NC Rural Center
Economic Innovation Grant

Carteret Community College
Marine Biotechnology Facility

Final Report
February 26, 2007

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Marine Biotechnology Facility
Final Report

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ECONOMIC INNOVATION GRANTS

Final Report

All final reports must include a review of performance and activities over the entire project period. Your report should include general information as specified, a one-page project summary, and a report narrative that includes an assessment of achievement of project goals, a discussion of innovative and demonstration-specific project components, an assessment of collaboration and leveraging of funds, and a discussion of project outcomes. The following questions are to be used as a guide: some may not pertain to your specific project.

Please note that in addition to accounting for the use of the project funds during the current fiscal year, the final report must include a detailed final financial report by category (i.e., salaries, materials, equipment, etc.) showing all expenditures during the entire term of this grant. The financial report must also detail the sources and amounts of all other funds used to support this project.

General Information:

- Name of your organization and project
  Carteret Community College, 3505 Arendell Street, Morehead City, NC 28557
  Marine Biotechnology Economic Stimulus Demonstration Project

- Date submitted and reporting period covered
  February 23, 2007
  March, 2005-March 2007 (entire grant period plus one year)

- Name, telephone number, and email address of individual submitting the report
  Philip S Kemp Jr, Project Director
  252-222-6114
  kemps@carteret.edu

One-Page Program Summary (for potential publication by The Rural Center):

The Marine Biotechnology Economic Stimulus Demonstration Project was designed to establish and equip a demonstration and incubator facility for marine biotechnology in eastern North Carolina. The principle project goal is to initiate and foster partnerships with academia and industry, which develop novel marine biotechnologies. The intent for the project is to ultimately stimulate job creation by innovative spin-off businesses utilizing mariculture species and techniques. This goal relates to CCC's mission to be a leader in improving the quality of life for all citizens of Carteret County and Eastern North Carolina by offering high-quality, innovative education and training. The project was implemented by the CCC Aquaculture Technology Program by contacting existing colleagues, seeking new ones and by expanding the college's resources and capabilities for biotechnology education and partnering.

Existing partnerships were expanded to include new industries and academia. The project included research by UNC-CH Institute of Marine Sciences and UNC-Wilmington in the Rural Center-funded Marine Biotechnology Facility (MBF) with CCC student

participation. One project expanded the understanding of bryozoan ecology and life-history which has implications for educational specimens and for pharmaceutical bio-active compounds for cancer and Alzheimer's research. Another project was the propagation of bay scallops for resource enhancement.

A private company, AquaPotential Co., hired two students and conducted research and business activities in the MBF. Blood arks were cultivated for the first time in North Carolina. These mollusks hold potential for a new aquaculture crop but also have implications for the biotechnology field because of their blood which, unlike other mollusks, contains hemoglobin- the oxygen-carrying molecule in human blood. Also, horseshoe crabs were held in captivity and maintained on artificial diet for the duration of an experiment to increase blood production for pharmaceutical purposes. The horseshoe crab blood isolate, LAL, is used as a contaminant test in injectable drugs. CCC students conducted the work in the MBF. The work has potential for improving the existing harvest practices and declining populations of horseshoe crabs as well as creating potential new bio-business utilizing mariculture techniques.

The NC Aquarium conducted oyster hatchery operations utilizing the MBF equipment for specific operations. Three new employees were hired by NCA, including two CCC students, to conduct the hatchery. The oyster hatchery produced 8 million oysters which were donated to the NC Division of Marine Fisheries. Those oysters were remotely settled onto oyster shell cultch and subsequently planted as spat-on-shell in state oyster sanctuaries; it was the first time that the state has used hatchery-produced oysters to establish oyster sanctuaries.

The Town of Emerald Isle and US Army Corps of Engineers funded a project for a novel marine biotechnology, which utilized the MBF resources and CCC aquaculture facilities for resource enhancement aquaculture research. That project hired one full-time college employee for two years and two part-time project assistants. It developed new spawning techniques for Donax spp. (coquina clams), which improved propagation methods and could lead to a new industry for resource enhancement following beach nourishment.

CCC-sponsored summer biotechnology camps benefited over 60 middle school and high school students and utilized the MBF to teach the concepts of HPLC and compound separation and purification. Students learned about horseshoe crab bleeding and its importance to the pharmaceutical industry. Richmond Community College students conducted a strip-spawn of oysters at their inland location of Hamlet, NC to learn about biotechnology, mollusc reproduction and larval development.

The MBF provides laboratory-grade deionized water for CCC chemistry department labs and an autoclave sterilizer and filtered and u-v sterilized seawater for the CCC biology department.

The primary difficulty for the project was obtaining follow-through by an original industry partner. While it was intended to be an integral part of the project, the company was unable to obtain start-up funding during the course of the project.

There were no changes made to project goals other than to seek alternative industry partners as a laboratory tenant. Several alternative partners were identified and participated in the project.

The CCC Marine Biotechnology Facility has been recognized as a bona fide participant in the up-and-coming industry for marine biotechnology. The MBF continues to seek industry tenants but it has successfully recruited academic partners for future collaborations.

Total project costs over the three-year project impact approached $400,500 and included the Rural Center-funded grant as well as leveraged funds from a Golden LEAF BioNetwork equipment grant, the NC Aquarium oyster hatchery, Town of Emerald Isle and US Army Corps of Engineers Donax spp. aquaculture enhancement project, AquaPotential Co. blood ark and horseshoe crab project, CCC Biotechnology summer camp and UNC Institute of Marine Sciences bryozoan development projects.

Final Report Narrative

Achievement of Project Goals:

- Were the objectives proposed for this project met? Explain.

Yes, all objectives were eventually met although the time frame was one year past the original intended timeline.

- Detail any changes that were made to the project goals during the course of the project and discuss why those changes were necessary.

The project was required to develop an additional goal, which was to recruit an industry partner that could replace the intended partner, Zuzu Bioceuticals, Inc. The number of jobs created was fewer than originally expected, however jobs were created and prospects for continued expansion appear very positive.

- What obstacles were encountered and how were they addressed? How did they affect the goals and implementation of the project?

The e-Procurement process utilized for purchasing encumbered the orderly progress for the project because the system was newly activated and there were no dedicated project personnel for purchasing. The biotech lab was not previously wired for 220 volt electricity (required by some project equipment) and the installation of appropriate wiring took longer than anticipated. The original intended industry partner did not materialize although an alternate partner was secured. Plumbing water and drain for a sink in the lab was also an unanticipated add-on, which required sourcing appropriate funds and extra time to complete.

- Research and planning goals
  - Describe the results of feasibility studies, marketing plans, business plans, website development, etc., as appropriate. Include a description of the research components (marketing, cost, financial needs assessment, job creation, sustainability, growth, etc.) and what progress was made on each component.

The original MBF project did not include a research component; however it recruited researchers to the facilities. One of those researchers, Dr. Niels Lindquist of UNC-CH Institute of Marine Sciences, proceeded with a project to develop bio-active compound, bryostatin, from marine organisms called bryozoans, and used the MBF to conduct the research. That research is continuing at the MBF to develop new methods for mass-cultivation of bryozoans and to develop partnerships with private growers.

The feasibility of such a partnership keys on the value of the bryostatin and the ability to produce it. The market price for bryostatin-1 currently ranges from $61 - $208 per micro-gram. The proposed scenario is for private growers to produce bryozoans and harvest the larvae during 2 seasons (fall and spring). Larvae are processed to extract sufficient bryostatin to sell for a total return of $450,000. The figures are from a presentation Dr. Lindquist gave to the NC Aquaculture Development Conference, February 10, 2007.

  - What activity will result from these components in the future?

We expect that once the partnerships are developed potential culturists of bryozoans will begin collecting and developing cultures for future production and sales.

- Discuss the methodology employed (data collection, analysis and evaluation)

Data for bryostatin production was presented to the NC Aquaculture Development Conference, February 10, 2007.

- Progress in the planning/implementation of construction or renovation phases
  - Assess the implementation of construction and/or renovation projects. Include photographic documentation if relevant/applicable.

N/A

  - Describe difficulties encountered in the construction process and lessons learned throughout. What steps could have been taken to ensure a more timely or efficient construction and renovation process?

N/A

- Discuss success and/or difficulties in identification and recruitment of invested parties (e.g. workers, volunteers, investors, collaborators, etc.). How could groups and individuals with an interest in this project have been more effectively included?

Effective collaborations only work with the support and enthusiasm of the participants. It is difficult to assess the true interest of a potential partner without some previous knowledge, experience or track record. Recruiting and screening proposed partners for these qualities before initiating a project could be a way to increase the successful partnership. That process however would require advance notice of the FRP in sufficient time to accomplish the partner search.

- Discuss success in providing training and education
  - Include information about the number of individuals that received training

Training was conducted for twenty aquaculture technology students, sixty middle and high school students, four community college student internships (technicians) for cooperative work experience and four community college professors.

  - Indicate if the individuals who received training were students, dislocated workers, etc., if applicable: see above
  - Include information about the goals of the training and about how many hours of training were completed

Training is a mission of the community college and as such it is a primary goal of the aquaculture technology department. The MBF provides a new category of training for the students, which previously had been limited to traditional aquaculture skills. Biotechnology is a branch of marine aquaculture technology which requires these new specialized skills. The training afforded to students in the MBF has successfully recruited a new type of student to the program.

As a consequence of this enhanced value, East Carolina University and CCC developed a memorandum of agreement, which allows CCC students earning the AAS degree in Aquaculture Technology to transfer up to 63 semester hours (half of the required credits for bachelor's degree) toward a Bachelor of Science degree from ECU Department of Technology Systems.

  - Include information about the institution or individual(s) responsible for the training

Carteret Community College Aquaculture Technology program is a college-level curriculum program, which trains students in practical hands-on lab practicum courses. Shimadzu Corporation and New Brunswick Scientific Corp. are scientific equipment manufacturers, which market high-end scientific laboratory equipment to industrial and

academic research clients. Other training is conducted by collaborative partners as a routine part of orientation for employees or student internships.

- Assess success in the planning, design, and production of products and samples, marketing materials, etc. How will these materials be utilized in the future? N/A
- Describe success in the planning and holding of special events related to the project

The goals of the training are to develop skills in using equipment that a CCC graduate would find in a biotechnology or marine biology laboratory. Students exposed to new fields and trained on many and various pieces of equipment have greater marketability for a broader number of job types.

The Small Business Center and the MART project used the facilities for training. Those training sessions were so popular and successful that duplicate sessions were required to accommodate all the interested parties.

The Aquaculture Department advisory board discussed incorporating the equipment into a new summer course for four-year university students during their summer semester between sophomore and junior years. We are working to develop articulations which would allow university students to receive credit for courses at CCC and for CCC students to matriculate seamlessly to the university programs.

Innovation and Demonstration-Specific Components:

- How did the components of this project combine to make it especially unique or innovative for the area?

Carteret Community College is the only institution in the area teaching students how to use the HPLC and the Bio-Flo fermenter. The collecting platform enables collection trips to areas that were formerly unreachable and increases student interest and retention. The platform has been used to make collections and has been optimizing the gear performance.

- Describe any new ideas, initiatives, or complementary projects that have occurred as a result of the progress of this project

One new direction is the production of biodiesel from algal lipids, which is a student-led project. Also, a new project came about to improve existing methods for culture of blood ark, *Anadara ovalis*. The project has written a lab protocol for the HPLC methods which will be used in future Aquaculture courses and by future lab partners. Other protocols have been written including horseshoe crab bleeding, spectrophotometer, laminar flow-hood and autoclave operations.

- For Economic Stimulus Demonstrations:
  - Describe how this project utilized comprehensive, creative strategies to ensure job and business creation and private sector investment

The best strategies utilized by this project to create jobs involved combining the goals of collaborative partners to achieve more than either participant would have achieved alone. The cooperation of efforts toward common goals allows both entities to a greater level of achievements and a greater public exposure of their accomplishments than would have been possible otherwise.

  - Explain how this project employed a variety of integrated strategies to create new jobs and businesses

Two biotech business jobs were created during summer of 2006 by combining assets and funds from the Rural Center project and a private company's project. The result was an opportunity for expanding the understanding of the role that aquaculture can play in new bio-businesses but it also resulted in an opportunity for two students to accomplish

the required cooperative work experience course for college credit. Three jobs were created for the NC Aquarium oyster hatchery initiative which used biotechnology techniques to propagate oysters for resource enhancement purposes.

That partnership was made possible through funding from the Transitional Production Program of the legislative oyster hatchery study committee. Those jobs used Rural Center funded equipment and facilities.

- How did this project capitalize on, initiate, or expand local and/or regional assets, resources, and/or partnerships?

This project has enabled Carteret Community College to be recognized by area marine science universities as a bona-fide contributor and player in the new field of marine biotechnology. It has proved the worth of the community college in promoting and fostering the development of and support for new businesses.

CCC has become a major participant in workshops, seminars and conferences promoting biotechnology and collaborations in the marine sciences. Presentations on the project have been given to university and industry groups resulting in an expansion of existing partnerships and the initiation of new collaborations.

- For Shared-Use Agriculture Facilities Demonstrations: N/A
- For Community Innovations Demonstrations:
  - How did this project spark short-term economic recovery in your community, and how will it support long-term sustainable economic development? N/A
  - How successful was this project in establishing links to other local economic development or community-building initiatives?

This project contributed directly to recognition by the Carteret County Economic Development Council that applied marine science-based businesses are desirable for the coastal economy. The EDC has been working primarily with the Marine Trade sector (boat building and marinas) but has been exposed to the potential for marine sciences and now includes it as a potentially new industry for economic development at the coast.

Collaboration and Fundraising:

- What successes occurred in initiating or expanding partnerships and collaborative efforts with other organizations and individuals? See below
  - Who was involved and what roles did they play? See below
  - What anticipated collaborations did or did not materialize? Will they be sustained or expanded in the future? Explain.

Three ongoing projects at the CCC Aquaculture Department collaborated with the Rural Center project to enhance their respective projects: Donax aquaculture enhancement project and the oyster shell recycling project. The availability of dedicated laboratory space and equipment improved the overall results and successes encountered by those projects.

Two collaborations materialized that were not anticipated: the NC oyster hatchery program- Transitional Production Program and the AquaPotential Co. biotechnology project. Laboratory space and specialized equipment improved the successes of these projects.

Collaborations with UNC-Wilmington- Center for Marine Sciences, Duke University Marine Laboratory and UNC-CH Institute of Marine Sciences developed during the course of the project as a direct result of project capabilities and student-to-student partnerships. Those collaborators provided additional equipment, labor and consumable supplies.

These types of collaborations are the life-blood of the aquaculture technology operation plan and will continue as long as there are willing students and professors in marine science institutions.

The anticipated collaboration with Zuzu Bioceuticals Inc. did not materialize. However, the invitation to Zuzu is active and may yet come about pending sufficient investment capitalization.

- What success occurred in leveraging funds and locating potential funders to complete the project and to sustain it over time? Will additional funding sources be needed to sustain the project in the future, and have they been secured?

The Rural Center funds were leveraged by other projects which complemented the EIG project: Leveraged funding was contributed by a Golden LEAF BioNetwork funded equipment grant ($50,000) to augment the Rural Center funding for biotechnology equipment. Portions of partners' projects that were conducted during the course of the project were NC Aquarium oyster hatchery ($100,000), Town of Emerald Isle Donax spp. aquaculture enhancement project ($126,000), AquaPotential Co. blood ark and horseshoe crab project ($3000), Biotechnology summer camp (est. $1000), UNC Institute of Marine Sciences (est. $1000).

Additional funding sources will be needed to continue the project. The only currently secured funds are from the Aquaculture Technology department, contributed as needed to perpetuate the project. Other funds will be forthcoming from future partners as the partnerships develop; such is the history of the CCC Aquaculture Department in seeking and sustaining collaborations.

Assessment of Project Outcomes:

- Economic and social indicators: N/A
- How many jobs and/or businesses were created (include details such as type of job/venture, hours, level of commitment, etc.)? How many jobs or businesses will be created in the future as a result of this project?

Created jobs during the project: 7 jobs

AquaPotential: 3 jobs part-time, 1020 hours, student cooperative work experience
NC Aquarium: 3 jobs (1 full-time T-1, 2000 hours; 2 part-time T-1, 1200 hours) student coop
UNC Inst Mar Sci: 1 job (part-time student project labor, 100 hours)

Expected jobs in the future: 5+ jobs

UNC Inst Mar Sci: 1 job (part-time student project labor, coop work experience- 320 hours)
AquaPotential: 2 jobs (part-time, project related 1020 hours)
Solicited industry partner for biotechnology lab: 1-2 full time employees @ 2000 hours / year

- What changes occurred in land/facility usage, hours worked, productivity, business and entrepreneur recruitment and investment, investment in research and development, poverty rates, technology adoption, tax base, etc.?

The project required extensive additional hours by the aquaculture technology instructor, which would otherwise have been put toward teaching and using traditional techniques. With the new equipment and facilities provided by the project, the possibilities for students' learning have expanded over what was traditionally taught. As marine biotechnology develops and the traditional fishing industry dwindles there exists the possibility for the elasticity of applied marine sciences occupations.

The declining number of jobs in the commercial fishing industry may one day be supplanted by bio-businesses which would maintain a water-based economy for that

community. Such a transformation of jobs could potentially increase revenues and environmentally friendly industries.

- What sorts of existing services and/or facilities have been expanded or revised as a result of the project?

The Aquaculture Technology department has implemented the instruction and use of the project equipment as a part of its regular courses for college students. The capabilities of the aquaculture department have been immeasurably improved to introduce new technologies to future students.

- What changes in rates of tourism have you seen as a result of your project? How will this be tracked in the future? N/A
- What impact has your project had on the education and civic participation rates of the members of your community?

The CCC Aquaculture Technology instructor routinely gives lectures and luncheon talks to civic and high school clubs such as Rotary International, Kiwanis and Lunch-and-Learn. This exposure has helped to increase the public awareness of the aquaculture program and the potential for new bio-businesses. The project actively involves oyster gardeners in activities, which are then carried to new citizens as a grass-roots effort.

- What other unique and important impacts has your project had on the community and surrounding region? How is your project improving the lives of the citizens of your community?

This project has piqued the interest and aspirations of community leaders and news media for expanding environmentally-friendly industries for the future of this area's sensitive coastal environment. The project has been intimately involved in the education and training of a new group of citizens who have obtained permitting for oyster gardening as a way to improve environment and restore over-fished oyster populations. These citizens are learning about the coastal and marine environment in a family-oriented way. Future projects can improve on this base of knowledge for sensible coastal growth as North Carolina's coastal population continues to increase.

- What is the future of this project? How will it be sustained and maintained in the future?

This project will continue to support the CCC Aquaculture Technology program and other college departments. Local academic partners have already contacted CCC to pursue partnerships to continue applied marine sciences research in collaborative arrangements. Future sustenance will come from partnership arrangements with academic institutions, which can fund the consumables required to operate equipment.

Staffing will be provided by students and professors conducting the research. Industry partners will also be solicited, which can fund their own operations in the CCC marine biotechnology facility. Another community college has expressed an interest in collaborating with CCC to include biotechnology as a new aquaculture program emphasis.

- How does this project complement economic development initiatives in your area?

CCC is participating in ongoing interactions with Marine Science and Education Partnership (MSEP) and the newly formed UNC Marine Sciences Task Force to foster and develop collaborations in the applied marine sciences. The Carteret County Economic Development Council is spearheading the MSEP, in which CCC participates. Several grant applications have been applied for by CCC and two have been funded to further expand the concept of bio-businesses in the area of marine sciences.

Complete detailed financial description (include chart):

Total project costs for the Marine Biotechnology Facility included the Rural Center-funded EIG ($120,000) and a Golden LEAF BioNetwork funded equipment grant ($50,000) to augment the Rural Center funding. Portions of our partners' projects that were conducted during the course of the project provided additional funds. Those partners and total project funds include the NC Aquarium oyster hatchery ($100,000), Town of Emerald Isle Donax spp. aquaculture enhancement project ($126,000), AquaPotential Co. blood ark and horseshoe crab project ($3500), UNC Institute of Marine Sciences (est. $1000).

Category of Expenditure	Rural Center EIG MarBiotech	Bio-Network Equipment grant	NC Aquarium-Oyster hatchery	Aqua-Potential	UNC IMS	Donax project
Labor	$ 6,000	$ 0	$ 40,000	$ 3,000	$ 1,000	$ 70,000
Materials and Supplies	$ 16,000		$ 15,000	$ 500		$ 26,000
Equipment	$ 98,000	$ 50,000	$	$ 0		$ 30,000
Total	$ 120,000	$ 50,000	$ 100,000	$ 3,500	$ 1,000	$ 126,000

Appendix: Photographs of CCC Marine Biotechnology Facility

Meg Rawls instructing CCC Biotech Camp students in chromatography lesson

CCC Aquaculture student and Rural Center project employee Kris Lewis testing HPLC

Jackie Williams instructing students on the bleeding of horseshoe crabs
Biology lesson

Bleeding demonstration

Blue blood from horseshoe crab

Onslow County high school students learn about phytoplankton in the CCC marine biotech lab.

Dr. Ami Wilbur (l), UNCW and Dana Schmidt (r), AquaPotential, prepare spawns and larvae cultures for propagation of native bay scallops for resource enhancement.

Janet Hanson (l), AquaPotential employee, and Dr. Niels Lindquist (r), UNC-CH Institute of Marine Sciences with bryozoan lifecycle manipulation experiment using multi-level recirculating aquaculture system for CCC marine biotechnology lab.

Dana Schmidt, AquaPotential, teaches students in the CCC biotechnology camp about the HPLC – high performance liquid chromatography and marine biotechnology applications.

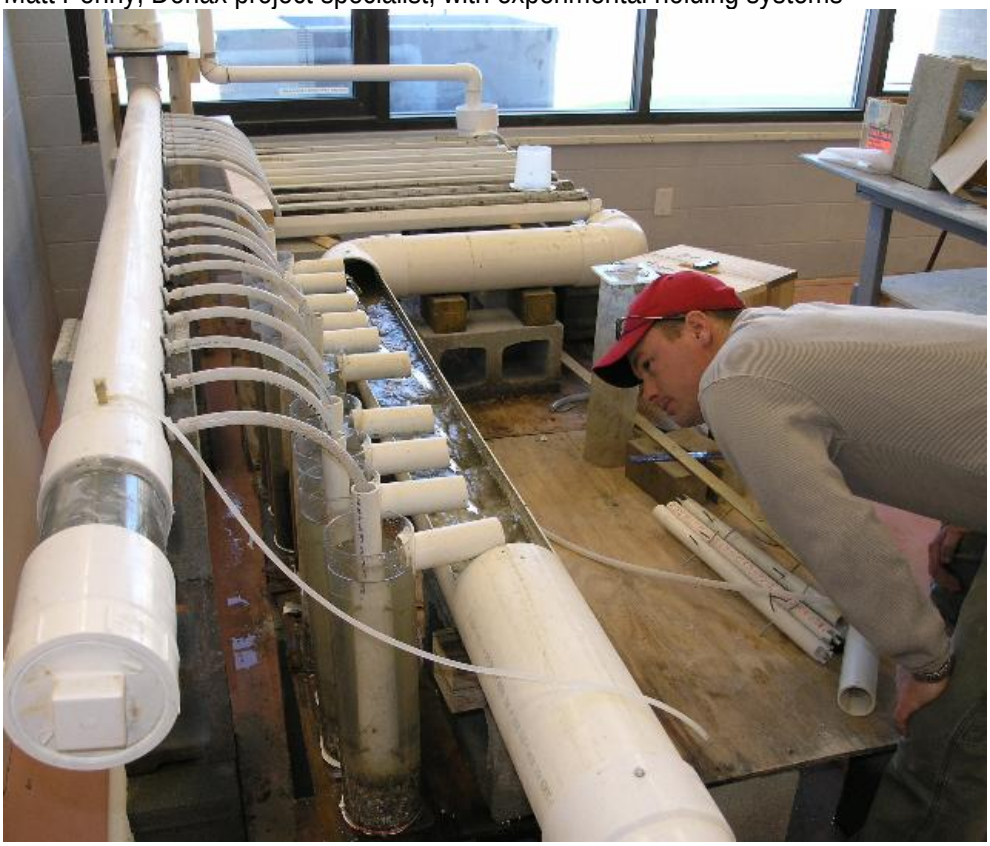
Janet Hanson, CCC Aquaculture student, teaches CCC biotechnology camp students about the sterile techniques required for bleeding horseshoe crabs for pharmaceutical products.

CCC / AquaPotential Co. and student interns on bio-prospecting and collections trip

NC Aquarium oyster hatchery and CCC student interns, Nelson Bullock and Jeff Militano, strip spawning oysters

NC Aquarium oyster hatchery student intern, Nelson Bullock, preparing microalgae

Matt Penny, Donax project specialist, with experimental holding systems



Matt Penny and student intern Nelson Bullock conducting Donax spawning test

Developing a digital image gonad index for aquaculture propagation of Donax spp.

CCC receives $120,000 grant for marine biotechnology project

MOREHEAD CITY – Carteret Community College has been awarded a $120,000 grant from the North Carolina Rural Economic Development Center for a marine biotechnology economic stimulus demonstration project.

The Marine Biotechnology Economic Stimulus Demonstration will not only stimulate job creation through expanded partnerships with the community, industry and academia involved in marine biotech endeavors, but it will, through the state-of-the-art facilities at CCC, increase the number of people receiving biotechnology training and attract biotechnology firms to the area.

The grant will provide additional funding for equipping a multipurpose aquaculture laboratory facility at CCC that will serve as an incubator for marine biotechnology entrepreneurs as well as educate students who may end up working in the field.

"We are in a perfect position to help develop the marine biotechnology potential that exists right here in Carteret County," said Dr. Joe Barwick, president of Carteret Community College.

"Whether it's helping entrepreneurs who need lab space to work with marine organisms that may yield future useful compounds or giving our students the skill set for working in these future jobs, it's a new avenue for our aquaculture technology program beyond its traditional activities."

With the money, CCC will enhance its recently renovated aquaculture facility by dedicating certain lab space and purchasing specialized equipment that can be used for marine biotechnology purposes.

The equipment can be used for instruction and by industry partners who are developing marine biotechnology products.

Although several BioNetwork Biotechnology Centers exist throughout the state, the new partnership lab at Carteret Community College would be the first to focus on ocean and marine organisms.

"One company in eastern North Carolina, ZuZu Bioceuticals, plans to complete development on a process for which it already holds patents," said Skip Kemp, coordinator of the aquaculture technology program at the college.

"A successful demonstration of a marine biotechnology endeavor would offer hope to many coastal communities struggling with the decline in traditional fishing harvests, while giving the students working in and around the lab exposure to the future opportunities that will come from the sea."

The grant developed from discussions with collaborative agencies and institutions, such as: University of North Carolina's Institute of Marine Science, NOAA, National Ocean Service, N.C. Aquarium, N.C. Shellfish Gardeners Association, N.C. Coastal Federation, The Nature Conservancy, N.C. State University School of Veterinary Medicine, Duke Marine Laboratory, N.C. Division of Marine Fisheries, and the N.C. Sea Grant Program.

"It's a way of looking into the future," Mr. Kemp said. "There is already a lot of different marine research going on in the county, but here we are talking about the practical applications resulting from marine biotechnology."

The lab will operate from 7 a.m. to 10 p.m. seven days a week with part of the time dedicated for use by CCC students.

AquaPotential's Applied Marine Biotechnology Program

Summer 2006

A new era of applied marine science was introduced to CCC through the Aquaculture facility this summer. By combining the culture and husbandry of species with advanced technical applications we can conserve our marine resources. Carteret County is the ideal area for marine-based technology; research and production. The extensive equipment in the biotechnology room was learned and observed (at various levels of detail) by almost 60 people this summer. The genuine interest expressed by all ages who visited revealed the necessity for further program development of Applied Marine Biotechnology. To have this equipment and our marine resources available to teach a workforce or develop new scientists is truly impressive.

Marine resources are becoming a trend for medical, nutritional, and energy research and products. The HPLC (High Pressure Liquid Chromatography) has become a standard tool for advanced technical analysis in many fields. By understanding the principles of the machine and the theory of the analysis, three CCC students learned how to utilize this sensitive machine this summer. Extensive preparation, of raw materials and the machine, must be strictly adhered to for protection of the machine. The following list must be performed for each analysis:

1. extraction filled septum (raw material to .45 micron in solution)
2. mobile phase selection (hydrophobic/hydrophilic eluent characteristics)
3. mobile phase preparation (purging, eluent changes, and health of machine)
4. method development (computer controlled timing and sequence of analysis parameters: gradient or isocratic, UV lamp setting, heat control, flow control, sample placement, sampling size, shutdown procedure)
5. computer file management (method, sequence, data)
6. analysis review (comparison to standards and reports)

Dr. Hans Paerl's Lab at the Institute of Marine Science monitors the health of the Neuse River by monitoring its phytoplankton (pigments) regularly using an HPLC. We were able to visit (Karen Rossignol) to learn their procedures. We then practiced our technique using cultured algae from our shellfish hatchery. With further work (and expensive standards) we can now analyze cultured algae for nutritional purposes and energy related research (lipids).

Dr. Niels Lindquist (IMS) is researching the bryostatin compound from marine bryzoans. He also uses the HPLC for his analysis. Bryostatin is currently being used in Alzheimer's and cancer treatments. We are still working with Dr. Lindquist to keep the invertebrate in a year round spawning state to collect bryostatin using the HPLC. Carolina Biological Supply has expressed interest to Dr. Lindquist in purchasing live spawning cultures on a continuous basis as an educational tool for their customers.

Adult horseshoe crabs have been used in the medical industry for decades. Their copper-based blood is reduced to amoebocytes (LAL) which form a clot in the presence of bacterial contamination. The current method catches the crab, bleeds the maximum amount and releases the crab. Our proposed research was to hold the crabs in culture and bleed a lesser amount more often to see if the LAL increased. Another aspect was to use the hemolymph from the blood, which is usually discarded, for the bait industry

(eel and whelk). Virginia is currently researching other means for horseshoe crab bait without harming the crabs (cage traps).

Meg Rawls (CCC Biology instructor) sponsors a biotechnology camp for eighth grade students. Every morning for a week students come to learn many aspects of biological science. The CCC marine biotech lab personnel assisted Mrs. Rawls and her 29 eager scientists. They learned about DNA (real DNA extraction from banana, based pair configuration and structure of DNA, DNA separation – electrophoresis, and basic DNA forensic analysis), antibiotic development principles, microbiology diffusion, growth hormones on plants, and more.

The last day of their camp all 29 students came for a detailed tour of the CCC Marine Biotechnology facility. Three small groups were rotated to see the HPLC extractions and analysis process, bleeding and extraction of LAL from a horseshoe crab, and the oyster hatchery and sterile techniques of algal cultures. Fun was had by all! Those bright individuals will be back to learn more, and discover something great one day.

The CCC marine biotechnology lab was involved with additional projects this summer including the deployment and retrieval of blood ark spat collectors, Hobo temperature recorders, Global Positioning System seminar and hands-on learning opportunities, marine specimen bio-prospecting and collections including pen shells, bay scallops, sea urchins, red and brown brittle sea starfish and feather blennies.

Dana Schmidt, proprietor
AquaPotential

Memorandum of Agreement
Between
Department of Technology Systems, East Carolina University
And
Carteret Community College

The Department of Technology Systems at East Carolina University agrees to accept technical and general education credit from the institution above to satisfy the requirements for the degree identified. This agreement will be revised if either entity makes substantive changes to the program content.

Community College Degree: AAS – Aquaculture Technology
East Carolina University Degree: BS – Industrial Technology concentration in Bioprocess Manufacturing

Program requirements

- Completed an AAS in Aquaculture Technology
- Transfer up to 63 semester hours of the 126 required from any accredited community college or technical institute.
- Only courses with a 'C' or better will transfer.
- At least 63 semester hours of the 126 required semester hours must be completed at a four year institution.
- At least 42 semester hours of major, technical coursework must be completed at East Carolina University.

Courses to transfer (63 hours)

Based on the technical content of the Aquaculture Technology degree, the Department of Technology Systems will award a block transfer of 37 hours for lower level technical courses after the student is accepted by East Carolina University. This block transfer is based on the course content and the instructor credentials at Carteret Community College.

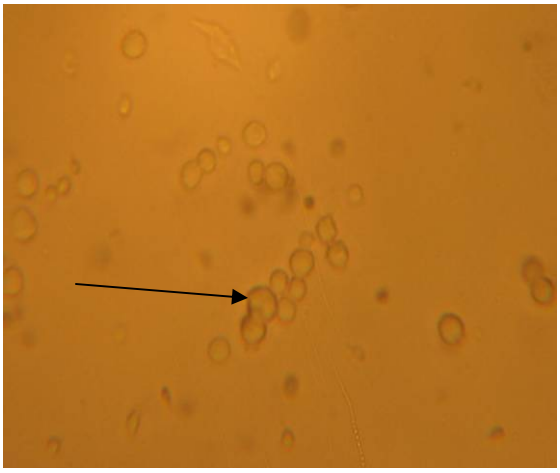
Graduates from the Aquaculture Technology program, can receive up to 26 hours of general education applied towards their degree. The credits are based on the North Carolina Community College System and the University of North Carolina System agreement. For admission into East Carolina University, Aquaculture Technology graduates must have at least 24 hours of general education at a minimum of 2.5 GPA. Based on current course program requirements, students will receive the 26 hours of general education and 37 hours of technical content and students. If changes in the program content or courses occur, this agreement is not valid. Review of the agreement and program should be conducted annually.

Dr. Ralph Rogers College of Technology and Computer Science Dean	Dr. Joseph T. Barwick Carteret Community College, President
Dr. Andrew Jackson Technology Systems Chair	Dr. Fran Emory Vice President Instruction & Student Services

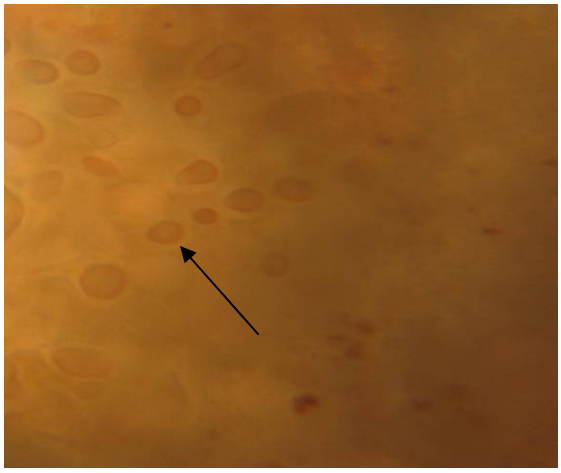
Illustrated *Donax spp*. Gonad Index

I The gonad is not visible through dissection. Gametes are not present. The gonad is immature and unable to spawn.

A The gonad is very small and barely visible using the naked eye. Coloration of the different sexes can be seen with a keen eye. Gametes are present and clearly identified using 30X magnification. Eggs are small and have a pedunculate or pear shape. Nearly 100% of sperm are in the early spermatid stage. No tail is visible. The gonad is immature and unable to spawn.

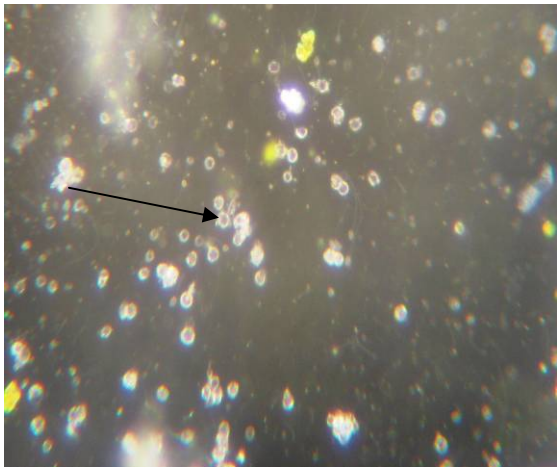


Early spermatid

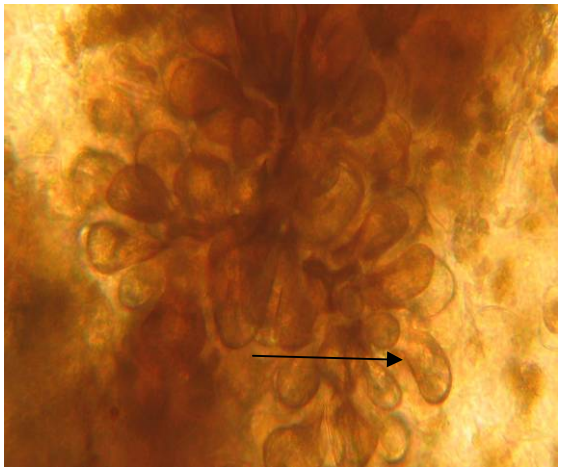


Immature eggs

B The gonad is small but clearly visible and colors can be differentiated by the naked eye. Gametes are present and clearly identified using 30X magnification. Eggs are small and have a pedunculate or pear shape. Nearly 90% of sperm are in the early spermatid stage. Late spermatids are present in small numbers. The gonad is immature and unable to spawn.

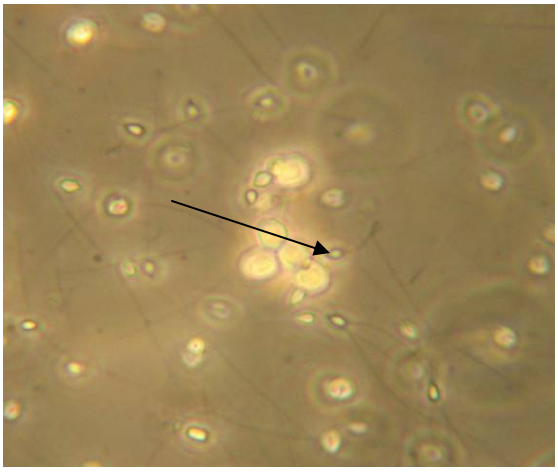


Early to late spermatid

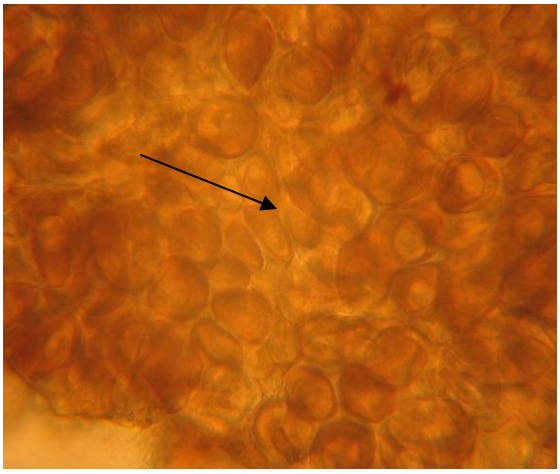


Small pedunculate eggs

C1 The gonad is large, clearly visible, and sexes can be differentiated easily by the naked eye. The coloration of the gonad is well advanced. Gametes are present and clearly identified using 30X magnification. Eggs are range from large to small and from round to peduculate or pear shape. Sperm are free swimming to early spermatid stage. This stage is distinguished from C2 stage by estimating greater then 50% of eggs and sperm are immature but can produce spawns.

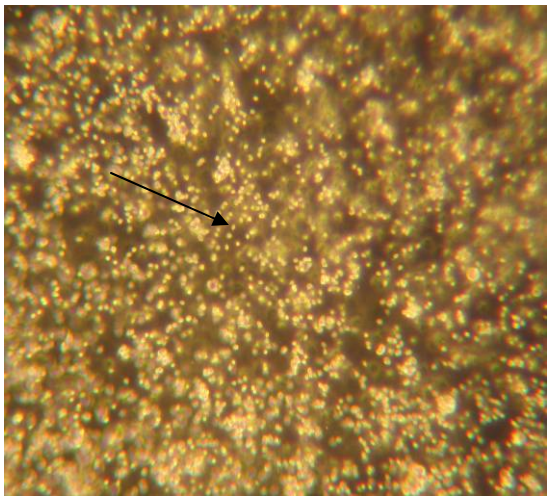


Late spermatid to swimming sperm

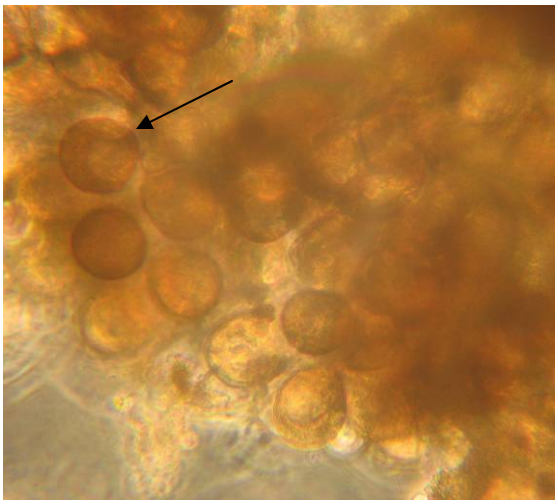


Mixed immature and mature eggs

C2 The gonad is large, clearly visible, and sexes can be differentiated easily by the naked eye. Gametes are present and clearly identified using 30X magnification. Eggs are range from large to small and from round to pear shape. A portion of eggs will be free from canal. Sperm are free swimming to late spermatid stage. This stage is distinguished from C1 stage by estimating greater then 50% of eggs and sperm are mature and can produce spawns.

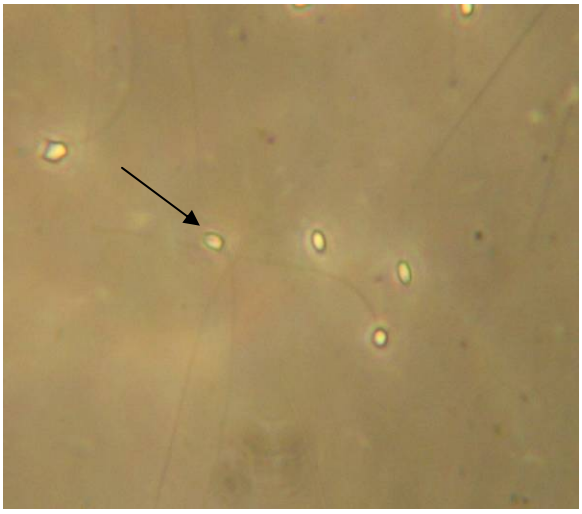


Swimming sperm

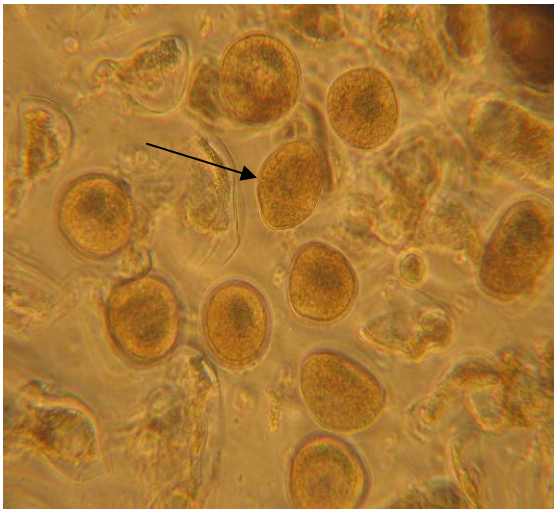


Mature eggs

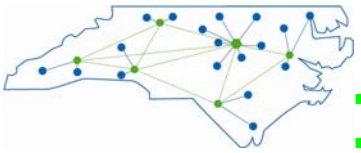
D The gonad is small is size, clearly visible and sexes can be differentiated easily by the naked eye. The coloration of the gonad is becoming fainter. Gametes are present and clearly identified using 30X magnification. Eggs are round and large in size and are free from canal. Sperm are free swimming. This stage indicates recent spawning activity.



Mature but small amount of sperm



Mature but small number of eggs



BioNetwork

BioNetwork Funding (Circle One)

Center Innovation Equipment/ Facility Enhancement Distance Learning

FINAL REPORT

Report should be received by the BioNetwork office Within 45 days of completion of the project

Date Report Completed: _December 8, 2005

Name of Grantee: ___Carteret Community College_____

Address: ___3505 Arendell St., Morehead City, NC 28557 _____

Telephone: _252-222-6114___ Contact Person: ___Philip S. Kemp Jr._

Project Title: _____ Marine Biotechnology Collaborative Project: Equipping the lab _

Date Grant Received: _07/01/05__ Date of Project Completion: _10/31/05_

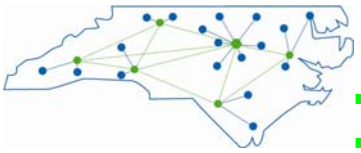
Please be concise and specific with your answers, but feel free to attach additional supporting information about the outcomes of your project as well as any press clippings or other relevant materials or reports.

1. What were the original goals and expectations for the project supported by this grant?

To support and enhance the capabilities of the marine biotechnology lab in our Aquaculture Program, which was funded by NC Rural Center Economic Innovations Program.

2. Provide a brief description of the activities and accomplishments associated with the project funded by this grant.

- Trained 8 college employees, 12 aquaculture students and 20 high school-level biotechnology camp students on the use of HPLC operation
- Developed lab protocol for aquaculture and chemistry students to learn the use of biotechnology equipment.
- Supported the CCC Aquaculture Dept Oyster Hatchery, which produced 8 million eyed-larvae oysters and distributed to 3 environmental habitat enhancement projects and 25 citizens' oyster gardening efforts.
- Collaborated with NOAA, Charleston, SC Lab on Southeast Phytoplankton monitoring project training; 18 participants.
- Facilitated one CCC aquaculture student's independent studies lab practicum for spectrophotometric estimation of populations of high-density algae cultures.
- Enhanced ConEd continuing education course on Aquaculture; 32 students.



BioNetwork

3. Provide information about the specific population that was served by the project and how many people were served.

See above.

4. Describe how those served by the project were impacted or are being impacted. Include specific information to support conclusions and judgments about the project's impact.

- Independent study student is now employed by an area veterinarian and uses skills developed from project to improve quality of work.
- Faculties trained on equipment are better enabled to teach appropriate course material.
- High School students learned new possibilities for future study in college.
- Oyster Habitat restored with oyster larvae produced in collaboration with this project.
- Project highly publicized by News&Observer, local papers and national newsletters.
- Collaborative partners for lab occupancy are continuing start-up phase and seeking capital acquisitions.
- Federal lab, Charleston, SC, developed and trained local partners for volunteer phytoplankton monitoring project, which also involved aquaculture and biology students.

5. Please also complete the following table as it applies to summarizing the impact of your project (e.g. Agriculture: increase in gross or net farm income, sales projections etc; Economic Development & Workforce Preparedness: jobs created or maintained, annual payroll contributed by the economic activity, total new investment attributed by the project, etc.).

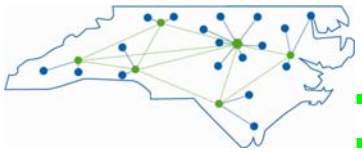
(Provide data for each category that applies.)

New jobs created 1	Jobs retained 4	Worker skills upgraded 8
New investment	Tax base increase ($)	New People Reached by Marketing
Farmers Assisted/Educated 15	Farmers in New Production 3	New Acres in Production 1
Increase in Farm Income	Amount of New Sales	Payroll Increase
Sites Certified	Total Number Served 119	Other (Explain in summary)

6. Provide a brief statement about any revisions to the project. Include information addressing lessons learned. (These were changes approved by BioNetwork/Golden LEAF through the process.)

No revisions to project.

7. Provide information about any significant Board and/or Staff changes in your organization.



BioNetwork

One new temporary employee added to set up and operate the mariculture biotech lab and develop protocols for student labs; funded by NC Rural Center.

8. On the form provided below (or on a separate page), complete the Final Project Financial Report detailing how the funds granted were utilized.

Total Project Income to Date	Projected Project Budget	Golden LEAF Grant Award	Project Expenditures
$	$	$50,000	$49,996.19
Approved Expense Items		Total Project Budget / Golden LEAF Budget	Golden LEAF Expenditures / Other Funding Expenditures / Total Expenditures
Equipment		$44,400	$ 44,398.03
Supplies		$5,600	$ 5,598.16
TOTALS		$50,000	$ 49,996.19

Budget Modifications must be approved by BioNetwork prior to the expenditure of funds.

List other funding sources for this project:
Source NC Rural Center Amount $120,000

Completed By: Philip. S. Kemp Jr.,
Aquaculture Curriculum Area Coordinator Date: December 8, 2005
(Name and Title)

Report should be received by the BioNetwork office Within 45 days of completion of the project

REPORT CAN BE SUBMITTED ELECTRONICALLY TO allsburyk@ncbionetwork.org

BioNetwork Equipment Project Evaluation

Final Questionnaire 2005

Instructions: *To input text, click within the gray rectangles on the instrument and type your information. Text can also be copied from other documents and pasted within the gray areas.*

Community College: Carteret **Date**: 10/28/2005

Project Director: Philip S. (Skip) Kemp, Jr. **Project Title**:

Marine Biotechnology Collaborative Project: Equipping the Lab

A. Biotechnology Capacity Building

Infrastructure Development

1) ***Equipment*** -- Identify the major equipment, tool(s), or unit purchased by this grant in 2004-05.

Water quality controller
RO and DI water processor
Bench model pelletizer/flaker
LCD projector wireless video pkg.
Multi-level aquaria recirculation system
Laboratory digital balance scales
refrigeration unit and drying oven and incubator
High density rotifer and artemia culture system
Laboratory compound microscopes and dissecting scopes
conical Kalwall cell culture reactors

2) ***Space*** -- List the acquisition or allocation of new or up-fitted space associated with this project in 2004-05.
[If project space allocations are a result of earlier special projects, bonds, or grants, mention that here as well.]

Carteret Community College used $750,000 in Renovation and Repair funds (bond and annual allocation) to renovate the small Robert B. Howard Classroom Building into a state-of-the-art aquaculture/marine biotechnology laboratory. The Howard Building renovations includes 500 square feet that is earmarkled for pilot testing innovative marine biotechnology projects.

3) ***Personnel*** -- How many full-time staff were assigned/hired for the operation/use of this equipment?
How many part-time (in full-time equivalence) were assigned/hired?

One full-time faculty member is assigned to this project. One part-time operator is hired to work in the facility where this equipment resides.

4) ***Funds***
   a. What additional grants or fund-raising efforts were undertaken in 2004-05?

This GLF BioNetwork equipment grant was proposed and issued to support our Marine Biotechnology iniative funded by the NC Rural Center Economic Innovation grant. Carteret Community College has prepared a National Science Foundation Partnerships for Innovation Grant. If funded, this grant would greatly assist with technology transfer of marine biotechnology research into marketable products that can underpin a more stable, higher wage economy for the region. Additionally, Carteret Community College has submitted a preliminary NSF Advanced Technological Education grant to expand activities that will prepare the biotechnical workforce and K-12 teachers.

b. Describe any successes in acquiring these funds.

The Rural Center Economic Innovation grant was awarded for $120,000 to outfit and set up the Collaborative Marine Biotechnology Lab at Carteret Community College.

5) ***Priming Other Resources*** -- If this grant has augmented/primed other projects, grants, or initiatives you are doing, describe that enhancement.

see #4 above

6) ***Other Infrastructure*** -- Identify any infrastructure developments completed but not covered in #1-5.

The equipment purchase with this grant also supports the Aquaculture Technology Program, a curriculum program which is collaborative with Brunswick Community College. The program is a college-transfer level curriculum through the 2+2 program with UNC-Wilmington Marine Sciences Department. Aquaculture students are exposed to and learn to use the equipment during their lab exercises.

Faculty/Staff Development in Biotechnology

7) ***Professional Development (A)*** -- List any major "*in-house*" professional development activities completed in 2004-05 associated with the acquisition of this equipment.

CCC sponsored in-service training on the use of the HPLC for 8 college employees, 12 aquaculture students and 20 high school-level biotechnology camp students. August 18th - Wendy Wicke and Julie Cahill from NOAA Charleston, SC provided a phytoplankton refresher training course at the CCC Aquaculture Lab for phytoplankton monitoring program volunteers and aquaculture students.

8) ***Professional Development (B)*** -- List major *external* professional development activities completed in 2004-05 associated with the acquisition of this equipment.

Mr. Kemp attended in-service training on the use of the New Brunswick Bio-Flo 110 fermenter at the Bioprocessing Center of Pitt CC in Greenville.

B. Biotechnology & Bioprocessing Training Associated with Equipment Grant

Instructional Program Utilization

9) ***New or Enhanced Programs*** – (A) List new programs in which the new equipment was used 2004-05.

Independent studies as an alternative form of Aquaculture practicum were introduced during the course of this grant and one student used the equipment to complete his independent study for two separate semesters.

(B) List on-going programs in which the new equipment was used.

CCC Aquaculture Technology, Chemistry and Biology programs used the equipment for their Aquaculture Practicum labs, Chemistry labs, regular Biology labs, and biotechnology camp used the new equipment.

10) ***New or Enhanced Courses*** – (A) List any new courses in which the new equipment was used.

no new courses used the equipment

(B) List on-going courses in which the new equipment was used.

AQU 163 Aquaculture Practicum 3
AQU 163 IS2 Aquaculture Practicum 3 Independent study
AQU 165 Aquaculture Practicum 5
AQU 112 Aquaculture 2
AQU 230 Aquaculture Genetics and Breeding
AQU 240 Fish Nutrition and Diseases

11) ***Student Access*** -- How many trainees/students were enrolled in courses or trainings which used this equipment during 2004-05?

35

12) ***Faculty Access*** -- How many faculty members used this equipment in 2004-05?

6

13) ***Customization*** -- List any ways this equipment was used to customize training for a specific company in 2004-05.

none at this time

14) ***Train-the-Trainer*** -- List any ways this equipment was used for "Train-the-Trainer" programs in 2004-05.

Training seminars by Shimadzu for CCC instructors.

15) ***Other Training*** -- Identify any training initiatives (associated with this new equipment) completed but not covered in #9-14.

Instructional Outcomes

16) ***Skill Emphases*** --Rate how utilization of the new equipment emphasized the following skills.

*[**4** - High emphasis; **3** - Moderate emphasis; **2** - Rare emphasis; **1** - No emphasis]*

4 - Critical thinking
3 - Communication skills
3 - Computer skills
3 - Teamwork
4 - Biotechnology processes
4 - Industrial safety practices
4 - Quality assessment/control
4 - Documentation and validation
4 - Instrumentation and calibration
Click to Select - Other: *[describe]*

C. Project Outreach

17) ***Overall Strategy*** -- Rate your use of these strategies to make targeted groups aware of your new equipment resources.

*[**4** - Extensive use; **3** - Moderate use; **2** - Rare use; **1** - No use]*

2 - Website
4 - Speaking engagements
4 - Local media releases
2 - Direct mail
3 - Industry trade shows
4 - State media releases
2 - Telemarketing
3 - Education fairs/expos
3 - Community forums
2 - Paid media (e.g. ads, billboards)
Click to Select - Other: *[describe]*

18) ***Website*** – (A) Describe website developments (including updates or improvements) during 2004-05?

no developments or improvements to date

(B) List your Project's website address:

http://www.carteret.edu/education/academicprograms/AQUA/aquacultmain.htm
http://main2.carteret.edu/~kemps/
http://www.carteret.edu/
http://www.carteret.edu/aqu/cogp/

D. Industry Practices and Partnerships

Monitoring Equipment Needs and Trends

19) ***Major Sources*** -- Which information source(s) did you primarily use to determine equipment needs and trends?
[Click on chosen shaded boxes.]

☐ Company managers
☐ CC training coordinators
☒ Potential industry partners
☒ University partners
☐ Other: *[describe]*

☐ Your own industry surveys
☐ NC Biotechnology Center surveys
☒ Advisory panel
☐ Industry trainers

Development of Industry Partners

20) ***New Companies*** -- Describe any major plans your project utilized to recruit new companies to your service area.

Recruited new company based on P.I. personal contacts and advisory board contacts. Also recruited new company from current Aquaculture students who are interested in the entrepreneurial and business aspects of aquaculture rather than merely taking a job.

21) ***Current Companies*** -- Describe any major plans used to augment existing partnerships.

none at this time, the project was initiated to recruit and attract new companies because there are no existing companies

22) ***Strategies*** -- Rate your use of these strategies to foster industrial partnerships.

*[**4** - Extensive use; **3** - Moderate use; **2** - Rare use; **1** - No use]*

3 - Work with economic development agencies to recruit
4 - Use of "incubation models"
4 - Meetings with prospective companies
2 - Outreach at industry trade shows
2 - Special training incentives to start-up companies
Click to Select - Other: *[describe]*

23) ***Collaborators*** -- In the list below, rate the involvement of collaborators to achieve your project's goals.

[**4** - *Extensive;* **3** - *Moderate*; **2** - *Rare*; **1** - *No plan to involve*]

3 Existing local companies
2 Local K-12 schools
2 Community development agencies
4 Other departments/programs at your CC
4 University project/program partners

3 Economic development agencies
4 Prospective local companies
3 Faculty/staff at other CC's
4 Your advisory panel
Click to Select Other: *[describe]*

E. Major Project Accomplishment

24) ***Major Outcome*** **--** What was your project's major or most important accomplishment in 2004-05.

We established and outfitted the first collaborative Marine and Mariculture Biotechnology support and training and facility in North Carolina at Carteret Community College. The facility was set up in a dedicated section of the current Aquaculture Technology Program facility. The equipment was installed and calibrated. Facility users, students and instructors were trained and tests were run with samples. An investigation was begun by project partners in the analysis of the properties of mass-cultured algae for value-added aquaculture purposes. Project collaborative partners were supportied in their efforts to obtain organizational and start-up infrastructure. The Aquaculture Program advisory board members was introduced to the equipment and facility and supportive in attracting future users and partners.

Please submit this completed questionnaire by Friday, October 28, 2005
to the BioNetwork Evaluation Team member, Dr. Tom Scheft.

Submit on-line to tscheft@nccu.edu

Or, if electronic submission is impossible, submit by mail to:

Dr. Tom Scheft
North Carolina Central University
School of Education
712 Cecil Street
Durham, NC 27707

Thank You!