**Carlon, Year 8: Annual Progress Report**

A. Grant Number: NA05NOS4261157  
B. Amount of Grant: $77,125

C. Project Title: Sources and sinks of a keystone herbivore on Hawaiian coral reefs

D. Grantee: David B. Carlon

E. Award Period: From: 08/01/2005 to 12/3/2006

F. Period Covered by this Report: From 06/01/006 to 10/31/2006

G. Summary of Progress and Expenditures to Date:

1. Work Accomplishments: (as related to project objectives and schedule for completion)

   a. *Provide a brief summary of progress, including results obtained to date, and their relationship to the general goals of the grant;*

   In addition to sequences of the mitochondrial gene COI described in the previous report, we have now genotyped 703 urchin (*Tripnuestes gratilla*) samples at seven microsatellite loci, collected from four of the Main Hawaiian Island: Kauai, Oahu, Maui, and Hawaii. Sample sizes from each Island are > 100 individuals. Analyses of both COI data and these seven microsatellite loci show no evidence for population structure within or among the Hawaiian Islands. In fact, all inter-island comparisons were not significantly different from and $F_{ST}$ value of 0, indicating the highest possible levels of gene flow at all spatial scales (Table 1).

   Table 1. $F_{ST}$ values from seven microsatellite among four Hawaiian islands. A “ns” below the diagonal indicates that the $F_{ST}$ value was not significantly different from 0.

<table>
<thead>
<tr>
<th></th>
<th>Kauai</th>
<th>Oahu</th>
<th>Maui</th>
<th>Hawaii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai</td>
<td>0</td>
<td>0.0028</td>
<td>0.0008</td>
<td>0.0002</td>
</tr>
<tr>
<td>Oahu</td>
<td>ns</td>
<td>0</td>
<td>0.0004</td>
<td>0.0008</td>
</tr>
<tr>
<td>Maui</td>
<td>ns</td>
<td>ns</td>
<td>0</td>
<td>-0.0003</td>
</tr>
<tr>
<td>Hawaii</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
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</tbody>
</table>

   These results are consistent with larval rearing studies in *Tripnuestes gratilla* that show a range of 18-40 days are required to complete planktonic development and attain the ability to settle (e.g. “larval competence”). Genetic data indicate larvae are freely dispersing the distance from Hawaii to Kauai, even a moderate current of 5 cms$^{-1}$ could advent larvae this distance in 30 days assuming net flow in one direction. A major goal of this research was to provide information on larval dispersal of keystone reef organisms that would be useful for MPA design. In light of our results, an important point to consider is that larvae are traveling 100s and perhaps 1000s of kilometers from their origin. A reasonable approach to protecting reef resources is an MPA network of no-take reserves on all the Main Islands. Each one of these reserves should be as large as possible to maximize their ability to act as settlement sites for important fisheries and reef species.
b. Provide a brief summary of work to be performed during the next year of support, if changed from the original proposal; and indication of any current problems or favorable or unusual developments; and any other significant information pertinent to the type of project support by COP, or as specified by the terms and conditions of the grant.

We are almost at the end of the Year 8 funding cycle, and remaining work on this proposal includes finishing a publication on the development of the markers (described in 2.c.1 below) and a second paper dealing the conservation implications of our genetic findings. We do not anticipate any changes in the general results.
2. Applications:

a. Publications, presentations, workshops;

1. Presentation: “Sources and sinks of keystone herbivores on Hawaiian coral reefs” HCRI Quarterly Meeting, Aug. 23, 2006


b. Applications to management or research;

1. The finding of high rates of dispersal among all Main Islands can be applied to MPA network design. Specifically, the network should include large no-take reserves on all the Main Islands, with as broad a geographic coverage within islands as politically possible.

c. Data and/or information products;

1. We have established a genetic baseline of population structure of *Tripneustes gratilla* around the four main Hawaiian Islands.

2. This research has resulted in 11 new microsatellite loci that will be added to the NCBI Genbank database, on acceptance of a paper describing the development and application of these genetic markers. We (myself and the GA on this Grant: Catherine Lippe) plan on submitting this paper “Eleven new microsatellite markers for the tropical sea urchin *Tripneustes gratilla* and cross-amplification in *Tripneustes ventricosa*” to the journal Molecular Ecology Notes by the end of this year. In addition to Genbank, the journal Molecular Ecology Notes also maintains a database of microsatellite primers for animal and plant species.

d. Partnerships established with other federal, state, or local agencies, or other research institutions (other than those already described in the original proposal).

Hawaii’s Department of Aquatic Resources (DAR): Dan Polhemus, Ivor Williams, Bill Walsh, Skippy Hau, and Wade Ishikawa. All have supported this research either conceptually and logistically and have contributed to the success of the 1st year of funding.

3. Expenditures:

a. Describe expenditures scheduled for this period.

Salary $5,102
Materials and Supplies $16,472 (total budget)

b. Describe actual expenditures this period.

Salary $5,102
Materials and Supplies $14,058

c. Explain special problems, differences between scheduled and actual expenditures, etc.

I do not anticipate any problems with spending the remaining budget for Materials and Supplies between 10/30/2006 and 12/31/2006

Prepared By:

David B. Carlon, November 29, 2006
Subsequently, all NOAA COP recipients with approved grants will be asked to file a COP Annual Progress Report in the specified format. The first section of the proposed format is taken from the COP implementation plan and has some advantages in that previously-funded investigators will be familiar with the format. Consistency in reporting requirements for competitive research grant programs is desirable and this is behind COP’s efforts in proposing a standardized format. This annual report format will enable COP program staff to monitor each project supported by an award.

Public reporting burden for this collection of information is estimated to average 300 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed and completing and reviewing the collection of information.

Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing this burden, to the National Ocean Service, CSCOR/COP Office, 1315 East-West Highway, Silver Spring, MD 20910. Grant files are subject to the Freedom of Information Act (FOIA). Confidentiality will not be maintained—the information will be made available to the public. However, unpublished research results shall not be published without prior permission from the recipient.

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