Comparison of Two Sampling Methods For Estimating Zooplankton Densities In Fish Culture Ponds

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4200 Smith School Road
Austin, Texas 78744

ABSTRACT

Zooplankton population densities in 0.1 and 0.2-ha saltwater fish culture ponds were estimated by pooling 5-L samples from five locations, and collecting a 25-L sample from a single location. A ratio estimator ($\hat{R}$) was used to determine relative differences between population estimates derived by the two sampling methods. With the exception of *Oithona* sp. in 0.1-ha ponds, the two methods produced significantly different population density estimates. Total zooplankton, rotifers, and copepod nauplii population estimates were greater in pooled samples. *Acartia tonsa* densities were greater in single 25-L samples. The ratio estimator allows estimation of population densities produced by pooled samples from those produced by single 25-L samples. Although the pooled sampling method is preferred where precise zooplankton data are required, the single sample method is more time and labor efficient for routine hatchery operations.

INTRODUCTION

Zooplankton population density estimates are essential for management of hatchery ponds used to culture planktivorous fishes. Estimates on most hatcheries are derived from samples collected at a single pond location, due to time and labor constraints. However, zooplankton are not uniformly distributed in a body of water and widespread sampling is recommended (Weber 1973). This study compares selected zooplankton population densities estimated by pooling samples from five locations in saltwater fish culture ponds with one sample collected from a single pond location. The specific study objective was to determine if the less labor intense single sample method would reliably estimate zooplankton populations for routine hatchery operations.

MATERIALS AND METHODS

The study was conducted 11 May to 6 June 1982 in six 0.1-ha and six 0.2-ha rectangular earthen ponds at the Texas Parks and Wildlife Department Perry R. Bass Marine Fisheries Research Station, Palacios, Texas. Three 0.1-ha ponds were fertilized with 568 kg/ha chicken manure; the remaining ponds with 568 kg/ha cottonseed meal. Ponds were filled with filtered (0.5 mm saran) Matagorda Bay water.

Three randomly selected ponds of each size were sampled every other day by pumping pond water through a 64μ Wisconsin plankton net using a previously described pump apparatus (Farquhar and Geiger 1984). All samples were collected by raising and lowering the pump intake throughout the water column. Pooled samples were collected by pumping 5-L of water from each pond corner and the drain box. Following pooled sample collection a single 25-L sample was collected from the pond drain box. Pond drain box depths in 0.1 and 0.2-ha ponds were 1.5 m and 1.7 m, respectively. Pond corner depths were 0.3 m.

Zooplankton samples were preserved in 4% buffered formalin-sucrose solution (Haney and Hall 1973) until analysis. Each sample was diluted in a graduated cylinder until it contained 200-500 organisms/ml (Weber 1973). Diluted samples were mixed to ensure homogeneity and a 1-ml subsample recovered with a Hensen-Stemple pipette. Organisms were enumerated and identified using a Ward plankton counting wheel and stereomicroscopy. If individual subsamples yielded <200 organisms, additional subsamples were counted until 200 organisms or five subsamples were examined. Densities (organisms per liter) of mixed rotifers, mixed copepod nauplii, mixed polychaete larvae, the calanoid copepod *Acartia tonsa*, the cyclopoid copepod *Oithona* sp. and total zooplankton were determined.

The relative difference between the two sampling methods was estimated for each pond size using the ratio estimator equation $\hat{R} = \bar{y}/\bar{x}$ (Cochran 1977), where:

$\hat{R}$ = ratio estimator
$\bar{y}$ = mean organisms/liter from five 5 L sample
$\bar{x}$ = mean organisms/liter from one 25 L sample

A *t*-test was used to determine if $\hat{R}$ was significantly different from unity. Significance indicated a difference in population estimates.

RESULTS AND DISCUSSION

The sampling methods produced significantly different population density estimates for each group with the exception of *Oithona* sp. in 0.1-ha ponds (Table 1). Rotifers, copepod nauplii and to a lesser extent, *A. tonsa* were the most common organisms collected. Polychaete larvae and *Oithona* sp. were frequently absent from samples and showed no consistent distribution among sample types. Total zooplankton, rotifers, and copepod nauplii densities were greatest in pooled samples whereas, *A. tonsa* densities were greatest in single 25-L samples. These data suggest rotifers and copepod nauplii tend to occupy shallow pond areas and *A. tonsa* deeper areas.

Differences in zooplankton density estimates yielded by the two sampling methods demonstrated uneven zooplankton distribution and emphasizes the need for multiple sampling locations if precise zooplankton densities are desired. Use of the ratio estimator, however, allows estimation of zooplankton population densities produced by pooled samples from those produced from single samples. The latter, more time efficient, method is preferable for routine determinations on fish hatcheries. Nevertheless, hatchery personnel must consider annual and seasonal changes in zooplankton species composition and distribution and, depending on the desired accuracy, periodically recalculate the ratio estimator.

LITERATURE CITED

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Table 1. Mean zooplankton density (no./liter) in five pooled 5-L samples ($\bar{y}$) and in a single 25-L sample ($\bar{x}$), from 0.1 and 0.2-ha saltwater ponds 11 May - 6 June 1982, Perry R. Bass Marine Fisheries Research Station, Palacios, Texas. (V = variance, $\hat{R}$ = ratio estimator, and _t_ = t test statistic)

Species	Pond Size (ha)	n	$\bar{y}$	$\bar{x}$	V	$\hat{R}$	_t_
Acartia tonsa	0.1	33	88	100	0.02	0.88	4.87 **
	0.2	37	101	107	0.02	0.94	2.58 *
Oithona sp.	0.1	33	11	12	0.08	0.93	1.42 NS
	0.2	37	15	28	0.04	0.53	14.29 **
Copepod nauplii	0.1	33	379	294	0.02	1.29	11.78 **
	0.2	37	308	197	0.02	1.53	24.09 **
Rotifers	0.1	33	513	425	0.04	1.21	6.03 **
	0.2	37	301	215	0.11	1.40	7.34 **
Polychaete larvae	0.1	33	14	19	0.04	0.73	7.76 **
	0.2	37	33	27	0.08	1.20	4.30 **
Total zooplankton	0.1	33	1190	968	0.03	1.23	7.63 **
	0.2	37	874	656	0.03	1.33	11.59 **

* = $P<0.05$
** = $P<0.01$
NS = not significant at $P=0.05$

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