SOUTHERN CALIFORNIA EDUCATIONAL INITIATIVE

PROGRAM YEAR 10

QUARTERLY REPORT 3

for the period

January 1, 1999 – March 31, 1999

A Cooperative Program
between the
University of California
and the
Minerals Management Service

April 16, 1999

SOUTHERN CALIFORNIA EDUCATIONAL INITIATIVE

PROGRAM YEAR 10

QUARTERLY REPORT 3

for the period

January 1, 1999 – March 31, 1999

A Cooperative Program

between the

University of California

and the

Minerals Management Service

Russell J. Schmitt
Program Manager

Coastal Research Center
Marine Science Institute
University of California
Santa Barbara, California 93106

April 16, 1999

Program Manager's Report

for the period January 1, 1999 – March 31, 1999

This constitutes the quarterly report for the third quarter of Program Year 10 of the Southern California Educational Initiative, a cooperative research agreement between the Minerals Management Service, the state of California and the University of California.

As of this quarter, 13 projects currently are being conducted under the aegis of the Southern California Educational Initiative.

Major programmatic progress and actions during the quarter are summarized below for the period of January 1, 1999 – March 31, 1999.

- Contract and budget negotiations for 4 new projects were finalized. MMS approval of transfer of funds for these projects is required;
- The Final Report for *Identification of Bioactive Compounds from Produced Water Discharge / Characterization of Organic Constituent Patterns at a Produced Water Discharge Site* was completed and sent to MMS for distribution;
- The Final Report for *Characterization of Organic Constituent Patterns at a Produced Water Discharge Site/Barium Relations to Bioeffects of Produced Water* was completed and sent to MMS for distribution;
- Several other final reports are being edited and will be sent to MMS next quarter.

Environmental Assessment: Statistical Description of Variable Effects on Fluctuating Populations

Adding Biology to BACI: Exploring the Use of Functional Groups, Trophic Relationships and Multiple, Ecologically Similar Comparison Sites in Choosing Models and Estimating Effects Impacts Analysis

Principal Investigator: Allan Stewart-Oaten, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106, **Stephen Schroeter** Marine Science Institute, University of California, Santa Barbara Ca 93106

Major Accomplishments, October 1, 1998 – December 31, 1998

My coauthor, Dr. Bence, returned his revision of our long paper only in early March. I have not yet worked on it. I expect it to put significant time into it during the next few weeks, partly as preparation for two talks I will be giving (see below).

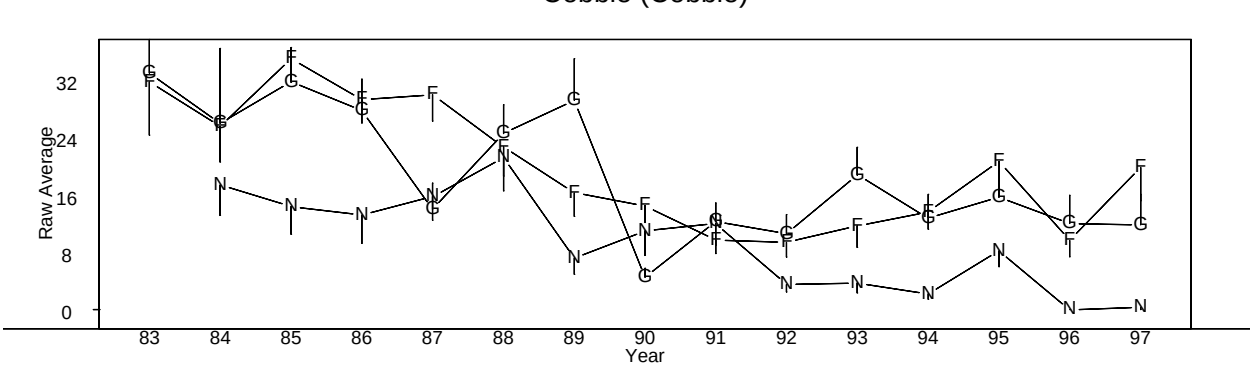
Much of the work of the last three months has been programming to "mine" the Channel Islands data for clues as to whether sites tend to track each other and, if so, what the main factors in this tracking are. This has taken longer than I had hoped, partly because the datasets are large and somewhat complex (e.g., allowance had to be built in for changes in sampling methods over time). We now have Splus functions which can extract yearly averages and SE's, transform them (and also the SE's, using Taylor series approximations), plot them, calculate correlations over time, select sites or species with low or high correlations, or groups of sites which are highly intercorrelated.

Some of these results are promising. One argument that sites might track each other is that physical conditions at nearby sites should fluctuate similarly over time, even if the sites themselves are not identical. One example comes from work of Pete Raimondi, Dan Reed and Mark Carr, showing that the sites seem to separate into "North" and "south" groups on the basis of water temperatures; these may indicate sources of larval recruitment, so that recruitment results might be more similar within these two groups than between them. Another example is illustrated in Figure 1. This is a plot of the fraction of substrate which was cobble at three of the closest sites, "N6" = Cathedral Cove, "N7" = Landing Cove, and "S6" = Admirals Reef, all on Anacapa Island. (The slightly odd graph title arises because the data treat cobble as a "species" and our program automatically puts both the Latin and common names of species in the title.) Plots of the other two substrate types, rock and sand, at these three sites are similar. To the extent that a species abundance is determined by suitable substrate, we might expect these roughly synchronous changes to lead to similar changes in abundance. Figure 2 gives an example where this hope may seem realized. It should be stressed, however, that this species was deliberately selected to be one of those that did exhibit high correlation over time between these sites, and even then there are indications in later years that synchronicity is imperfect. (The vertical lines on the plot show one Standard Error of the estimated mean for that date at that site, i.e., they measure sampling error.) Many species do not have high correlations at these sites, some even have negative correlations, and others have high correlations only because the one or two non-zero years were the same at each site.

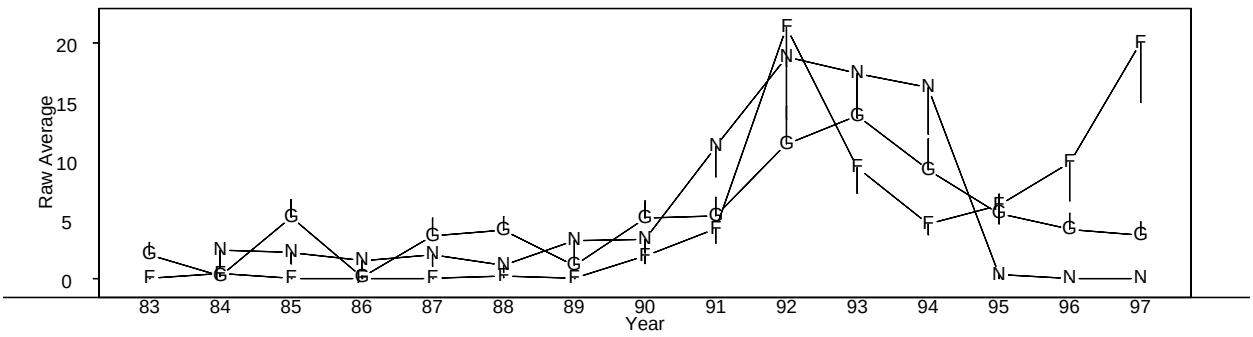
On the other hand, it may be that correlations are better than we have seen so far. Most of our exploration has been done using raw averages; log(average), √average or another transformation might be better. Almost all of our searching has been for pairs or groups of sites that exhibit synchronicity, as indicated mainly by correlation. This seems the most likely way for some sites to

serve as predictors of others, but it is not the only way. E.g., sites on either side of the target site might not predict well individually but do much better in combination. Also, a severe problem is sampling error, which is often as large as, or larger than, the temporal variation, and tends both to reduce correlation sharply and also, by chance, to lead to our selecting the wrong sites and species as "most promising."

Figures 1 and 2



Sites: F=N6:AI-CC, G=N7:AI-LC, N=S6:AI-AR



Sites: F=N6:AI-CC, G=N7:AI-LC, N=S6:AI-AR

Problems Encountered: Mainly those described above - messier data, murkier messages and greater sampling error than we would like. Also, some programming problems have taken longer than we hoped, mainly due to problems of missing data. Future programs may be more difficult.

MMS Action Required: None.

Future Plans: There are two immediate tasks: complete and send off the revision of the long basic paper, and prepare for two presentations - a 50-minute one to the UCSB Statistics Department on May 4, and a 25-minute one for the Biometric Society meeting in Seattle in late June. The talks will be similar (I regard the first as practice for the second), containing a mixture of the long paper and material like that described above.

Some of the plans described in the last report are not complete. Some should be easy: (i) plots and summaries of differences of averages, differences of log(average), difference between prediction and

actual with 1 Control, and comparisons of variances and autocorrelations for original data and for differences; (ii) show which species are abundant and which are rare (either in numbers or in frequency over time) at a site and which sites have high or low abundances for a given species; (iii) extend programs written so far, so that they can combine results for different transformations to select "most promising" cases. Others look difficult: figure out a way to see how well 2 or more "controls" can predict a "target" site; summarize cross-correlation functions to allow for time lags between sites (though lags of more than a year seem unlikely to make much biological sense); find ways of addressing the problems arising from selection of species and site combinations (the "best" of such a large group is likely to be impressive just by chance) and from sampling error. Separating sites into pseudo-sites by breaking the main transect into sections seems to have intermediate difficulty.

We need to discuss the temperature data with Pete Raimondi et al: this is a very large data set (20 MB), so any cheap clues will be valuable!

We have begun modeling work, but run into a snag. The models that seem most promising at present - not so much for impact assessment as for description - are of the form $N_{st} = R_t + D_{st}$ + sampling error, where N_{st} is the observed average at site s and time t, R_t is a measure of "regional" abundance at time t, and D_{st} is the deviation of site s at that time. For analysis purposes, R_t is treated as a parameter - in essence, it contains the regional temporal variation we hope to eliminate (or reduce) by using control sites. However, this means we have a large number of parameters. We have tried simulating a few models of this kind (varying by how the R's and D's are assumed to be generated), but the Splus maximization programs we used to "estimate" the parameters of these simulations did not converge. We may need to write our own, in Fortran or C (or, rather, copy them from the book, Numerical Recipes). Splus has an interface which allows one to incorporate such "foreign language" programs in its own, but I've never used it and need to relearn these languages.

I am hoping that the programs I have written run well enough for Dr. Schroeter to explore the data and get ideas about biological mechanisms for the patterns he finds. Unfortunately, I already found some problems just in writing this report - as often, due to programs crashing when data are missing for some species-site-year combination. It is not hard for me to avoid or work around these problems, but will be harder for him. However, he will be taking a special course in Splus this month; I hope he will come out of it able to improve my programs, not just work with them!

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%
Project Year 3	87%

Effects of Biologically Degraded Oil on Marine Invertebrate and Vertebrate Embryos and Larvae

Principal Investigators: **Gary N. Cherr**, Bodega Marine Laboratory, University of California, Davis, CA 94923, **Rick Higashi**, Crocker Nuclear Laboratory, University of California, Davis, CA 95616, **Frederick J. Griffin**, Bodega Marine Laboratory, University of California, Davis, CA 94923.

Major Accomplishments, January 1 - March 31, 1999

We have recently probed marine invertebrate larvae for the presence or absence of an multixenobiotic resistance transporter (MXR)-like immunogenic protein. Immunoblots and immunocytochemical analyses of adult oyster (*Crassostrea gigas*) using monoclonal antibody C219 have shown the presence of an approximately 220kD protein. A protein of similar molecular weight was also observed in immunoblots of control and the soluble fraction of biologically degraded crude oil (BWSF) exposed (5%) prehatch oyster larvae. MXR proteins were also observed in control and exposed (5%) *Urechis caupo* larvae. Exposure to BWSF did not seem to cause increased accumulation of MXR protein, however we have not excluded the possibility that either increased turnover of MXR protein is occurring or that post-translational modification of existing protein results in increased net protein activity. In contrast immunoblots of both control and exposed pre-hatch and late sea urchin (*Lytechinus anamesus*) larvae did not show the presence or expression of MXR protein. These findings are consistent with the previous observations that sea urchin larvae do not express a significant level of verapamil-sensitive rhodamine dye exclusion. While antibodiea and dye exclusion have been the traditional methods for determination of MXR activity in marine larvae and mammalian cell lines, we are currently testing the hypothesis that species such as sea urchins may possess other MXR-like proteins with different immunogenic properties and substrate specificities. It is also possible that the expression of these protein is developmentally regulated and does not occur in larval stages.

We have recently expanded the scope of our investigations into the suitability of BWSF as a substrate for MXR. Using NIH 3T3 Swiss mouse embryo fibroblasts transfected with a full length MDR cDNA, we are testing the possibility that mammalian MDR protein can also mediate tolerance to biodegraded crude oil. We have recently confirmed that control fibroblasts exhibit significant reductions in growth when exposed to concentrations of BWSF ranging from 2.5-5.0%. Preliminary results do not suggest that the MDR transfected fibroblasts are susceptible to these concentrations. We plan to confirm the substrate suitability of BWSF for MDR using competitive dye exclusion studies. Future studies plan to investigate the possibility of transfecting fibroblasts with marine MXR cDNAs. We have recently constructed primers against the highly conserved ATP binding domains of these proteins and we plan to use RT-PCR to probe adult and larval tissues. Because MDR-like proteins have a wide range of substrate specificities ranging from highly precocious to single substrates, this technique holds particular promise for screening large numbers of toxicants for species-specific MXR activities.

We have initiated a collaboration with Dr. Peter Raimondi's laboratory at UC Santa Cruz. Dr. Anthony Boxshall will be exposing marine invertebrate and vertebrate larvae to low concentrations of BWSF in order to investigate effects on larval swimming behavior.

Future Plans

We will continue our development of *in vitro* assays for BWSF effects. We have sampled blood cells from invertebrates that are found near seep sites in the Santa Barbara Channel and will be sampling these animals over the next two quarters in order to determine if exposure to BWSF in the field induces expression of MXR protein in animals which do not normally express it.

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%
Project Year 3	80%

Detecting Ecological Impacts: Effects of Taxonomic Aggregation in the Before-After/Control-Impact Paired Series Design

Principal Investigators: Sally Holbrook, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106, **Mark H. Carr**, Department of Biology, University of California, Santa Cruz, CA 95064, **Craig W**. **Osenberg,** Department of Zoology, University of Florida, Gainesville, FL 32611-8525.

Major Accomplishments, January 1, 1999 - March 31, 1999

- While some files are still being formatted to facilitate data analysis, preliminary data analysis has begun at Osenberg's lab. After several efforts were made to collaborate with Dr. Karen Green, who had agreed to provide functional designations for the taxa, we have determined that such a collaboration is highly unlikely. Thus, we will focus our efforts on the effects of taxonomic aggregation rather than functional aggregation. However, some analyses based on ecological functional aggregations can be done from existing information in the literature and based on broad phyllogenetic differences in trophic relationships.

- Processing of bivalve and crustacean samples for size-frequency analysis continues in Carr's lab at UCSC with the image analysis system. At present, bivalve samples from Gaviota have been imaged and processing of Carpinteria samples is underway.

Future plans:

- We expect to continue most of the analyses through years 3 and 4 (i.e., we anticipate a 12 month no-cost extension, which will be supported via cost-savings during years 1 and 2). All other samples designated for size frequency analysis will be shipped to UCSC. We are making arrangements to have all samples not designated for size frequency analysis to be archived at the Los Angeles County Museum. Osenberg's lab will continue analysis of the MRC data and begin analysis of the Gaviota and Carpinteria databases. Carr's lab will continue to process size-frequency samples.

Estimated Percentage of Budget Expended:

Project Year 1 100%
Project Year 2 100%
Project Year 3 52%

Public Policy, Oil Production, and Energy Consumption in Twentieth-Century California

Principal Investigator: Rachel Schurman, Energy and Resources Group, University of California, Berkeley, CA 94720; **Paul Sabin**, Department of History, University of California, Berkeley, CA 94720

Major Accomplishments, October 1, 1998 – December 31, 1999

We continue to write up results from our accumulated research. We are currently completing a section on efforts to control the overproduction of oil in California during the 1920s and 1930s.

Future Plans: Work will proceed as scheduled, once we receive the no-cost extension.

MMS Action Required: Approval of no-cost extension for 1998-1999

Estimated Percentage of Budget Expended:

Project Year 1	100%
Project Year 2	100%
Project Year 3	0%

Evaluating the Impact of Oil Spills on Southern California Rocky Intertidal Populations and Communities: Development of a Handbook

Principal Investigator: Richard Ambrose, Environmental Science and Engineering Program, Department of Environmental Health Sciences, University of California, Los Angeles, CA 90095

Major Accomplishments, January 1, 1999 - March 31, 1999

There has been relatively little activity on this project during this quarter. Previously, we completed a draft of the handbook and submitted it to MMS, Cal OSPR and NOAA for review. The comments were generally favorable, though of course many suggestions for improvement were made. We received the reviews right as the academic year was beginning. Revisions for some of the chapters have been completed, but unfortunately other obligations have prevented us from completing the revision of the handbook during this quarter.

Future Plans:
The final version of the handbook, revised based on the agency comments, should be completed in the next quarter.

Problems encountered:
No problems were encountered.

MMS Action Required:
No action is required at this time.

Estimated percentage of Budget Expended:
Project Year 1 100%

Effects of an Oil Spill on Multispecies Interactions that Structure Intertidal Communities

Principal Investigator: Peter Raimondi, Department of Biology, University of California, Santa Cruz, California 95460.

Major Accomplishments, January 1, 1999 - March 31, 1999

The plots established at Boathouse, on Vandenberg Airforce Base, were sampled in late February. Data was collected on the number and the sizes of barnacles in the cleared plots and the tarred plots. Barnacles were present in the cleared and the tarred plots. Recruits were in higher numbers on the tarred plots than in the cleared plots. In contrast, in December there were more barnacles on the cleared plots than on the tarred plots. This is very interesting, particularly because barnacles settle to the rock surface in response to chemical cues from conspecifics. Therefore, the barnacles may have adapted to the chemicals present in tar over the hundreds of years that tar has been coming onshore from subtidal oil seeps.

The implications of tar cover for the life history traits of barnacles are currently being investigated using computer modeling. Samantha Forde is continuing a project with Professor Marc Mangel on a dynamic computer model that is assessing the consequences of chronic tar exposure to life history traits and population regulation of the barnacle, *Chthamalus anisopoma*. So far, the model has asked what the relative loss of fitness is to an individual barnacle when the decision to grow or reproduce in the event of an oil spill is made based on the evolutionary expectation of tar cover. This evolutionary expectation is based on the probability of being covered with low, chronic levels of tar. The model will assess how the loss of fitness on an individual level translates into population recovery from an oil spill.

Personnel
Samantha Forde is funded as a graduate student research assistant.

Future plans:

Samantha will continue to work on the computer model with plans to publish the results within a year. Sampling will continue on a quarterly basis. Once the tar patches show evidence of change (degradation), and assuming there are no barnacles on the tar patches, the control plots will be cleared, and barnacle recruitment to the bare rock in the tar plots and the control plots will be compared. Incorporation of other member species of the community will be evaluated.

Samantha Forde will continue to work on the computer model with plans to publish the results within a year.

Estimated Percentage of Budget Expended:
Project Year 1 12%

Inventory of Rocky Intertidal Resources in San Luis Obispo, Northern Santa Barbara and Orange Counties

Principal Investigators: **Peter Raimondi**, Department of Biology, University of California Santa Cruz, CA 95064

Major Accomplishments, January 1-March 31, 1999:
During this quarter 9 of the 10 study sites in San Luis Obispo (SLO) and Northern Santa Barbara Counties (SBC) were sampled. Sampling occurred during February 26-28 (northern SBC sites), and March 14-18 (SLO sites). One of the northern SBC sites, Government Point, could not be sampled during this period because access by land has been revoked by the Cojo/Bixby Ranch Corporation (to all researchers requesting access to the area). We hope to sample this site by boat during the late spring or summer months when sea conditions are more favorable.

The black abalone recruits that were recorded in relatively high numbers (about 10 per plot) at Point Sierra Nevada (SLO) during the fall 1998 sample, were still present at the site. Continued monitoring of these black abalone recruits, as well as adult black abalone at this site is important, as populations south of the SLO site on Vandenberg Air Force Base (northern SBC sites) continue to decline due to the fatal condition termed withering syndrome. Black abalone numbers at Purisima, the northernmost site on VAFB are down to about 10% of what they once were, and sites further south contain only a few animals per plot.

Another notable observation made at both Point Sierra Nevada and Piedras Blancas (SLO) is that *Postelsia palmaeformis*, a distinctive brown alga which occurs on wave exposed ridges in the low intertidal, has completely disappeared. This alga cannot tolerate warm water and most likely could not persist through the elevated water temperatures of last years' El Nino event.

Future Plans:
Work for the next quarter will involve scoring photographic slides, and entering these percent cover data along with field data into computer files.

Problems Encountered:
Funding is getting low for this project. The Santa Barbara County portion of the funding has not yet been received. It is critical that we receive funds as soon as possible.

Estimated Percentage of Budget Expended:
Project Year 1 50%

Inventory of Rocky Intertidal Resources in Los Angeles, Ventura, and Southern Santa Barbara Counties

Principal Investigator: Dr. Richard F. Ambrose, Dept. of Environmental Health Sciences and Environmental Science and Engineering Program, University of California, Los Angeles, CA 90095-1772

Major Accomplishments, January 1-March 31, 1999:
During this quarter, a new technician, Steven Lee, has been hired to work on the project. During the first part of the quarter, time was spent orienting Steven to the project and he began working on the backlog of necessary tasks that had piled up following the departure of the previous technician. Data, paperwork, and computer files had to be located and organized, and supplies had to be purchased. Steve has started to score slides from the Fall 1998 sampling period, but there is still a backlog of slides that need to be scored, and data to be entered into the computer files.

In January, the photoplots at one of the LA County sites, White's Point, were re-shot because the Fall '98 slides for that site did not come out properly. In March, the Spring '99 sampling was done at 8 of our 10 sites (Table 1). MMS MINT members assisted us at most sites. The two sites on Santa Catalina Island were not sampled this spring due to a lack of funding for the LA County sites. The other two LA county sites, Paradise Cove and White's Point, were sampled even though we did not have funding to do so. We hope to obtain funding for LA County in the future so that sampling of these four sites can continue.

Table 1. Sampling schedule for Spring 1999.

Location	Date	Comments
Alegria	March 1	Some repairs made
Arroyo Hondo	March 2	Some repairs made
Coal Oil Point	March 29	Heavy sand inundation: Surfgrass transects estimated
Carpinteria	March 16	All plots sampled; some repairs made
Mussel Shoals	March 17	Repairs made

The video portion of the project is in the process of being reconsidered. Some suggestions have been made as to how to improve the benefits of this data collection tool, but no concrete decisions have been made to date. In any case, we are still waiting to receive a new video camera that was to be purchased by MMS. We were not able to videotape White's Point, Paradise Cove or Coal Oil Point because we did not have a videocamera.

Prior to the spring sampling, we made the very beneficial purchase of a metal detector. This metal detector enabled us to locate and recover bolts, and entire plots previously thought to be lost. A considerable amount of repair work was done this quarter to get all of the sites back in shape. One notable exception is the Coal Oil Point site. This site was heavily inundated with sand during this spring's sampling, and most of the plot/transect locations had to be approximated. Another observation worthy of mention was at White's Point, where there has been substantial recruitment of the bay mussel, *Mytilus galloprovincialis*. These recruits looked to be about a year old, and may be the result of the recent El Niño event. It will be interesting to see how these mussels will fare over time at this relatively exposed site.

Future Plans:
Work for the next quarter will involve scoring photographic slides and entering these percent cover data, along with field data, into computer files. We will continue to work on reducing the backlog of tasks, which piled up in the absence of a technician.

Problems Encountered:
No major problems were encountered during this quarter. The only major issue continues to be the lack of funding for the LA county sites.

MMS Action Required:
We are still waiting for a new video camera, and player.

Early Development of Fouling Communities on Offshore Oil Platforms

Principal Investigators: H. Mark Page and **Jenifer Dugan**, Marine Science Institute, University of California, Santa Barbara, California 93106

Major Accomplishments, January 1, 1999 - March 31, 1999

During this quarter (approximately mid March) we received funding for the project. We completed our preliminary survey of Platforms Hogan and Houchin on March 29. Much of Platform Hogan remains to be cleaned of invertebrates. Cleaning operations are farther along on Platform Houchin. The layout of the platforms is very similar to Platform Holly which will facilitate our work. We have also interviewed a prospective graduate student (Jason Bram). If we accept Jason, he will use the platform study for his Master's Thesis work. We have also ordered image analysis software for use in analyzing digital photographs taken during monthly sampling of invertebrates on the platforms.

Future plans: work will continue on schedule

Estimated Percentage of Budget Expended:

Project Year 1 0%