

**V(A). Planned Program (Summary)**

**Program # 8**

**1. Name of the Planned Program**

Agricultural Biotechnology and Genomics

Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			33%	
304	Animal Genome			33%	
306	Environmental Stress in Animals			34%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	0.0	0.0	0.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	42367	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	67116	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Discovery research was conducted under this planned program with regards to mechanisms of plant hormone (auxin) transport and signal transduction, how turnover of messenger RNAs is regulated in yeast, and which molecular mechanisms induce a fatal leukemia in soft shell clams. Clam leukemia contributed to the collapse of the soft shell clam fishery the northeastern U.S. and Canada in the 1990s, which resulted in major job losses and other economic hardships.

**2. Brief description of the target audience**

Molecular and marine biologists, university undergraduate and graduate students, clam fisherman and shellfish scientists in the U.S. and Canada. Outcomes of this research are also of interest to the broader public because of the long term productivity for agriculture, restoring the shellfish industry and for understanding cancer.

**3. How was eXtension used?**

eXtension was not used in this program

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	158	20	13	28

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

Year: 2012  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2012	Extension	Research	Total
<b>Actual</b>	0	4	4

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Undergraduate students trained in state of the art molecular biology.

<b>Year</b>	<b>Actual</b>
2012	16

**Output #2**

**Output Measure**

- Graduate students trained in the project

<b>Year</b>	<b>Actual</b>
2012	3

**Output #3**

**Output Measure**

- Book chapters published describing research results

<b>Year</b>	<b>Actual</b>
2012	2

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Development of clam model system for leukemia
2	Implementation of new analytical approach to examine how organisms adapt to environmental changes by using altering gene expression via translational regulation

## **Outcome #1**

### **1. Outcome Measures**

Development of clam model system for leukemia

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

The soft shell clam develops a fatal leukemia at high incidence (up to 20%) in natural populations along the northeastern coastal U.S. and Canada. This disease contributed to the collapse of the soft shell clam fishery in the 1990s. Over the course of this study, a culture system of cancerous hemocytes (clam blood cells) was developed to investigate leukemia in clams and provide comparisons and insights into the development of human leukemia.

#### **What has been done**

- The sequencing and annotation of the genome of soft shell clam, *Mya arenaria*;
- Monitored changes in the intracellular localization of a tumor suppressor protein p53 associated with the onset of cancer.
- Human cell lines for human neuroblastoma and acute myeloid leukemia (AML) and cancerous clam hemocytes were treated with small, interfering RNAs (Rnai) to decrease production of protein mortalin, which acts on p53.

#### **Results**

Walker's lab in the NHAES:

- led work to obtain the full genomic sequence for *Mya arenaria* and disseminated this data to interested individuals,
- determined that cytoplasmic sequestration of wild type p53 is responsible for immortalization of clam hemocytes; this transformation is a hallmark of cancers,
- confirmed that mortalin is over-expressed and responsible for inactivation of p53,
- demonstrated the high conservation of molluscan p53 upstream and downstream gene regulatory sequences with those of human p53 related genes,
- data from this study was used to initiate studies of human cancers with cytoplasmic sequestration of p53 in human neuroblastoma and Burkett's lymphoma.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals

#### Outcome #2

##### 1. Outcome Measures

Implementation of new analytical approach to examine how organisms adapt to environmental changes by using altering gene expression via translational regulation

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

The Central Dogma of Molecular Biology states that information stored in DNA is transcribed into messenger RNA (mRNA), which is translated into protein. The control of mRNA metabolism represents one of the major steps in the regulation of protein synthesis and is important to all organisms as an essential component of adaptation to rapid changes in the environment. New approaches are needed to understand the function of protein complexes that regulate translation. mRNAs have a long polyadenylated (polyA) tail. The protein CCR4 degrades the polyA tail, destabilizing the mRNA and thereby reducing protein production. The length of the polyA contributes to how long each mRNA exists, and hence the amount of protein that can be made from that mRNA.

###### **What has been done**

A very sensitive fluorescent detection system combined with analytical ultracentrifugation (AU-FDS) was developed by UNH researcher Prof. Tom Laue. AU-FDS was used to detect changes in mRNA bound to protein complexes associated with changes in protein translation, and specifically with those RNA-binding proteins associated with CCR4 during mRNA polyA breakdown.

###### **Results**

The AU-FDS system detected a new translational complex, not previously described by other experimental approaches. This complex, including CCR4 and other proteins is associated with deadenylation of mRNA. Since CCR4 is functionally conserved in plants and animals, the new

complex is expected to have a role in the regulation of agriculturally important organisms that regulate translation in response to rapid environment changes. These results were described in four peer-reviewed papers.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

#### **V(H). Planned Program (External Factors)**

##### **External factors which affected outcomes**

- Appropriations changes

##### **Brief Explanation**

NH State Appropriations to the University System and the NHAES were dramatically reduced in the last bienium. As a result less support dollars were available to NHAES research projects

#### **V(I). Planned Program (Evaluation Studies)**

##### **Evaluation Results**

The primary criteria for productivity for projects covered in this planned program are a robust record of publication. For the last fiscal year, three NHAES researchers in the area published four peer reviewed papers in prominent journals and two book chapters.

The work on the Clam Leukemia system has attracted the wide spread attention of environmental scientists and cancer researchers.

The three research projects covered in this planned program have been particularly successful in training undergraduates, with approximately 16 students participating in research over the last federal physical year.

##### **Key Items of Evaluation**

Understanding what triggers the high incidence of clam leukemia in the Northeast is of continued concern for the shellfish industry and is of interest to human cancer researchers. NHAES Walker researcher presents research progress updates annually at the Maine Fisherman's Forum.