SPONSORED PROJECT TERMINATION

Date: September 10, 1976

Project Title: Computer Analysis of Methods for Measuring Production of Aquatic Animals

Project No: C-10-631 (Continued by G-32-633)

Project Director: Dr. A.C. Benke

Sponsor: National Science Foundation

Effective Termination Date: 8/31/76

Clearance of Accounting Charges: 8/31/76

Grant/Contract Closeout Actions Remaining: None

- Final Invoice and Closing Documents
- Final Fiscal Report
- Final Report of Inventions
- Govt. Property Inventory & Related Certificate
- Classified Material Certificate
- Other

Assigned to: ERC (School/Laboratory)

COPIES TO:
- Project Director
- Division Chief (EES)
- School/Laboratory Director
- Dean/Director—EES
- Accounting Office
- Procurement Office
- Security Coordinator (OCA)
- Reports Coordinator (OCA)

Library, Technical Reports Section
- Office of Computing Services
- Director, Physical Plant
- EES Information Office
- Project File (OCA)
- Project Code (GTRI)
- Other

CA—4 (3/76)
Dr. J. Thomas Callahan  
Associate Program Director  
Ecosystem Studies Program  
National Science Foundation  
Washington, D.C. 20550  

Subject: Annual Technical Letter -- BMS75-03151  

Dear Dr. Callahan:  

This letter represents our annual technical letter for NSF grant BMS75-03151 entitled "Computer analysis of methods for measuring production of aquatic animals," from the period 1 January 1975 to present.

We have been successful in simulating the growth of hypothetical populations of freshwater invertebrates under a variety of conditions. We are able to vary size-specific growth rates, size-specific mortality rates, and degree of developmental synchronization. For any given simulation, survivorship for each instar is plotted and total actual production is calculated according to size-specific biomass conversion factors. A subprogram "samples" the population at prescribed intervals during the simulation. This sample data is then utilized in each of the four common field methods for estimating secondary production: instantaneous growth, Allen curve, removal-summation, and the Hynes method.

Our results to date show that errors usually increase in all methods used as development becomes less synchronous, and as growth becomes more non-linear. Errors are much larger under certain mortality schedules than others. To illustrate, the enclosed figure shows different mortality schedules for a population which has eight instars. The enclosed table shows estimated and actual turnover ratios (production/average standing stock) for each mortality case in a univoltine population with extremely synchronous development and linear growth. For certain mortality cases, all methods are quite accurate. Errors are higher in all methods for cases 1-80, 2, 4 and 6. In other simulations in which there is less synchrony and growth is non-linear, underestimates are greatly compounded, particularly in these latter mortality cases. Production is frequently underestimated by a factor of three. Annual turnover ratios of 40 are
easily generated. Such a turnover ratio is much higher than commonly re-
ported values from field data. So far, our simulations suggest that all 
methods will usually underestimate annual production, and under certain 
combinations of mortality, growth and developmental synchrony, these 
underestimates can be quite large.

It was our intention to make field verifications of our computer 
findings by more in-depth analysis of an ongoing project on secondary 
production in the Satilla River. Unfortunately, our simulations went 
very slowly the first year due to continual shutdowns of a new computer 
at the University of Georgia. As a result, we were not able to design 
experiments or sample populations in ways suggested by simulation output. 
Therefore, our field work consisted of sampling invertebrates more frequently 
in the summer of 1975 and conducting invertebrate colonization studies 
during the summers of 1975 and 1976. These data are now being analyzed 
and we anticipate they will enhance our understanding of secondary pro-
duction in the Satilla. They will also provide a data set of several kinds 
of invertebrate life histories which will be very useful in helping under-
stand the significance of the computer simulations. Hopefully, the com-
bination of computer and field studies will either lead to a new method 
for estimating production or enable us to correct for underestimates in 
current methods.

As a result of our work to date, a paper (see below) has been presented 
at a national meeting and a paper has been accepted for publication. We 
also anticipate submitting a paper on the first phase of our computer 
simulations in about a month.

Amer. 57: 42 (abstract of paper presented at the 1976 AIDS 
Meeting, New Orleans, Louisiana).

Freshwater Biology 7 (in press).

If you require any further information on our progress to date, please 
let us know.

Sincerely yours,

Arthur C. Benke 
Assistant Professor

ACB/ta
Turnover Ratios for Populations which Hatch over a 7-Day Interval and Spend Equal Amounts of Time in Each Instar

<table>
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<th>Mortality Case</th>
<th>Actual</th>
<th>Removal-Summation</th>
<th>Instantan. Growth</th>
<th>Hynes-Coleman</th>
<th>Allen Curve</th>
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<td>1 - .30</td>
<td>7.31</td>
<td>6.75</td>
<td>6.47</td>
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