstract: The Alaska Coastal Current flows counterclockwise along the edge of the Gulf of Alaska carrying the river runoff, nutrients and plankton that fuel the productive coastal-marine ecosystem. As seen in satellite images, a strong "chlorophyll front" develops in summer between the nutrient-poor region to seaward and a productive region around Kodiak island that extends northward to the Kenai Peninsula. Conventional wisdom predicts that the Gulf ecosystem should not be productive because the average wind pattern favors downwelling oceanic conditions that fail to restore nutrients to the sunlit upper layers. The chlorophyll front presents a natural study area over which low- and high-productivity regions lie in close proximity. The Alaska Marine Highway System ferry M/V *Tustemena* crosses this front over 280 times each year. We propose to instrument the *Tustemena* to measure physical and biological oceanographic parameters across the Alaska Coastal Current and in Prince William Sound. This will begin a GEM oceanographic monitoring program in the Gulf that will lead to understanding nutrient replenishment and document ecosystem trends for years to come.

Funding:	EVOS Funding Requested:	FY 04 $ 167.1 k	
		FY 05 $ 239.8 k	
		FY 06 $ 263.3 k	TOTAL: $ 670.2 k
	Non-EVOS Funds to be Used:	FY 04 $ 77.1 k	
		FY 05 $ 143.5 k	
		FY 06 $ 49.0 k	TOTAL: $ 269.6 k
Date:	13 June 2003		

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Biophysical Observations Aboard Alaska Marine Highway System Ferries

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I. NEED FOR THE PROJECT

A. Statement of Problem

Background

The productive ecosystem of the coastal Gulf of Alaska (GOA) supports some of the nation's largest fisheries and vast numbers of birds and mammals. The region around Kodiak Island is of particular importance as the habitat for numerous economically and ecologically important fishes including walleye pollock (Brodeur and Wilson, 1996), Pacific cod (Abookire, in preparation), juvenile Pacific halibut (Norcross et al., in press), juvenile Arrowtooth flounder (Norcross et al., in press), and capelin (Doyle et al., 2002). This ecosystem is maintained by lower trophic level production that is not uniformly distributed about the GOA.

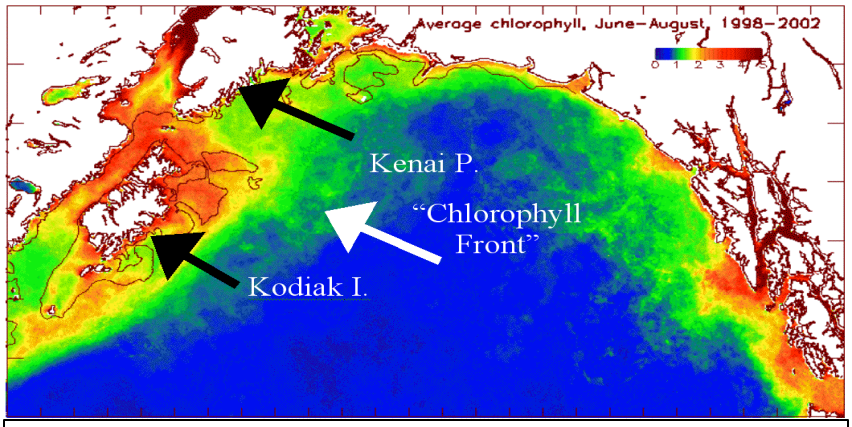

Figure 1. Chlorophyll-a distributions from SeaWiFS composite images from June to August of 1998-2002. The 100-m isobath is shown.

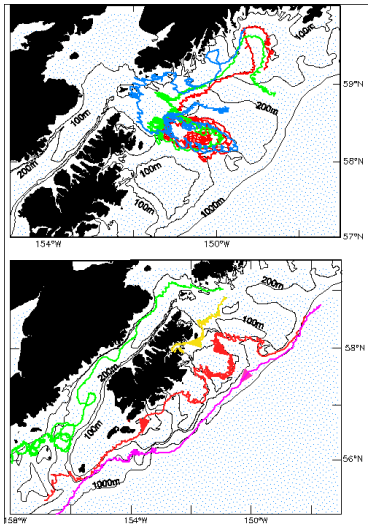

Figure 2. Satellite-tracked drifter trajectories near Kodiak Island, May-Aug.

In summer, composite satellite images show high concentrations of ocean chlorophyll in the vicinity of Kodiak Island relative to other surface shelf waters in the GOA (Fig. 1). Normally phytoplankton bloom in the surface layers in the spring and exhaust the nutrients by summer. Nutrients are usually resupplied slowly from the rich, deeper layers. Upwelling forced by the wind is a common upward transport mechanism, but on average the wind pattern in the GOA produces downwelling. Therefore, vertical or cross-shelf transport must be occurring via another mechanism.

On the southeastern side of Kodiak Island, the bathymetry contributes to the high chlorophyll content. The sea bottom consists of banks and troughs with the highest chlorophyll

Figure 3. Moored nitrate vs. salinity at the mouth (190 m) and head (161 m) of Amatouli Trough and in Chiniak Trough (123 m) in 2001 and 2002.

concentrations over the shallow banks. Satellite-tracked drifting buoys (with sea anchors at 40 m) often circulate around Portlock Bank, remaining there for weeks to months (Fig. 2a). Drifters deployed at the shelf break move up the northeastern and down the southwestern sides of canyons (Fig. 2b). Current meters deployed near bottom in canyons show a similar pattern of up- and down-canyon flow. Figure 3 shows a striking correlation between moored nitrate and salinity at depth. Hydrographic sections taken across Portlock Bank in June 2002 show the water column to be well mixed or weakly stratified in both temperature and salinity (Fig. 4). The increased nutrients over the bank are sustained throughout the summer by intrusions of nutrient-rich water through near-bottom mechanisms (Mordy *et al*., in preparation). Nutrients appear to be advected onto the shelf by up-canyon flow (see Fig. 2b and 4c), injected onto the bank, and then mixed to the surface by tidal currents.

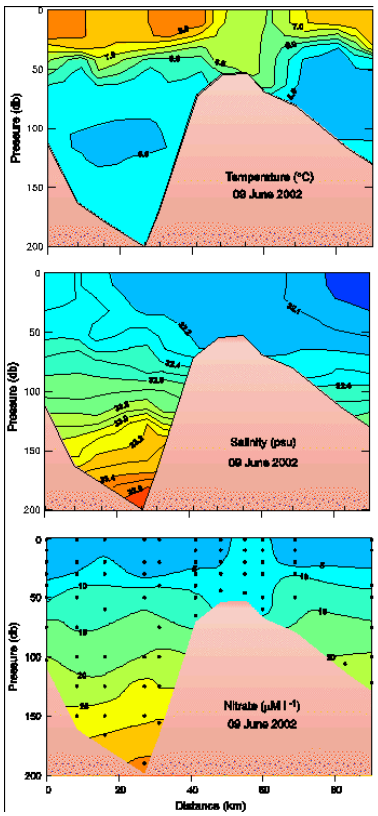

Figure 4. Temperature, salinity and nitrate sections taken across Portlock Bank in June 2002.

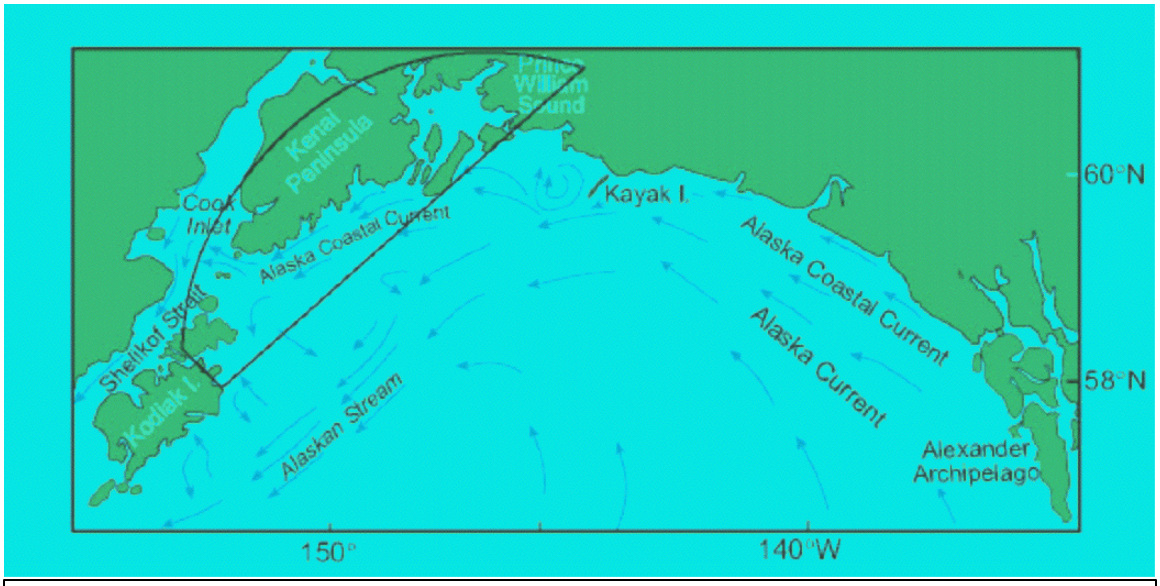

Figure 5. The major currents in the Gulf of Alaska.

Over the continental shelf in depths less than 200 m, the Alaska Coastal Current (ACC) dominates the circulation in the Gulf of Alaska, transporting dissolved (e.g. nutrients) and particulate (e.g. plankton) substances (Fig. 5). It provides critical habitat for numerous fish species; it is a nurturing area for larvae of demersal shelf species and a migration pathway for juvenile and adult salmonids. The ACC flows along the Alaskan coast from the Alexander Archipelago to Unimak Pass (165° W). It is driven by the wind and freshwater inflow (baroclinicity) along the coast. Maximum transport is in winter when downwelling forcing is greatest, and the largest baroclinic signal is in autumn coinciding with maximum freshwater discharge. Alongshore transport can exceed 3.0 x 10^6 m^3 s^{-1} (Stabeno et al., 1995; Stabeno and Hermann, 1996) and speeds can exceed 100 cm s^{-1} (Stabeno et al., 1995). The flow is modified by broad-scale, cross-shelf, wind-induced Ekman transport, by episodic eddies, and by topographic steering. Drifter trajectories indicate that the ACC bifurcates at Kodiak Island, flowing along the southeastern side and through Shelikof Strait (Fig. 6). Drifters on the southeastern side can also be caught up in the substantial Alaskan Stream that forms near there and flows southwestward (Figs. 2 & 6).

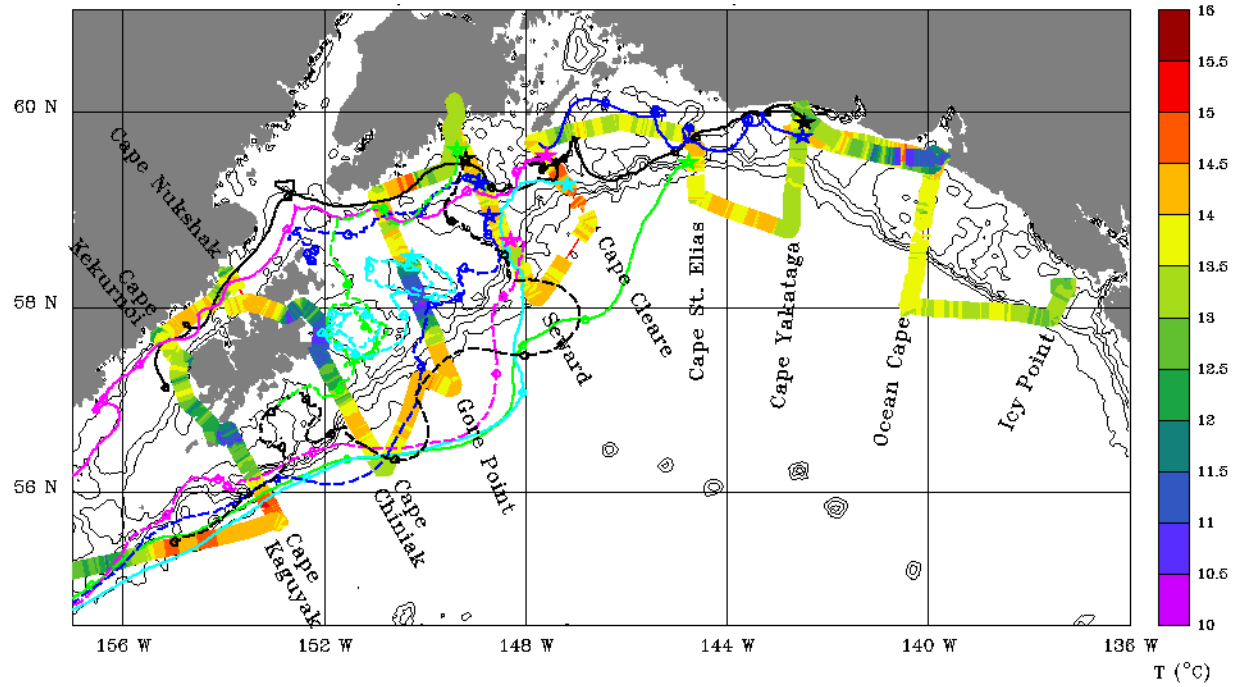

Figure 6. Along-track sea surface temperature from the OCC/GLOBEC juvenile salmon cruise aboard F/V *Great Pacific*, 17 July-8 Aug 2001. Satellite-tracked drifter trajectories begin at the star symbols and are marked every 10 d for 90 d.

A dramatic feature in Fig. 1 is the sharp gradient in concentration, the "chlorophyll front" (green to yellow to red transition), along the seaward side of Kodiak Island and across the continental shelf to the Kenai Peninsula. This appears to be a persistent feature of the summer chlorophyll distribution. On the low-concentration side there is a seasonal draw down of nitrate. Data from GLOBEC research southeast of the Kenai Peninsula show a drop in surface nitrate concentrations from about 8-16 µM in spring to < 2 µM in October (GLOBEC, 2000). As already mentioned, nutrients on the high-concentration side are likely provided by topographically induced mixing. Tidal mixing at the entrance to Cook Inlet provides some of the

highest levels of new production measured in this region (Stabeno et al., 2003). The divergence of the ACC around Kodiak Island may also lead to upwelling.

Opportunity

The Alaska Marine Highway System (AMHS) ferry M/V *Tustemena*, crosses the Alaska Coastal Current between the Kenai Peninsula and Kodiak Island 284 times per year with "summer" (May-September) crossings predominating (Table 1). Most of the crossings (189) are between

Table 1. Number of M/V *Tustemena* Ferry Crossings per Month

Month / Route	ACC: Homer-Kodiak I.	ACC: Kodiak I.-Seward	PWS: Seward-Cordova	PWS: Cordova-Valdez
January	5	10	5	8
February	5	10	5	9
March*	0	0	0	0
April*	1	1	0	0
May	40	8	0	0
June	28	8	0	0
July	30	10	0	0
August	24	8	0	0
September	24	8	0	0
October	12	12	5	9
November	10	10	8	17
December	10	10	9	18
Total Crossings	**189**	**95**	**32**	**61**

***No *M/V Tustemena* crossings during the 6-week shipyard period, usually in March and April each year.

Homer and Kodiak Island (Port Lions and Kodiak) and require 10 hours (Fig. 7). The rest (95) are between Kodiak and Seward requiring 13 hours. In the winter months the ferry serves Cordova and Valdez in Prince William Sound. (*Tustemena* also makes a few trips as far out as Dutch Harbor in the Aleutian Islands.) While oceanographic shiptime is at a premium costing upwards of $20,000 per day, the ferry route provides a wonderful scientific opportunity with "free" ship time. A comparison of Figures 1, 5 and 7 shows that the route crosses the ACC, the high-chlorophyll region between the Kenai Peninsula and Kodiak Island, and the chlorophyll front between Kodiak and Seward. The crossings are concentrated in summer just when the chlorophyll contrast is greatest.

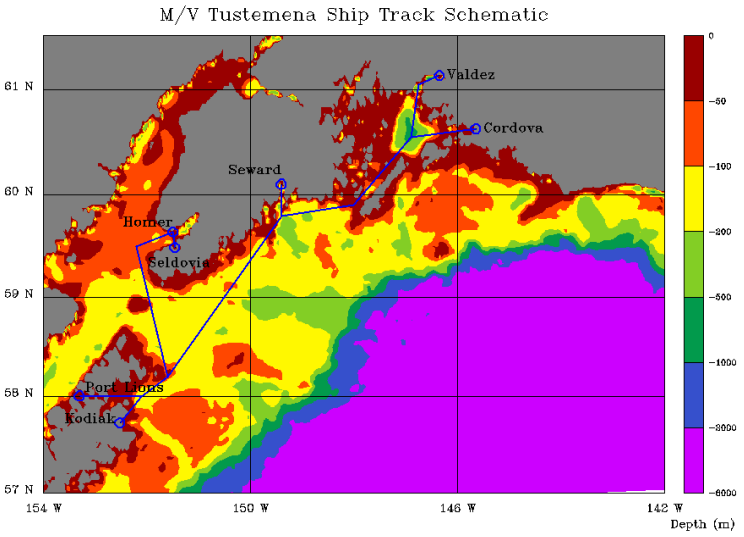

Figure 7. M/V Tustemena route across the Alaska Coastal Current and in Prince William Sound.

B. Relevance to GEM Program Goals and Scientific Priorities

We propose to instrument the *Tustemena* to measure physical and biological parameters across the Alaska Coastal Current and in Prince William Sound. This is in direct response to GEM's invitation (*Invited Proposals by Category for FY04, Gulf Ecosystem and Monitoring and Research Program*) to meet its top priority to

> …initiate the process that leads to collecting basic physical (temperature and salinity) and biological observations (optical measures, such as fluorescence) from a vessel of the Alaska Marine Highway System…

We will use the information to decipher the seasonal development of the chlorophyll front, to understand the roles of horizontal advection and vertical mixing in maintaining summer production in the vicinity of Kodiak Island and at the entrance to Cook Inlet, and to study the exchange of water between the ACC and Kachemak Bay (near Homer). The time series will help fill the gaps in SeaWiFs satellite image coverage (e. g. Fig. 1) made sporadic by clouds over the Gulf of Alaska.

When all the instruments are installed, we will be able to measure those physical (sea-surface temperature and salinity, optical attenuation, ocean current) and biological parameters (nutrients, chlorophyll fluorescence, colored dissolved organic matter fluorescence) of the ecosystem that can be observed automatically with off-the-shelf components. These instruments cover the range from physics to nutrients to phytoplankton (Miller, 2002). The installation will be analogous to "ferry-box" systems in Europe (Schroeder & Petersen, 2002) and Japan (Harashima *et al*., 1997). Regrettably, no zooplankton measurements will be made because Continuous Plankton Recorders require some human intervention enroute and labor-intensive laboratory analysis (Batten and Welch, 2001).

The data set will allow researchers to establish the seasonal variability in the ACC ecosystem and will initiate a study of long-term trends. It will complement the GLOBEC Long-Term Observing Program (LTOP, 1997-2004, http://www.ims.uaf.edu/GLOBEC/results/index.html) along the Seward and Cape Cleare Lines. With water column measurements and dedicated oceanographic ships, LTOP is more comprehensive than our program, but it covers just 6-7 cruises per year and does not cross the mean position of the chlorophyll front.

We will maintain a web site for the project with graphs of results. We will QC the data and work with GEM data managers for dissemination to the scientific community. Besides quality-controlled time series, we will produce maps of along-track variables similar to the temperature maps shown in Figure 6. Public outreach will include a passenger display on the ferry that explains the project and shows time series of results as they are gathered in real time. This can be highlighted in the U.S. Forest Service interpretive program provided for passengers.

The GEM Invitation for Proposals states the following:

> The proposal would develop the feasibility of installing specific instruments to collect temperature, salinity and optical measures of primary productivity on AMHS vessels and present those options (year one), initiate a pilot project (year two), and develop a fully operational real-time data acquisition and delivery program (year three).

We will do more in the first year. Based upon our experience on NOAA research ships and instrumenting fishing vessels for GLOBEC and other programs, in FY04 we will design and

install a sampling system during *Tustemena*'s scheduled shipyard period (1 March-15 April 2004). Leading up to that, we will consult with AMHS managers and engineers on the design of an automated, flow-through, seawater-sampling system that takes scientific goals and ship's safety into account. Owing to the spring timing of *Tustemena* shipyard periods, it is better to initiate sampling in the first year rather than wait until spring of 2005. For that reason, our first-year costs exceed GEM's estimates.

The project will ramp up with the installation of additional instruments each year. In FY04 we will purchase and install an underway thermosalinograph and intake-temperature sensor. We will loan the program a nitrate sensor (for one month), a transmissometer, a chlorophyll fluorometer, and a colored dissolved organic matter (CDOM) fluorometer. In FY05 we will buy these items. Additionally, we will loan and install a vessel-mounted acoustic Doppler current profiler (ADCP) and an accurate GPS heading device/inertial navigation system. In FY06 we will buy these items.

The intake or hull-conductance thermometer, thermosalinograph, nutrient sensor, transmissometer, chlorophyll fluorometer and CDOM fluorometer instruments are recommended in the *Report of the PICES 2002 Volunteer Observing Ship Workshop* (Miller, 2002).

The PICES VOS report (Miller', 2002) report recommends recording the ship's Doppler speed log. *Tustemena* has no such device, and if it did a GPS/INU would be required for sufficient accuracy - something the report glossed over. Plus a Doppler speed log would only give the ocean current at one depth, not over the water column. It would not be adequate for monitoring the ACC at depth. An ADCP measures a vertical profile of the horizontal velocity of the water with respect to the moving ship. Combining that with very accurate position and heading measurements gives the velocity of the water with respect to the earth - the ocean current. The ship's position is best gotten from a differential GPS (DGPS) receiver, and the ship's heading from a very expensive GPS/INU (inertial navigation unit). Heading accuracy is extremely important and must be measured to 0.1 degrees - better than an iron gyroscope can attain. At a typical ship speed of 10 kt, a 1-degree error in heading leads to a false, cross-ship current of 10 cm/s. That value exceeds many ocean currents. We desire 1 cm/s current accuracy or 0.1 degree heading accuracy.

In the long–term, a Volunteer Observing Ship (VOS) program with a dedicated technician aboard could include the deployment of expendable conductivity-temperature-depth (XCTD) probes and satellite-tracked drifting buoys. The technician could collect samples for analysis of phytoplankton species composition and tow a continuous plankton recorder (CPR). Bird and mammal observers could also ride the ferry. This is beyond the scope of the present proposal.

The Principal Investigators have experience in Alaska and are involved in field projects making underway measurements. Dr. Cokelet, a physical oceanographer, has deployed an underway system on the F/V *Great Pacific* and F/V *Sea Storm* as part of OCC/GLOBEC salmon surveys and operated the first long-term mooring in the Bering Sea basin (Cokelet and Stabeno, 1997). As a nutrient chemist, Dr. Mordy has deployed nitrate moorings in the GOA and routinely measures underway nitrate on GLOBEC and FOCI expeditions. Presently he receives GEM funding for underway nitrate measurements on Cokelet's OCC/GLOBEC salmon survey cruises and has published articles on nutrient supply and production in the GOA and along the Aleutian Islands. Dr. Pegau, an ocean optics expert, has designed and deployed sensors on volunteer

observing ships and autonomous vehicles. He has research projects in Kachemak Bay and Lower Cook Inlet.

This three-year project is a pilot program that could lead to similar measurement suites on other AMHS ferries, especially in Prince William Sound. It will give data sets for GEM to maintain and serve. It will help to form the basis for a long-term monitoring program of the ACC and Prince William Sound. Through a broad interdisciplinary partnership with other programs and modeling and resource management teams, we foresee a monitoring network that closely matches the GEM vision, i.e.

> The end point for monitoring is a geographically distributed network gathering data on the state of the marine ecosystem in the GEM region, using spatially structured survey methods. This implies a broad spatial scale for monitoring, as a combination of GEM with that of other entities. These data are transformed into information for user groups by using synthesis, research, modeling, data management, and information transfer.

II. PROJECT DESIGN

A. Objectives

The goal of the proposed research is to install an automated underway system on the Alaska ferry *Tustemena* to obtain high-resolution surface maps of physical and biochemical properties across the ACC and the chlorophyll front during the ship's regular transits between the Kenai Peninsula and Kodiak Island. The specific objectives of this research are as follows:

Objective 1: Consult with AMHS, design and install an automated, oceanographic sampling system on the M/V *Tustemena*.

Hypothesis: It is possible to design an automated, seawater-sampling system that meets both scientific goals and ship's safety concerns.

Objective 2: Initiate a long-term monitoring program of physical and biochemical time series in the ACC.

Hypothesis: Such time series will establish the annual variability in the ACC and lead toward measuring interannual and decadal trends in the ecosystem. The measurements will also provide high-resolution, temporal data to resource-modeling teams.

Objective 3: Map surface temperature, salinity, nitrate, transmittance, fluorescence, dissolved organic matter, and currents on M/V *Tustemena* transits between the Kenai Peninsula and Kodiak Island. Characterize the seasonal development of the chlorophyll front.

Hypothesis: In summer, surface waters southeast of the Kenai Peninsula are depleted in nitrate and chlorophyll; whereas mixing over shoals off Kodiak Island and in lower Cook Inlet sustains post-bloom production. The result is the seasonal development of a chlorophyll front.

B. Procedural and Scientific Methods

Objective 1: Consult with AMHS, design and install an automated, oceanographic sampling system on the M/V *Tustemena*.

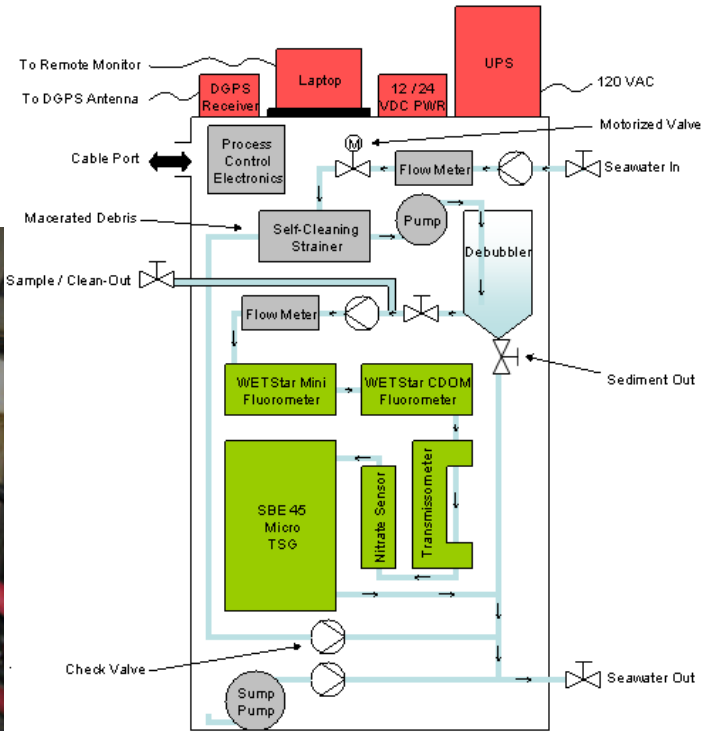

Figure 8. (a) A simple thermosalinograph installation with a sea strainer, pump and motor controller. (b) A schematic of a full flow-through sampling system with flow meters, automatic cut-off valves, self-cleaning sea strainer, debubbler, chlorophyll fluorometer, CDOM fluorometer, transmissometer, nitrate sensor and thermosalinograph.

Method: Some of this work has already begun. Dr. Cokelet has discussed ideas with George Poore, Port Engineer with AMHS. PMEL's A. J. Jenkins has worked up a preliminary design schematic (Fig. 8), as has Dr. Pegau. We have specified and priced equipment and anticipated peripheral items. When funded, this work will continue. Dr. Cokelet will visit the AMHS staff in Juneau to show them some of the equipment and continue the dialogue. Safety and scientific goals will be the overriding concerns. We will refine the design based upon logistical requirements. The instruments will be purchased, and the shipyard contacted about plumbing and wiring. Gear will be installed during the March-April 2004 shipyard period. Equipment shakedown will occur during scheduled ferry operations.

The intake thermometer measures the sea water temperature as close to the ocean as possible minimizing ship thermal influence. The thermosalinograph measures water temperature and conductivity that can be converted to salinity via well-defined algorithms. Two types of nitrate meters are considered in this proposal. The EnviroTech model, on loan from PMEL, measures nitrate chemically. The ISUS nitrate sensor uses a convenient optical method requiring no reagents. The transmissometer measures optical beam attenuation to provide an estimate of particulate organic carbon (POC) and total suspended solids (TSS). These give an excellent

measurement of sediment in the water - valuable for discerning glacially derived water. The CDOM is a limited proxy for dissolved organic carbon (DOC) that tends to be highest in fresh water systems - therefore providing a marker for freshwater sources.

Figure 8a shows the simplest possible system design with a sea strainer, pump and controller and thermosalinograph. Figure 8b is a schematic for a complex system with a full suite of flow-through instruments and safety devices. Seawater enters the ship's hull from the sea chest (not shown) and immediately past an SBE-38 temperature sensor (not shown), through a manual valve, into a flow meter to ascertain the system is pumping, past a motorized valve that can be closed automatically in case of emergency, into a self-cleaning strainer that removes zooplankton and other debris, through the pump, into a debubbler where air bubbles float free, past another flow meter, into the WETStar chlorophyll fluorometer, into the WETStar CDOM fluorometer, into the transmissometer, into the nitrate sensor, and finally into the SBE-45 MicroTSG thermosalinograph. This is the final instrument because it contains a biocide that could affect phytoplankton. Self-cleaning strainer debris and sediment from the debubbler can be drained out. There is a tap to take seawater samples for QC. The entire system is placed within a box that can be pumped out if leaks occur.

Water-sampling data will be logged on a laptop computer running NOAA's Shipboard Computer System (SCS). SCS was developed for NOAA research vessels and can accept a variety of input data types. It also gives real-time tabular and graphical displays for monitoring data quality. Data will be logged once every 15 seconds which is frequent enough to give 100-m spatial resolution at the *Tustemena*'s cruising speed of 14 kt.

Table 2. Equipment Purchase and Loan Schedule

Year	Purchased with GEM Funds	Loaned to Project
1	TSG, temperature probe, computer, DGPS, data computer, passenger display, self-cleaning sea strainer, valves, fittings, etc.	NAS-2E Nitrate Monitor[1], WETStar fluorometer[2], C-Star transmissometer[2], WETStar CDOM fluorometer[2]
2	ISUS Nitrate Monitor, WETStar fluorometer, C-Star transmissometer, WETStar CDOM fluorometer, ADCP computer, GPS compass	RDI 300-kHz Workhorse Mariner ADCP[1], Seapath 200 GPS/INU[1]
3	RDI 300-kHz Workhorse Mariner ADCP, GPS/INU[3]	

[1] On loan from PMEL

[2] On loan from KBRR

[3] Purchase pending quality of data from GPS compass

Depending upon the year, some instruments will be loaned to the project or purchased by it. Table 2 shows a brief list. PMEL can provide an EnviroTech nitrate monitor for one month in summer 2004, and the timing of this deployment will coincide with the GEM project 040654 (Surface Nutrients over the Shelf and Basin in Summer: Bottom-up Control of Ecosystem Diversity, P. Stabeno & C. W. Mordy, in preparation). A Satlantic MBARI-ISUS optical nitrate sensor will be purchased for Years 2 and 3 (Table 2). An ADCP will be installed in Years 2 and 3, with PMEL loaning an ADCP to the project in Year 2. A newly developed GPS compass will

be bought for Year 2 and compared with the loaned Seapath 200 GPS/INU system for heading. If the GPS compass compares favorably, the project will not need to buy an expensive GPS/INU the third year.

We will install a remote monitor in a tourist-proof enclosure for passengers to view real-time plots of the data. In addition, posters explaining the research and the GEM program will be on display.

On a weekly basis, data from the instruments will be downloaded and sent to PMEL, the instruments will be cleaned and maintained, and discrete samples for salinity, nitrate and chlorophyll will be collected. Dr. Cokelet will be responsible for installation of the underway system and oversee QA/QC of temperature, salinity and ADCP data. Dr. Pegau will be responsible for the weekly collection of data and cleaning of the instruments, analysis of chlorophyll discrete samples, and QA/QC of the fluorescence, CDOM, and transmittance data. Dr. Mordy will be responsible for QA/QC of the nitrate sensors, for analysis of discrete nitrate samples, and for preparation of reports.

Objective 2: Initiate a long-term monitoring program of physical and biochemical time series in the ACC.

Method: This is a pilot project, and we are not certain how things will go. Preliminary plans are as follows:

Flow-through data will be recorded every 15 seconds. ADCP data will be ensemble-averaged into 5-minute intervals beginning in Year 2. Data will be downloaded weekly onto CDs in Year 1 and sent back to PMEL for processing. In Year 2 a cellular-telephone-based data transfer system will be installed. It will call a PMEL phone number and download the data. Data will be QC'd against water samples when applicable. Data will be revised after quality control.

Time series plots will be made available on the project's web site. P. Sullivan will liaise with GEM data managers to transfer data to them for archiving and access.

Objective 3: Map surface temperature, salinity, nitrate, transmittance, fluorescence, dissolved organic matter, and currents on M/V *Tustemena* transits between the Kenai Peninsula and Kodiak Island. Characterize the seasonal development of the chlorophyll front.

Method: The time series of Objective 2 must be turned into spatially dependent data before mapping can begin. Using computer programs in perl, Fortran, EPIC, Ferret and/or Matlab we will combine time series of position and environmental variables into spatial arrays binned along the ship track. We will map these and compare them with SeaWiFs satellite images and water samples obtained by other programs on a case-by-case basis.

It may be that variability over the tidal cycle could swamp annual or longer-term averages. It may be necessary to stratify the data by stage of the tide, for example by grouping all slack-tide data, all high-tide data, etc. In principle, this would be possible by running a tidal model of the region to predict the stage of the tide and/or current at any given time and use the predictions to group like-stage data. This merits further investigation. (Dr. Cokelet plans to use Foreman's finite-element tidal model (Foreman *et al.*, 2000) to remove tidal currents from ADCP-measured

currents over one 3-week period each year in 2001-2004 for a GLOBEC project in the Gulf of Alaska. Experience gained there will shed light on this problem.)

C. Data Analysis and Statistical Methods

Data Frequency – Temperature, salinity, transmittance and fluorescence data will be collected while the *Tustemena* is operating between ports at a frequency of once every 15 seconds corresponding to a horizontal resolution of ~100m at 14 kt. The ADCP will ping at a nominal rate of once per second with 4-m depth bins. Ensembles will be averaged into 5 minute groups corresponding to ~2 km horizontal resolution. Nutrient measurement frequencies are given below.

Error Removal: At PMEL, flow-through data in ASCII format will be subjected to outlier removal and consistency checks via data plotting techniques first and automated techniques later, once typical problems can be identified and error criteria developed. This will be done using perl scripts, PMEL's EPIC and Ferret software, and Matlab. ADCP data will be processed with the University of Hawaii's CODAS system.

Underway Temperature and Salinity: Three temperature sensors will measure intake-water, TSG-box and ship-hold air temperatures. An algorithm establishing relationships between these three will be devised and used to spot abnormal values. Sensors will be calibrated yearly by the manufacturer. The manufacturer suggests absolute accuracy better than ±0.001 °C for the SBE 38 and ±0.002 °C accuracy for the SBE 45 MicroTSG with a drift of less than 0.001 °C during a six-month period for both instruments.

Conductivity will be converted to salinity using internal calibration factors. Salinity will be measured with an accuracy of ±0.005 equivalent psu and a typical drift of 0.003 equivalent psu per month. Discrete salinity samples will be collected weekly, stored at the Kachemak Bay Research Reserve, and analyzed at PMEL using a Guildline Autosal (accuracy <±0.002 equivalent psu, maximum resolution <0.0002 Equivalent psu).

Underway Fluorescence and Transmittance: The WETStar chlorophyll fluorometer provides a highly sensitive (0.03 µg/l) measurement of chlorophyll fluorescence with a dynamic range of 0.03–75 µg/l (standard range). The C-Star is a single channel transmissometer precise to 1mV (0-5V signal) with a sensitivity of 1.25 mV, a temperature error of 0.02 % full scale per °C, and a linearity error of 0.1% full scale. Water samples will be taken periodically, filtered and their chlorophyll concentration determined to provide a statistical relationship to fluorescence.

Underway Dissolved Organic Matter: The WETStar CDOM fluorometer detects colored dissolved organic matter (CDOM). It has an excitation wavelength of 370 nm, an emission wavelength of 460nm, and is sensitive to 0.05 ppb quinine sulfate with a resolution of 0.00125V (0-5V full scale).

Underway Nitrate: In the first year, PMEL will provide an EnviroTech NAS-2E - an automated shipboard nitrate measurement package that has been deployed on cruises in the northern GOA since 2001. A technician will ride the ship during several crossings to ensure proper operation of the instrument, and to collect discrete calibration samples. The nitrate monitor uses standard wet chemistry techniques for diazotizing and coupling reduced nitrate and nitrite, for and measuring the absorbance of the resulting red azo dye. This method is directly comparable to the autoanalyzer that will be used by Mordy to analyze discrete samples. The automated underway

system will sample every 15 minutes with standards analyzed once per hour. Standards will be stabilized by pasteurization, with concentrations verified before and after each cruise. This technique for stabilizing standards has been used for moored nitrate analyzers and nitrate concentrations are stable for over 6 months. The NAS-2E corrects for background absorbance and sample turbidity. Data from the NAS-2E is accurate to about 1.0 µM with 0.2 µM precision.

In year 2, we request funding for an Satlantic MBARI-ISUS optical nitrate sensor that will sample continuously while the ship is in operation. This sensor measures nitrate concentrations by comparing the UV scan of seawater to the unique UV absorption spectra of nitrate. The instrument is accurate to ± 2 µM with ± 0.05 µM precision. Data will be collected every 30s, a rate much higher than obtainable with the NAS-2E.

Discrete calibration samples will be collected from the ship's underway system, filtered, and stored on ice until frozen at –20°C at the Kachemak Bay Research Reserve. Samples will be analyzed at PMEL according to WOCE-JGOFS protocols (Gordon et al., 1993).

ADCP: In theory the ADCP can measure currents with an accuracy of ~1 cm/s if system parameters, averaging intervals, GPS inputs and heading information are prescribed to that level. ADCP velocities are not calibrated. Troubleshooting comes through system check procedures. Data will be analyzed via standard CODAS software pioneered by Eric Firing at the University of Hawaii.

D. Description of Study Area

The study area is defined by the M/V *Tustemena's* ferry route shown in Figure 7. It lies between 57.5 N and 61.5 N and between 145 W and 154 W. The effective study areas are the ACC between the Kenai Peninsula and Kodiak Island and Prince William Sound.

E. Coordination and Collaboration with Other Efforts

All three PIs are investigators in other programs in the Gulf of Alaska. These include FOCI, GLOBEC, Steller Sea Lion and GEM. Dr. Cokelet in GLOBEC work provides a ship for another GEM project of Dr. Mordy. Dr. Pegau applies his ocean optics expertise to 2 funded GEM projects and has 2 pending. One of these relates to instrumenting a volunteer observing ship in Cook Inlet. These projects complement one another. We know of no conflicts.

III. SCHEDULE

A. Project Milestones

Objective 1: Consult with AMHS, design and install the initial automated, oceanographic sampling system on the M/V *Tustemena.* To be met by 1 May 2004.

Objective 2: Initiate a long-term monitoring program of physical and biochemical time series in the ACC. To be met by 30 September 2004.

Objective 3: Map surface temperature, salinity, nitrate, transmittance, fluorescence, dissolved organic matter, and currents on M/V *Tustemena* transits between the Kenai Peninsula and Kodiak Island. Characterize the seasonal development of the chlorophyll front. To be met by 30 September 2006.

B. Measurable Project Tasks

FY 04, 1st quarter (October 1, 2003-December 31, 2003)

October:	Project funding approved by Trustee Council
December 31:	Consult with AMHS staff

FY 04, 2nd quarter (January 1, 2004-March 31, 2004)

January 12-16 (tentative):	Annual GEM Workshop
Feb 1:	Purchase all instruments
March 1:	Complete system design

FY 04, 3rd quarter (April 1, 2004-June 30, 2004)

May 1:	Complete system installation

FY 04, 4th quarter (July 1, 2004-September 30, 2004)

September 1:	Submit annual report
September 30:	Web site up and running with time series graphs

FY 05, 1st quarter (October 1, 2004-December 31, 2004)

December 31:	Consult with AMHS staff

FY 05, 2nd quarter (January 1, 2005-March 31, 2005)

(dates not yet known):	Annual GEM Workshop
Feb 1:	Purchase all instruments
March 1:	Complete ADCP installation design

FY 05, 3rd quarter (April 1, 2005-June 30, 2005)

May 1:	Complete ADCP installation

FY 05, 4th quarter (July 1, 2005-September 30, 2005)

September 1:	Submit annual report

September 30:	ADCP data on web site
	Graphs of annual cycle of ACC on web site

FY 06, 1st quarter (October 1, 2005-December 31, 2005)

December 31:	Consult with AMHS staff

FY 06, 2nd quarter (January 1, 2006-March 31, 2006)

(dates not yet known):	Annual GEM Workshop
Feb 1:	Purchase all instruments

FY 06, 3rd quarter (April 1, 2006-June 30, 2006)

May 1:	Complete ADCP installation

FY 06, 4th quarter (July 1, 2006-September 30, 2006)

September 1:	Submit final report
September 30:	Chlorophyll front data analyzed and interpreted
	Spatial maps of chlorophyll front on web site

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

Several aspects to this project foster community interaction. The most obvious will be a science display on the ferry with a poster explaining the project in language oriented to the general public. A computer monitor will show the most recent time series data in realtime. This can be highlighted in the U.S. Forest Service interpretive program provided for passengers. Direct local involvement is represented by collaboration with Dr. Pegau and the technical staff of the Kachemak Bay Research Reserve.

B. Resource Management Applications

Variability of biological populations is coincident with environmental oscillations, and management of biological resources can improve with a better understanding of this linkage. Data from this will project be used in ongoing meteorological and NPZ (nutrient-phytoplankton-zooplankton) modeling efforts such as those by NOAA/PMEL/FOCI's Dr. A. J. Hermann to refine our understanding of linkages between atmospheric forcing, variability in the ACC, and

biological variability. We have been in contact with one resource manager about this project, GEM's Dr. Phil Mundy. Improving the link between resource managers and scientific efforts has been discussed at recent GEM meetings, and this project represents and ideal opportunity to do so.

V. PUBLICATIONS AND REPORTS

In the near term, publications (2004-2006) will include progress reports, a final report, and a publication on biogeochemical distributions across the chlorophyll front. In the long term (2006-2007), we expect to synthesize GEM, GLOBEC, FOCI and Steller Sea Lion research and publish manuscripts on mechanisms of nutrient supply and mixing in lower Cook Inlet. In addition, we expect to publish a collaborative effort with the GAK 1 time series. We will publish our results in peer-reviewed journals, but it is too early to give. We have asked for no publication costs. We will acknowledge GEM funding and notify GEM of publications.

VI. PROFESSIONAL CONFERENCES

We have not requested travel funds for professional conferences aside from the annual GEM workshop. We will travel to conferences using other funds.

References

Abookire, A, in preparation. Distribution of Pacific cod among microhabitats in nearshore Kodiak Island, Alaska. *NOAA Fish. Bull.*

Batten, S. D. and D. W. Welch (2001) The continuous plankton recorder survey of the North Pacific,…, 8 pp.

Brodeur, R. D. and M. T. Wilson. (1996) A review of the distribution, ecology, and population dynamics of age-0 walleye pollock in the Gulf of Alaska. *Fish. Oceanogr.* 5(Suppl. 1): 148-166.

Cokelet, E.D., M.L. Schall, and D.M. Dougherty (1996): ADCP-referenced geostrophic circulation in the Bering Sea basin. *Journal of Physical Oceanography*, **26**(7), 1113-1128.

Cokelet, E.D., and P.J. Stabeno (1997): Mooring observations of the thermal structure, salinity, and currents in the SE Bering Sea basin. *Journal of Geophysical Research*, **102** (C10), 22,947-22,964.

Doyle, M. J., M. S. Busby, J. T. Duffy-Anderson, A. C. Matarese, and S. J. Picquelle. (2002) Early life history of capelin (*Mallotus villosus*) in the Northwest Gulf of Alaska: A historical perspective based on larval collections 1977-79. *ICES J. Mar. Sci.* 59(5): 997-1005.

Foreman, M.G.G., W.R. Crawford, J.Y. Cherniawsky, R.F. Henry, and M.R. Tarbotton, A high-resolution assimilating tidal model for the Northeast Pacific Ocean, *Journal of Geophysical Research*, 2000.

Gordon, L.I., J.C. Jennings, Jr., A.A. Ross, and J.M. Krest, (1994). In: A suggested protocol for continuous flow automated analysis of seawater nutrients (phosphate, nitrate, nitrite and silicic acid) in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study. WOCE Hydrographic Program Office, WHP Office Report WHPO 91-1, Part 3.1.3: WHP Operations and Methods, WOCE Report No. 68/91, November 1994, Revision

1, Woods Hole, MA, USA, unpublished manuscript, 52 pp., http://whpo.ucsd.edu/manuals/pdf/91_1/gordnut.pdf.

Miller, C. B. (Ed.) (2002) *Report of the PICES 2002 Volunteer Observing Ship Workshop*, PICES Scientific Report No. 21, North Pacific Marine Science Organization, Sidney, BC, Canada, 38 p.

Norcross, B., K. M. Bailey, J. T. Duffy-Anderson, and B. Holladay . In press. A synthesis of the distribution of the egg, larval, and juvenile stages of eight species of flatfish from the Gulf of Alaska: how did they get there? *J. Sea Research.*

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Stabeno, P. and Hermann, A.J. (1996) An eddy-resolving model of circulation on the western Gulf of Alaska shelf, 2, Comparison of results to oceanographic observations. *J. Geophys. Res*. 101:1151-1162.

Stabeno, P.J., Reed, R.K., and Schumacher, J.D. (1995) The Alaska Coastal Current: Continuity of transport and forcing. *J. Geophys. Res*. 100:2477-2485.

CURRICULUM VITAE

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Education

B.Sc. University of Washington, Oceanography, 1970
M.Sc. University of Washington, Oceanography, 1971
Ph.D. Cambridge University, England, Applied Mathematics, 1976

Professional Experience

Oceanographer, Pacific Marine Environmental Laboratory/NOAA, Seattle, 1978-present.

Oceanographer, Institute of Oceanographic Sciences, Wormley, Godalming, Surrey, England, 1975-1978.

Five Relevant Recent Publications

Cokelet, E.D., M.L. Schall, and D.M. Dougherty (1996): ADCP-referenced geostrophic circulation in the Bering Sea basin. *Journal of Physical Oceanography*, **26**(7), 1113-1128.

Cokelet, E.D., and P.J. Stabeno (1997): Mooring observations of the thermal structure, salinity, and currents in the SE Bering Sea basin. *Journal of Geophysical Research*, **102** (C10), 22,947-22,964.

Farley, E.V., Jr., B.L. Wing, E.D. Cokelet, C.M. Kondzela, E.C. Martinson, N. Weemes, J.H. Moss, M. Auburn-Cook, and C. Fitch (2001), Gulf of Alaska coastal research on juvenile salmon, July and August 2001, pp. 19, *North Pacific Anadromous Fish Commission Document 559*, Auke Bay Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 11305 Glacier Highway, Juneau, AK 99801-862.

S. R. Okkonen, G. M. Schmidt, E. D. Cokelet and P. J. Stabeno (2003), Satellite and

hydrographic observations of the Bering Sea 'Green Belt', submitted to special SeaWiFS edition of *Deep Sea Research*.

U.S. GLOBEC (1996): Report on Climate Change and Carrying Capacity of the North Pacific Ecosystem. *U.S. GLOBEC Rep. 15* (A. Hollowed, H. Batchelder, N. Bond, E.D. Cokelet, ..., A. Hermann, ..., J. Overland, ..., R. Reed, ..., J. Schumacher, ..., P. Stabeno, eds.), University of California, Berkeley, CA, 95 pp.

Other Relevant Publications

Brodeur, R.D., J.M. Napp, M.T. Wilson, S.J. Bograd, E.D. Cokelet, and J.D. Schumacher (1996): Acoustic detection of mesoscale biophysical features in the Shelikof sea valley, and their relevance to pollock larvae in the Gulf of Alaska. *Fisheries Oceanography*, **5**(Suppl. 1), 71-80.

Reed, R.K., A.V. Verkhunov, G.V. Khen, E.D. Cokelet, J.E. Overland and T.E. Whitledge (1992): Recent U.S.-U.S.S.R. cruise in Bering Sea. *Eos, Trans. Amer. Geophys. Un.*, **73**(16), 184.

Stabeno, P.J., J.D. Schumacher, K.M. Bailey, R.D. Brodeur, and E.D. Cokelet (1996): Observed patches of walleye pollock eggs and larvae in Shelikof Strait, Alaska: their characteristics, formation and persistence. *Fisheries Oceanography*, **5**(Suppl. 1), 81-91.

Collaborators in past 4 Years

M. Auburn-Cook, - NOAA/Auke Bay Lab.; N. Bond - NOAA/PMEL; J. Cullen - Dalhousie U.; R. Davis - Dalhousie U.; E. V. Farley, Jr. - NOAA/Auke Bay Lab.; C. Fitch - NOAA/Auke Bay Lab; J. Helle - NOAA/Auke Bay Lab; A. B. Hollowed - NOAA/AFSC; C. M. Kondzela - NOAA/Auke Bay Lab; E. C. Martinson - NOAA/Auke Bay Lab; J. H. Moss - NOAA/Auke Bay Lab; S. R. Okkonen - U. Alaska Fairbanks; T. Royer - Old Dominion U.; G. M. Schmidt - SAIC; P. J. Stabeno - NOAA/PMEL; N. Weemes - NOAA/Auke Bay Lab; T. Whitledge - U. Alaska Fairbanks; B. L. Wing - NOAA/Auke Bay Lab

Students advised and postdoctoral scholars sponsored: None

Graduate Advisor: Prof. M.S. Longuet-Higgins, University of Cambridge

Calvin W. Mordy

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PROFESSIONAL PREPARATION

Ph.D. Oregon State University, Chemical Oceanography, 1991

M.S. University of Kansas, Bioorganic Chemistry, 1986

B.S. Berry College, Chemistry, 1982

APPOINTMENTS AND AWARDS

Oceanographer, NOAA/Pacific Marine Environmental Laboratory (PMEL), 1993-present

Antarctic Service Medal of the United States, 1999

International WOCE Hydrographic Programme Planning Committee, 1995-1996

Postdoctoral Fellow, University of Southern California, 1991-1993

Research Fellow, University of Kansas, 1984

PUBLICATIONS

Five Relevant Publications

Mordy, C.W., S. Zeeman, C. Ladd, and S. Newsome (In Preparation): Nutrients and Productivity in the Central and Eastern Aleutian Islands. Fish. Oceanogr., Suppl.

Mordy, C.W., Stabeno, P.J., N. Kachel, C. Ladd, and D.P. Wisegarver (In Preparation): The role of Canyons and Banks in Sustaining Production in the Kodiak Archipelago. Cont. Shelf Res.

Mordy, C.W., P..J. Stabeno, A.C. Sigleo and S.A. Salo (Submitted, 6/03): Temporal Variability of Upwelled Nitrate off the Oregon Coast: a Moored Nitrate Time Series. *J. Geophys. Res.*

Stabeno, P.J., N.A. Bond, A.J. Hermann, C.W. Mordy, J.E. Overland and N. Kachel (Accepted): Meteorology and Oceanography of Northern Gulf of Alaska. Cont. Shelf Res.

Reed, R. K. and C. W. Mordy (1999): Bering Sea Deep Circulation: Water Properties and Geopotential. *J. Mar. Res.*, **57**:763-773.

Five Significant Publications

Ladd, C., G. Hunt Jr., C.W. Mordy, S. Salo, and P.J. Stabeno (In Preparation): Marine environment of the central and eastern Aleutian Islands. Fish. Oceanogr., Suppl.

Daly, K. L., W. O . Smith, Jr., G. C. Johnson, G. R. DiTullio, D. R. Jones, C. W. Mordy, R. A. Feely, D. A. Hansell, J.-Z. Zhang (2001): Hydrographic Structure and Distributions of Nutrients and Particulate and Dissolved

Carbon in the Pacific Sector of the Southern Ocean. *J. Geophys. Res. (C Oceans)*, **106**:7107-7124.

Zhang, J.-Z., C. W. Mordy, L. I. Gordon, A. Ross and H. E. Garcia (2000): Are Reported Trends in Deep Ocean Redfield Ratios Artifact? *Science*, **289**:1839a.

Mordy, C.W., D.M. Penny, and C.W. Sullivan (1995): Bacterioplankton dynamics in the Weddell-Scotia Sea marginal ice-edge zone during austral winter. *Mar. Ecol. Prog. Ser.*, **122**:9-19.

Mordy, C.W., and D.J. Carlson (1991): An evaluation of fluorescent techniques for measuring DNA and RNA in marine microorganisms. *Mar. Ecol. Prog. Ser.*, **73**:283-293

COLLABORATORS

Nickolas A. Bond, University of Washington; Edward D. Cokelet, Pacific Marine Environmental Laboratory; Kendra Daly, University of South Florida; G. R. DiTullio, Grice Marine Laboratory, University of Charleston; Richard Feely, Pacific Marine Environmental Laboratory; Hernan Garcia, Scripps Institution of Oceanography; Joaquim Goes, Bigelow Laboratory for Ocean Sciences; Louis I. Gordon, Oregon State University; Nicolas Gruber, Princeton University; Dennis A. Hansell, University of Miami; Albert J. Hermann, University of Washington; George Hunt, University of California, Irvine; Joe C. Jennings, Oregon State University; Gregory Johnson, Pacific Marine Environmental Laboratory; Nancy Kachel, University of Washington ; Robert Key, Princeton University; Carol Ladd, University of Washington; Allen S. Macklin, Pacifc Marine Environmental Laboratory; Jeffery Napp, Alaska Fisheries Science Center; Seth Newsome, University of California, Santa Cruz ; James E. Overland, Pacific Marine Environmental Laboratory; Scott Pegau, Alaska Fish and Game; Ronald K, Reed, Pacific Marine Environmental Laboratory; Chris Sabine, Pacific Marine Environmental Laboratory; Sigrid A. Salo, Pacific Marine Environmental Laboratory; Anne C. Sigleo, USEPA, Western Ecology Division, Newport, OR; Walker O. Smith, Jr., Virginia Institute of Marine Science , College of William and Mary; Phyllis J. Stabeno, Pacific Marine Environmental Laboratory; Suzanne Strom, Western Washington University; Frank Whitney, Institute of Ocean Sciences, Sidney, B.C; Terry E. Whitledge, University of Alaska Fairbanks; David P. Wisegarver, Pacific Marine Environmental Laboratory; Stephan I. Zeeman, University of New England; Jia-Zhong Zhang, Atlantic Oceanographic and Meteorological Laboratory

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Professional Preparation:

University of Alaska, Fairbanks	Physics	B.S./1990
Oregon State University	Oceanography	Ph.D./1996
Oregon State University	Oceanography	Post doc./1996-1997

Appointments:

Senior Scientist, Kachemak Bay Research Reserve (KBRR)	2002-present
Assistant Professor (tenure track), Oregon State University	1999-present
Faculty Research Associate, Oregon State University	1997-1999
Faculty Research Associate (Post Doc), Oregon State University	1996-1997
Graduate Research Assistant, Oregon State University	1990-1996
Research Assistant, University of Alaska, Fairbanks	1987-1990

Current duties:

Current duties at KBRR include maintaining and expanding the in-situ monitoring program, and developing new research programs examining the circulation and primary production in Kachemak Bay and Lower Cook Inlet. I am maintaining a quarter time position at OSU while completing grants from the Navy and NASA to investigate uses of hyperspectral remote sensing data, developing an autonomous underwater vehicle program, and discrimination of phytoplankton taxa using ocean color remote sensing.

Expertise:

My primary area of expertise is the interpretation of in-situ and remote optical measurements to determine types of materials in the water column, determination of vertical distributions from space, water masses, and circulation patterns. I have extensive experience in the conceptual design and deployment of sensors on a number of platforms ranging from traditional cages, ferry vessels, and autonomous vehicles. I also have experience determining heat fluxes using meteorological and oceanographic measurements.

5 related publications:

Pegau, W. Scott, Inherent optical properties of the central Arctic surface waters, *J. Geophys Res*, **107**, doi. 10.1029/2000JC000382, 2002.

Pegau, W. S., E. Boss, and A. Martinez, Ocean color observations of eddies during the summer in the Gulf of California, *Geophys. Res. Lett.*, **29**, 10.1029/2001GL014076, 2002.

Chang G. C., T. D. Dickey, O. M. Schofield, A. D. Weidemann, E. Boss, W. S. Pegau, M. A. Moline, and S. M. Glenn, Nearshore physical forcing of bio-optical properties in the New York Bight. *J. Geophys. Res.*, **107**, 10.1029/2001JC001018, 2002.

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Boss, E., W. S. Pegau, J. R. V. Zaneveld, and A. H. Barnard, Spatial and temporal variability of absorption by dissolved material at a continental shelf, *J. Geophys. Res.* **106**, 9499-9508, 2001.

5 other publications

Bartlett, J. S., M. R. Abbott, R. M. Letelier, and W. S. Pegau, Analysis of a method to estimate chlorophyll-a concentration from irradiance measurements at varying depths, *J. Atmos. Ocean. Tech.*, **18**, 2063-2073, 2001.

Weideman, A. D., D. J. Johnson, R. J. Holyer, W. S. Pegau, L. A. Jugan, and J. C. Sandidge, Remote imaging of internal solitons in the coastal ocean, *Remote Sensing of Environment*, **76**, 260-267, 2001.

Boss, E., and W. S. Pegau, The relationship of light scattering at an angle in the backward direction to the backscattering coefficient, *Appl. Opt.*, **40**, 5503-5507, 2001.

Pegau, W. S., J. R. V. Zaneveld, A. H. Barnard, H. Maske, S. Avarez-Borrego, R. Lara-Lara, and R. Cervantes, Inherent optical properties of the Gulf of California, *Ciencias Marinas*, **25,** 469-485,1999.

Pegau, W. S., D. Gray, and J. R. V. Zaneveld, Absorption of visible and near-infrared light in water: the dependence on temperature and salinity, *Applied Optics*, **36**, 6035-6046, 1997.

Collaborators E. L. Andreas (CRREL), S. Alvarez-Borrego (CICESE), D. G. Barber, A. H. Barnard (Bigelow), J. C. Blakey, E. Boss (OSU), G. C. Chang (UCSB), G. F. Cota (ODU), J. A. Curry, T. D. Dickey (UCSB), H. Eiken (UAF), C. W. Fairall, W. D. Gardner (TAMU), S. Glenn (Rutgers), D. Gray (TAMU), M. Gregg (UW), T. C. Grenfell (UW), A. J. Gow, R. E. Green (WHOI), P. S. Guest, J. Intrieri, D. R. Johnson (NRL), D. Kadko(U. Miami), R. W. Lindsay(UW), M. Landry, R. Lara-Lara (CICESE), J. Longacre, J. MacKinnon (UW), H. Maske (CICESE), M. G. McPhee, C. D. Mobley (Sequoia Scientific), M. Moline, J. Morison (UW), R. E. Moritz (UW), J. L. Mueller (SDSU), D. Musgrave (UAF), R. G. Onstott, C. A. Paulson (OSU), D. K. Perovich (CRREL), P.O.G. Persson, A. A. Petrenko, R. Pinkel (SIO), R. A. Maffione (Hobilabs), M. J. Richarson, J. A. Richter-Menge (CRREL), C. S. Roesler (Bigelow), G. C. Schoch (KBRR), O. Schofield (Rutgers), E. Skyllingstad (OSU), H. M. Sosik (WHOI), T. Stanton, H. Stern, M. Sturm (CRREL), W. B. Tucker III (CRREL), T. Uttal, M. Twardowski (WETLabs), E. Valdez-Holguin, I. D. Walsh (OSU), A. Weidemann (NRL), T. Whitledge (UAF), A. J. Williams III (WHOI), J. R. V. Zaneveld (OSU/Wetlabs)

CURRENT AND PENDING SUPPORT FORM

The following information must be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Edward D. Cokelet	Other agencies to which this proposal has been/will be submitted: None

Support: Current X Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries (**This proposal**)

Source of Support: EVOS GEM
Total Award Amount: $609 k Total Award Period Covered: FY2004-2006
Location of Project: Gulf of Alaska/Seattle, WA
Months of Your Time Committed to the Project: 3 FY04 3 FY 05 3 FY 06 Sumr:

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: The Influence of Mesoscale Eddies on Shelf-Slope Exchange in the Southeastern Bering Sea

Source of Support: North Pacific Marine Research Program
Total Award Amount: $378 k Total Award Period Covered: FY2000-2003
Location of Project: Bering Sea/Seattle, WA
Months of Your Time Committed to the Project: 4 FY 04 0 FY 05 0 FY 06 Sumr:

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: GLOBEC 2000 Factors Affecting the Distribution of Juvenile Salmon in the Gulf of Alaska

Source of Support: U. S. GLOBEC
Total Award Amount: $497 k Total Award Period Covered: FY2001-2005
Location of Project: Gulf of Alaska/Seattle, WA
Months of Your Time Committed to the Project: 3 FY04 3 FY 05 0 FY 06 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Months of Your Time Committed to the Project: FY 04 FY 05 FY 06 Sumr:

*If this project has previously been funded by another entity, please list and furnish information for immediately preceding funding period.

(USE ADDITIONAL SHEETS AS NECESSARY)

CURRENT AND PENDING SUPPORT FORM: C. W. Mordy

Investigator: Calvin W. Mordy	Other agencies to which this proposal has been/will be submitted:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Surface Nutrients Over the Shelf and Basin in Summer – Bottom up Control of Ecosystem Diversity

Source of Support: GEM
Total Award Amount: $49.5K Total Award Period Covered: FY04
Location of Project: Yakutat to Kodiak Island / Shelikof Strait
Months of Your Time Committed to the Project: 2 FY04 FY 05 FY 06 Sumr: 2

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: This Proposal

Source of Support: GEM
Total Award Amount: $670.2k Total Award Period Covered: FY04-FY06
Location of Project: Northern Gulf of Alaska
Months of Your Time Committed to the Project: 2 FY 04 3 FY 05 3 FY 06 Sumr: 8

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Cross-shelf Transport and Post-Bloom New Production Near the Pribilof Islands

Source of Support: NSF
Total Award Amount: $866k Total Award Period Covered: FY04-FY08
Location of Project: Pribilof Islands
Months of Your Time Committed to the Project: 3 FY04 3 FY 05 3 FY 06 Sumr: 9

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Impact of along shelf and across shelf advection of zooplankton and nutrients on shelf ecosystems of the Gulf of Alaska

Source of Support: GLOBEC
Total Award Amount: $2,064K Total Award Period Covered: FY01-FY05
Location of Project: Northern Gulf of Alaska
Months of Your Time Committed to the Project: 4.5 FY 04 5 FY 05 FY 06 Sumr: 9.5

*If this project has previously been funded by another entity, please list and furnish information for immediately preceding funding period.

Investigator: Calvin W. Mordy	Other agencies to which this proposal has been/will be submitted:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Collaborative Research: Global Ocean Repeat Hydrography, Carbon and Tracers

Source of Support: NOAA

Total Award Amount: $960 Total Award Period Covered: FY03-FY04

Location of Project: North and Equatorial Atlantic

Months of Your Time Committed to the Project: 2 FY04 FY 05 FY 06 Sumr: 2

CURRENT AND PENDING SUPPORT FORM

The following information must be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: W. Scott Pegau	Other agencies to which this proposal has been/will be submitted: None

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Visible remote sensing of the Gulf of Alaska

Source of Support: GEM

Total Award Amount: $77,100 Total Award Period Covered: 12/02-9/03

Location of Project: KBRR

Months of Your Time Committed to the Project: 0 FY04 FY 05 FY 06 Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Monitoring dynamics of the Alaska coastal current and development of applications for management of Cook Inlet salmon – a pilot study

Source of Support: GEM

Total Award Amount: $96,400 Total Award Period Covered: 12/02-9/04

Location of Project: KBRR

Months of Your Time Committed to the Project: 1 FY 04 FY 05 FY 06 Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: GLOBEC NEP: Topographic Control of Mesoscale Variability in the Gulf of Alaska

Source of Support: NSF via subcontract from UAF

Total Award Amount: $52,330 Total Award Period Covered: 3/03-2/06

Location of Project: KBRR

Months of Your Time Committed to the Project: 1 FY04 1 FY 05 FY 06 Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: The Prediction of diver visibility and its relation to spectral beam attenuation

Source of Support: ONR via subcontract from WETLabs

Total Award Amount: $94,570 Total Award Period Covered: 9/02-8/04

Location of Project: KBRR

Months of Your Time Committed to the Project: 1 FY 04 FY 05 FY 06 Sumr:

*If this project has previously been funded by another entity, please list and furnish information for immediately preceding funding period.

(USE ADDITIONAL SHEETS AS NECESSARY)

CURRENT AND PENDING SUPPORT FORM

The following information must be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: W. Scott Pegau	Other agencies to which this proposal has been/will be submitted:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Kachemak Bay NERR Operations

Source of Support: NOAA
Total Award Amount: $510,000 Total Award Period Covered: 07/03-06/04
Location of Project: KBRR
Months of Your Time Committed to the Project: 4 FY04 FY 05 FY 06 Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Studying the ACC within Cook Inlet using volunteer observing ships

Source of Support: GEM
Total Award Amount: $227,800 Total Award Period Covered: 10/03-9/06
Location of Project: KBRR
Months of Your Time Committed to the Project: 2 FY 04 2 FY 05 3 FY 06 Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Monitoring dynamics of the Alaska coastal current and development of applications for management of Cook Inlet salmon

Source of Support: GEM
Total Award Amount: $163,900 Total Award Period Covered: 10/03-9/06
Location of Project: Soldotna ADF&G and KBRR
Months of Your Time Committed to the Project: 2 FY04 2 FY 05 1.5 FY 06 Sumr:

Support: Current X Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries **(This proposal)**

Source of Support: EVOS GEM
Total Award Amount: $61,100 Total Award Period Covered: FY2004-2006
Location of Project: Gulf of Alaska/Seattle, WA
Months of Your Time Committed to the Project: 1.5 FY04 1.0 FY 05 1.0 FY 06 Sumr:

*If this project has previously been funded by another entity, please list and furnish information for immediately preceding funding period.

(USE ADDITIONAL SHEETS AS NECESSARY)

Budget Justification

Non-EVOS Funds/Cost Sharing

Personnel costs: E. D. Cokelet's personnel costs (3 months each year - FY04-06) are covered by NOAA/PMEL as part of the Fisheries Oceanography Coordinated Investigations (FOCI) because the proposed work fits within FOCI's goal.

Instrument loans: To start the GEM vessel-monitoring program the proposers will loan various instruments for 1 year. In the following years, GEM will buy new, equivalent instruments. In FY04, the Kachemak Bay Research Reserve will loan the GEM program the following WETLabs instruments: a WETStar chlorophyll fluorometer ($3.0k), a WETStar CDOM fluorometer ($3.5k) and a C-Star transmissometer ($3.3k). In FYO4, NOAA/PMEL will loan an EnviroTech nutrient sensor ($22.0k). In FY05, NOAA/PMEL will loan GEM a Seapath 200 GPS-Inertial Navigation System ($69.0k) and an RDI Workhorse Mariner 300-kHz vessel-mounted ADCP ($27.4k).

Government Agency Mandate

NOAA/PMEL/FOCI's goal is to understand the influence of the environment on the abundance of various commercially valuable fish and shellfish stocks in Alaskan waters and their role in the ecosystem. FOCI does not receive adequate NOAA base funds to support salaries, travel, instruments, computers, etc. for all of its research activities. FOCI and the scientific community find it useful and rewarding to leverage base funds through proposals to other funding agencies as long as the proposal objectives support FOCI's goal. Examples of such agencies are the North Pacific Marine Research Program and U.S. GLOBEC. In the present case, FOCI cost-shares through NOAA PI personnel costs and by instrument loans.

FY04

Personnel ($76.5k) - Costs to design and install underway system, QC data through weekly sampling, download data from instruments, clean instruments, process and analyze the observations, provide ferry passenger orientation and real-time data viewing, maintain a project web site, liaise with GEM data managers.

Travel ($22.8k) - Travel to liaise with AMHS managers in Juneau, supervise shipyard installation of equipment in Seward, test gear on several cruises from Homer and attend GEM meeting in Anchorage.

Contractual ($25.4k) - Shipyard wiring and plumbing for installation of thermosalinograph, 2 fluorometers, transmissometer and nutrient meter. The shipyard estimates are best guesses. We have not worked with the *Tustemena* or with the shipyard.

Commodities ($5.0k) - Covers monthly network computing and web-page-hosting and cleaning, filtration and chlorophyll analysis.

Equipment ($23.6k) - Thermosalinograph, pump, sea strainer, plumbing, flow monitoring and control, computer for data logging, DGPS receiver to measure position, and computer monitor and kiosk for passenger viewing of underway data.

FY05

Personnel ($93.2) - Costs to augment underway system, QC data through weekly sampling, download data from instruments, clean instruments, process and analyze the observations, provide ferry passenger orientation and real-time data viewing, maintain a project web site, liaise with GEM data managers.

Travel ($27.5k) - Travel to liaise with AMHS managers in Juneau, supervise shipyard installation of equipment in Seward, test gear on several cruises from Homer and attend GEM meeting in Anchorage.

Contractual ($41.9k) - Shipyard wiring for installation of ADCP and cellular-telephone data relay. The shipyard estimates are best guesses. We have not worked with the *Tustemena* or with the shipyard.

Commodities ($6.2k) - Covers monthly network computing and web-page-hosting, cleaning, filtration and chlorophyll analysis, and annual instrument maintenance and calibration.

Equipment ($51.2k) - WETStar chlorophyll fluorometer, WETStar CDOM fluorometer, C-Star transmissometer, ISUS nitrate analyzer, laptop computer for ADCP, GPS compass for accurate heading, LabView system for instrument control and logging, cellular telephone data system.

FY06

Personnel ($97.0k) - Costs to QC data through weekly sampling, download data from instruments, clean instruments, process and analyze the observations, provide ferry passenger orientation and real-time data viewing, maintain a project web site, liaise with GEM data managers.

Travel ($29.0) - Travel to liaise with AMHS managers in Juneau, supervise shipyard installation of equipment in Seward, test gear on several cruises from Homer and attend GEM meeting in Anchorage.

Contractual ($6.7k) - Shipyard replacement of ADCP transducer. The shipyard estimates are best guesses. We have not worked with the *Tustemena* or with the shipyard.

Commodities ($6.2k) - Covers monthly network computing and web-page-hosting, cleaning, filtration and chlorophyll analysis, and annual instrument maintenance and calibration.

Equipment ($220.3k) - POS/MV GPS-inertial navigation system and RDI Workhorse Mariner 300-kHz vessel-mounted ADCP. If a comparison conducted in FY05 between the heading performance of the Seapath 200 GPS/INU (on loan from PMEL) and the GPS compass proves successful, the project will not have to purchase the POS/MV GPS/INU.

Data Management and Quality Assurance/Quality Control Statement

3b. Physical Measurements

Physical measurements will be collected from instruments mounted on Alaska State Marine Highway ferries. The data will be periodically retrieved and mailed or sent electronically to the NOAA/PMEL office in Seattle.

We will collect ship's position, surface temperature, salinity, chlorophyll fluorescence, nutrient concentrations, dissolved organic matter fluorescence, and optical transmission data in the first year. The Sea-Bird thermosalinograph instrumentation includes software to convert voltages or machine values to scientific values, and applies drift and offset corrections based on Sea-Bird calibration numbers. The data are averaged to 15 seconds. Conductivity is converted to salinity according to the PSS-78 (http://www.seabird.com/application_notes/AN14.htm). In years 2 and 3 the only nutrient concentrations will be nitrate via a Satlantic MBARI ISUS nitrate sensor. In years 2 and 3 we will collect ocean current profile data from an RDI 300 kHz Workhorse Mariner ADCP. Ship's heading will be provided from a GPS-based system with inertial navigation.

Once the raw data are calibrated and converted, they will go through an in-house quality control phase where data points will be plotted and scrutinized for reasonableness and outliers. In-house software (EPIC:bridge) is sometimes used to fill small data gaps in the raw data using linear interpolation and spectral methods.

Time series will be converted to spatial data using the ship's along-track position. Spatial data may be averaged into along-track sectors and may be stratified by the stage of the tide.

PMEL gathers metadata for all of its incoming data, and uses the NetCDF protocol for data and attribute storage. NetCDF is a widely used scientific format created by Unidata/UCAR (http://www.unidata.ucar.edu/packages/netcdf/index.html). This is a binary file format that is capable of storing data in 4 dimensions (x,y,z,t), and bundles standard and user-added attributes (metadata) into each individual file. Axis definitions and variables are stored as key-coded attributes, where the key code defines the attribute name, short name, units, stored format, and short description. An additional list of non-coded attributes is stored with each data file. NetCDF allows for addition of any other desired attributes. The following lists delineate our required attributes:

Key-code-defined Attributes (axes plus variables)

- Time, begin and end
- Latitude
- Longitude
- Depth of instrument
- All variables

Additional Attributes

- Instrument type
- Data type
- Data subtype
- Data origin
- Coordinate system
- Water mass
- Experiment
- Project
- Delta T
- Data comments
- Water depth
- Variable description
- Fill flag
- Variable used for fill (for missing data points)
- Variable description
- Creation date (of data file)
- Program comment 1 (multiple comments attributes allowed)

The PMEL data access protocol is a web-based system called EPIC (http://www.pmel.noaa.gov/epic/index.html), which searches the PMEL NetCDF data file archives. It facilitates data searches based on location and time, creates plots on the fly, and provides download of data files in various formats. Additionally PMEL maintains the North Pacific Ecosystem Metadatabase (http://www.pmel.noaa.gov/bering/mdb/np/index.html), which will have metadata references to all collected data.

For this project, we will create and maintain a web site specifically dedicated to this GEM proposal. It will include research description, goals and information, updated maps, and plots of processed and analyzed data. The public will have access to FGDC metadata via this site. We will have links to our EPIC data access site, to the PMEL Metadatabase site, and to the Exxon Valdez Oil Spill Trustee Council's data archive. A data inventory will be maintained on the site and continually updated.

Biophysical Observations Aboard Alaska Marine Highway System Ferries

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: NOAA/PMEL GEM proposal, E.D. Cokelet

Publication_Date: 20030613

Title:

Biophysical Observations Aboard Alaska Marine Highway System Ferries

Edition: 1.0

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Seattle, Washington, USA

Publisher: NOAA/PMEL, E.D. Cokelet

Online_Linkage: <http://www.pmel.noaa.gov/>

Description:

Abstract:

Physical and chemical oceanographic data collected from ferry-mounted instruments during routine crossings.

Purpose:

For use in oceanography studies of the Gulf of Alaska and coastal areas

Supplemental_Information:

***** Spatial Reference Information (Beg) *****

Projection Parameters

Spatial Information Raster: Number of Columns: Number of Rows: Pixel Resolution (m): Data Type: real

***** Spatial Reference Information (End) *****

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 20031001

Ending_Date: 20060930

Currentness_Reference: ground condition

Status:

Progress: Planned

Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: 154

East_Bounding_Coordinate: 145.5

North_Bounding_Coordinate: 61.2

South_Bounding_Coordinate: 57.5

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: oceanography

Theme_Keyword: climate

Theme_Keyword: salinity

Theme_Keyword: temperature

Theme_Keyword: chlorophyll

Theme_Keyword: nutrients

Theme_Keyword: currents

Theme_Keyword: Exxon Valdez oil spill

Theme_Keyword: GEM

Theme_Keyword: Alaska Marine Highway

Theme_Keyword: Alaska Ferry

Theme_Keyword: Alaska Coastal Current

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: Gulf of Alaska

Place_Keyword: Cook Inlet

Temporal:

Temporal_Keyword_Thesaurus: None

Temporal_Keyword: 2004-2006

Access_Constraints: None

Use_Constraints:

Permission of PI. Acknowledgment of NOAA/PMEL and GEM for publication and other use.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: E.D. Cokelet

Contact_Organization: NOAA/PMEL

Contact_Address:

Address_Type: Mailing and Physical Address

Address:

7600 Sand Point Way, NE Bldg. 3

City: Seattle

State_or_Province: Washington

Postal_Code: 98115

Country: USA

Contact_Voice_Telephone: 206.525.6820

Contact_Facsimile_Telephone: 206.526.6485

Contact_Electronic_Mail_Address: Edward.D.Cokelet@noaa.gov

Resource_Description: GEM data

Distribution_Liability:

User bears all responsibility for use of data in any further analyses or comparisons.

Metadata_Reference_Information:

Metadata_Date: 20031001

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: E.D. Cokelet

Contact_Organization: NOAA/PMEL

Contact_Address:

Address_Type: Mailing and Physical Address

Address:

7600 Sand Point Way, NE Bldg. 3

City: Seattle

State_or_Province: Washington

Postal_Code: 98115

Country: USA

Contact_Voice_Telephone: 206.525.6820

Contact_Facsimile_Telephone: 206.526.6485

Contact_Electronic_Mail_Address: Edward.D.Cokelet@noaa.gov

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.6.0 on Fri Jun 13 15:45:18 2003

GEM PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (*Trustee Council/GEM Data Policy**, adopted July 9, 2002) and reporting requirements *(Procedures for the Preparation and Distribution of Reports***, adopted July 9, 2002).

PROJECT TITLE: Biophysical Observations Aboard Alaska Marine Highway System Ferries

Printed Name of PI: Edward D. Cokelet

Signature of PI: _____ Date 13 June 2003

Printed Name of co-PI: Calvin W. Mordy

Signature of co-PI: _____ Date 13 June 2003

Printed Name of co-PI: W. Scott Pegau

Signature of co-PI: _____ Date 13 June 2003

* Available at http://www.oilspill.state.ak.us/pdf/admin/datapolicy.pdf

** Available at http://www.oilspill.state.ak.us/pdf/admin/reportguidelines.pdf

GEM POSSIBLE PEER REVIEWERS FORM

Provide the names and contact information for 3 persons qualified to review your proposal, and identify each persons' area(s) of professional expertise from the classification list available at www.oilspill.state.ak.us/nonpdf_docs/invitation/classification_form.xls. These persons must not be current co-workers or collaborators of the proposer(s), major former professors of the proposer(s), or former graduate students of the proposer(s).

PROJECT TITLE: Biophysical Observations Aboard Alaska Marine Highway System Ferries

1st Name: Tom Weingartner

Contact Information: UAF

Area(s) of Expertise: Physical Oceanography, Gulf of Alaska

2nd Name: David L. Mackas

Contact Information: Institute of Ocean Sciences

Area(s) of Expertise: Physical and biological oceanography, Gulf of Alaska

3rd Name:

Contact Information:

Area(s) of Expertise:

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Budget Category:	Proposed FY 04	Proposed FY 05	Proposed FY 06		TOTAL PROPOSED
Personnel	$65.5	$76.3	$79.6		$221.4
Travel	$22.2	$26.7	$28.2		$77.1
Contractual	$25.0	$41.5	$6.3		$72.8
Commodities	$3.0	$3.5	$3.5		$10.0
Equipment	$23.6	$51.2	$102.7		$177.5
Subtotal	$139.3	$199.2	$220.3		$558.8
General Administration (9% of Subtotal)	$12.5	$17.9	$19.8		$50.3
Project Total	$151.8	$217.1	$240.1		$609.1

Cost-share Funds:

FY04 Personnel: Cokelet, E., Oceanographer, 3 months, 15.1K per month - TOTAL - $45.3
FY04 Equipment -Nutrient sensor - TOTAL - $22.0

FY05 Personnel: Cokelet, E., Oceanographer, 3 months, 15.7K per month - TOTAL - $47.1
FY05 Equipment: Seapath 200 - TOTAL - $69.0
FY05 Equipment: RDI Workhorse Mariner 300-kHz ADCP - TOTAL - $27.4

FY06 Personnel: Cokelet, E., Oceanographer, 3 months, 16.3K per month - TOTAL - $49.0

FY 04-06

Date Prepared: 12-Jun-03

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3A TRUSTEE AGENCY SUMMARY

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
A. Jenkins	JISAO/Research Scientist		5.0	6.7		33.5
M. Sullivan	JISAO/Research Scientist		2.0	7.7		15.4
C. Mordy	JISAO/Oceanographer		2.0	8.3		16.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		9.0	22.7	0.0	
					Personnel Total	$65.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Airfare - Seattle to Anchorage (NOAA)	1.6	1	6	0.2	2.8
Airfare - Seattle to Anchorage (JISAO)	2.0	1	6	0.2	3.2
Airfare - Seattle to Juneau (NOAA)	0.9	2	6	0.2	3.0
Airfare - Seattle to Anchorage (Seward trip) (NOAA)	1.6	1	6	0.1	2.2
Airfare - Seattle to Anchorage (Seward trip) (JISAO)	2.0	1	6	0.2	3.2
Airfare - Seattle to Homer (JISAO)	1.6	3	9	0.2	6.6
Rental car			12	0.1	1.2
Ferry trip					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$22.2

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Contractual Costs:	Contract Sum
Description	
Shipyard wiring - power to instruments, computers and monitor	10.0
Shipyard wiring - data I/O cables (crow's nest, passenger area, computer, instruments)	10.0
Shipyard plumbing - stainless steel	5.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$25.0

Commodities Costs:	Commodity Sum
Description	
Scientific computing	1.0
Web Page computing maintenance	2.0
Commodities Total	$3.0

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Contractual & Commodities DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
Sea-Bird SBE 45 MicroTSG / Sea-Bird SBE 38 Digital Oceanographic Thermometer and supplies	1	6.0	6.0
WETLabs C-Star flow tube, cables and A-D converters	1	2.1	2.1
Omega Engineering wall-mount thermocouple for hold air temp / K-Type thermocouple element	1	0.1	0.1
Hydracell/Baldor pump and controller and supplies	1	1.8	1.8
Sea strainer, self-cleaning	1	1.0	1.0
Debubbler (materials)	1	0.5	0.5
12-V Power supply and supplies	1	0.6	0.6
Calorimetric flow meters	2	0.8	1.6
Motorized ball-valve controls	2	0.2	0.4
Automatic shut-off valves	2	0.3	0.6
Laptop computer and supplies	1	3.4	3.4
Remote monitor for passengers and supplies	1	2.8	2.8
Northstar DGPS receiver and antenna	1	2.7	2.7
		New Equipment Total	$23.6

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
Nutrient Sensor	1	PMEL

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
A. Jenkins	JISAO/Research Scientist		5.0	6.9		34.5
M. Sullivan	JISAO/Research Scientist		2.0	8.0		16.0
C. Mordy	JISAO/Oceanographer		3.0	8.6		25.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		10.0	23.5	0.0	
					Personnel Total	$76.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Airfare - Seattle to Anchorage (NOAA)	1.7	1	6	0.2	2.9
Airfare - Seattle to Anchorage (JISAO)	2.1	2	12	0.2	6.6
Airfare - Seattle to Juneau (NOAA)	1.0	2	6	0.2	3.2
Airfare - Seattle to Anchorage (Seward trip) (NOAA)	1.7	1	6	0.1	2.3
Airfare - Seattle to Anchorage (Seward trip) (JISAO)	2.1	1	6	0.2	3.3
Airfare - Seattle to Homer (JISAO)	1.7	3	9	0.2	6.9
Rental car			12	0.1	1.2
Ferry trip			3	0.1	0.3
					0.0
					0.0
					0.0
					0.0
				Travel Total	$26.7

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Contractual Costs:	Contract Sum
Description	
ADCP installation	30.0
Wiring - ADCP and cell-phone-based data transfer system	10.0
Cellular telephone for data transfer system and supplies	1.5
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$41.5

Commodities Costs:	Commodity Sum
Description	
Scientific computing	1.0
Web Page computing maintenance	2.0
Sea-Bird SBE 45 MicroTSG / Sea-Bird SBE 38 Dig. Oc. Thermometer maintenance and calbn	0.5
Commodities Total	$3.5

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Contractual & Commodities DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
WETLabs WETStars miniature fluorometer (chlorophyll)	1	3.0	3.0
WETLabs WETStar CDOM fluorometer	1	3.5	3.5
WETLabs C-Stars Transmissometer	1	3.3	3.3
Satlantic MBARI ISUS Nitrate Analyzer and cable	1	25.9	25.9
Hydracell/Baldor pump maintenance	1	0.3	0.3
Laptop computer and supplies	1	3.2	3.2
Cable for RDI 300 kHz Workhorse Mariner ADCP	1	1.5	1.5
Furuno GPS compass, Model SC-120	1	7.0	7.0
LabView instrument control software	1	1.0	1.0
National Instruments analog-to-digital interface hardware	1	2.0	2.0
Cellular telephone equipment	1	0.5	0.5
			0.0
		New Equipment Total	$51.2

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
RDI 300 kHz Workhorse Mariner ADCP	1	PMEL
Seapath 200 GPS heading device	1	PMEL

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
A. Jenkins	JISAO/Research Scientist		5.0	7.2		36.0
M. Sullivan	JISAO/Research Scientist		2.0	8.3		16.6
C. Mordy	JISAO/Oceanographer		3.0	9.0		27.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		10.0	24.5	0.0	
					Personnel Total	$79.6

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Airfare - Seattle to Anchorage (NOAA)	1.7	1	6	0.2	2.9
Airfare - Seattle to Anchorage (JISAO)	2.2	2	12	0.2	6.8
Airfare - Seattle to Juneau (NOAA)	1.0	2	6	0.2	3.2
Airfare - Seattle to Anchorage (Seward trip) (NOAA)	1.7	1	6	0.2	2.9
Airfare - Seattle to Anchorage (Seward trip) (JISAO)	2.2	1	6	0.2	3.4
Airfare - Seattle to Homer (JISAO)	1.8	3	9	0.2	7.2
Rental car			15	0.1	1.5
Ferry trip			3	0.1	0.3
					0.0
					0.0
					0.0
					0.0
				Travel Total	$28.2

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Contractual Costs:	Contract
Description	Sum
ADCP - replace transducer	5.0
Cellular telephone service	0.8
Dial-up landline in Homer	0.5
Contractual Total	$6.3

Commodities Costs:	Commodity
Description	Sum
Scientific computing	1.0
Web Page computing maintenance	2.0
Sea-Bird SBE 45 MicroTSG / Sea-Bird SBE 38 Dig. Oc. Thermometer maintenance and calbn	0.5
Commodities Total	$3.5

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Contractual & Commodities DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
Hydracell/Baldor pump maintenance	1	0.3	0.3
Applanix POS/MV 220 GPS heading device	1	75.0	75.0
RDI 300 kHz Workhorse Mariner ADCP	1	27.4	27.4
		New Equipment Total	$102.7

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: NOAA/PMEL

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Budget Category:	Proposed FY 04	Proposed FY 05	Proposed FY 06	TOTAL PROPOSED
Personnel	$11.0	$16.9	$17.4	$45.3
Travel	$0.6	$0.8	$0.8	$2.2
Contractual	$0.4	$0.4	$0.4	$1.2
Commodities	$2.0	$2.7	$2.7	$7.4
Equipment	$0.0	$0.0	$0.0	$0.0
Subtotal	$14.0	$20.8	$21.3	$56.1
General Administration (9% of Subtotal)	$1.3	$1.9	$1.9	$5.0
Project Total	$15.3	$22.7	$23.2	$61.1

Cost-share Funds:

FY04 Equipment -WETLabs WETStar miniature fluorometer (chlorophyll) - TOTAL - $3.0
FY04 Equipment -WETLabs WETStar CDOM fluorometer - TOTAL - $3.5
FY04 Equipment -WETLabs WETStar C-Star transmissometer - TOTAL - $3.3

FY 04-06

Date Prepared: 13-Jun-03

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3A TRUSTEE AGENCY SUMMARY

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
S. Pegau	Senior Scientist		1.5	5.9		8.9
	Technician		0.5	4.2		2.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	10.1	0.0	
					Personnel Total	$11.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Homer - Seward - Homer		1	2		0.2
Homer - Seldovia - Homer		5			0.4
				Travel Total	$0.6

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Contractual Costs:	Contract Sum
Description	
Communication and computer	0.4
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.4

Commodities Costs:	Commodity Sum
Description	
Supplies (cleaning calibration water, filtration, chlorophyll analysis, misc repair)	2.0
Commodities Total	$2.0

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Contractual & Commodities DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
WETLabs WETStar miniature fluorometer (chlorophyll)	1	KBRR
WETLabs WETStar CDOM fluorometer	1	KBRR
WETLabs C-StarTransmissometer	1	KBRR

FY 04

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Equipment
DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
S. Pegau	Senior Scientist		1.0	5.9		5.9
	Technician		2.5	4.4		11.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.5	10.3	0.0	
					Personnel Total	$16.9

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Homer - Seldovia - Homer		8			0.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.8

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	Contract Sum
Description	
Communication and computer	0.4
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.4

Commodities Costs:	Commodity Sum
Description	
supplies (cleaning calibration water, filtration, chlorophyll analysis, misc. repair)	1.5
WETLabs WETStars (2) and WETLabs Transmissometer (1), maintenance and calbn	1.2
Commodities Total	$2.7

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Contractual & Commodities DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

FY 05

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Equipment
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
S. Pegau	Senior Scientist		1.0	6.1		6.1
	Technician		2.5	4.5		11.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.5	10.6	0.0	
					Personnel Total	$17.4

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Homer - Seldovia - Homer		8			0.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.8

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

Contractual Costs:	Contract Sum
Description	
Communication and computer	0.4
Contractual Total	$0.4

Commodities Costs:	Commodity Sum
Description	
supplies (cleaning calibration water, filtration, chlorophyll analysis, misc. repair)	1.5
WETLabs WETStars (2) and WETLabs Transmissometer (1), maintenance and calbn	1.2
Commodities Total	$2.7

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Contractual & Commodities
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 04 - FY 06

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

FY 06

Project Number:
Project Title: Biophysical Observations Aboard Alaska Marine Highway System Ferries
Agency: Alaska Dept of Fish and Game/KBRR

FORM 3B
Equipment
DETAIL