JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-6
SUB-PROJECT NO.: F-2
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Freshwater Monitoring (2440)

PERIOD COVERED: October 1, 1997 to September 30, 1998

SUMMARY

During FY98, the four previously selected watersheds were re-sampled. Faunal counts and habitat characteristics recorded in FY98 are summarized. The influence of Fena Reservoir on migrating fauna continues to be assessed. The results of the FY97 study were used as baseline data in comparative analyses with data collected in FY98.

BACKGROUND

Maintaining high quality watershed ecosystems is essential to protecting healthy coastal areas, which support fisheries. In order to monitor the quality of Guam's watershed ecosystems, biological and physical baseline data were collected from the following four watersheds in FY97: 1) Fena; 2) Manenggon; 3) Ylig; and 4) Pago. Annual monitoring of these parameters is essential for the effective watershed management that is necessary to protect Guam's coastal resources.

Further explanation regarding the purpose of the project and additional background information can be found in Freshwater Monitoring Annual Report (F-1R-5, F-2, 1-1).

OBJECTIVES

1. Continue to survey the four watersheds chosen in FY97, in order to monitor the health of stream ecosystems on Guam.

2. Continue to monitor the effect of Fena Reservoir on faunal migration.

3. Begin preparations for a stock assessment of Fena Reservoir.

4. Develop a more extensive freshwater field guide, building on information collected in FY97.

PROCEDURES

1-2. Species composition, organism density, and habitat characteristics were collected in the experimental and control rivers chosen in FY97, using the methods described in the annual report of FY97. The experimental rivers, located above Fena Reservoir, are: the Almagosa River, the Maulap River, and the Sadog River. The control rivers are: the Maagas River, the Manenggon River, the Pago River, and the Ylig River. When possible, analysis of variance was used for data comparison of the streams. However, when the data did not conform to the assumptions of ANOVA, appropriate non-

parametric tests were performed (StatView 4.51, Abacus Concepts, Inc., Berkeley, California, 94704-1014).

3. Preparations for the stock assessment of Fena Reservoir commenced in FY98. Various methods were researched and potential sites were explored. A mark-recapture method was chosen and the required materials were procured. The stock assessment will be performed in the dry season of FY99 (January - May). Methods and materials will be tested prior to implementation of the project.

4. Methods of photography were explored for use in compiling the freshwater field guide in FY98. Specimens were collected from several sites around the island and photographed in a v-shaped glass aquarium using various types of lighting, backgrounds, and ways to immobilize the organisms (i.e. anesthetics, reduced temperature). Additionally, some organisms were photographed *in situ* with an underwater camera.

RESULTS

Significantly fewer species per square meter were seen in all rivers in FY98 than in FY97 ($p < 0.01$; Fig. 1). However, there was no significant difference between FY97 and FY98 for total density in all rivers ($p > 0.05$; Fig. 2). The gobies *Mugilogobius cavifrons* and *Sicyopus leprurus*, the tucunare *Cichla ocellaris* and species of neritid gastropods were not recorded in any surveys. The Guam goby *Awaous guamensis* was the only species seen in all streams surveyed.

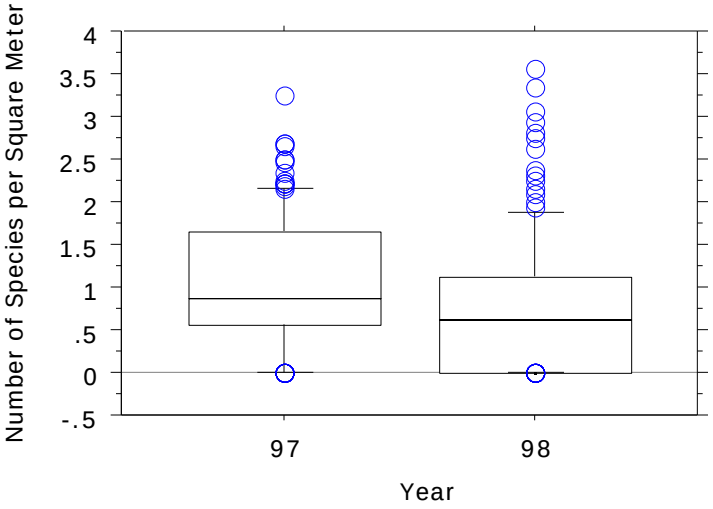

Figure 1. Mean number of species per square meter, in all rivers surveyed, grouped by year.

Both species density and total density did not differ significantly between experimental and control streams ($p > 0.05$; Figs. 3 and 4). Individually, densities of *A. guamensis*, the mountain goby *Stiphodon elegans*, the tilapia*Tilapia zillii* and the freshwater prawn *Macrobrachium lar* did not differ significantly between experimental and control rivers ($p > 0.05$). The flagtail *Kuhlia rupestris* and the eel *Anguilla marmorata* were present only in the control streams. The tilapia *Oreochromis mossambicus* was present only in experimental streams. Although *S. elegans* appeared to be more associated with harder substrate types, it was not found on these substrates significantly more often than on softer

ones ($p > 0,05$). Similarly, there was no significant difference between substrate types for *A. guamensis*, which is normally found on sand or silt ($p > 0.05$).

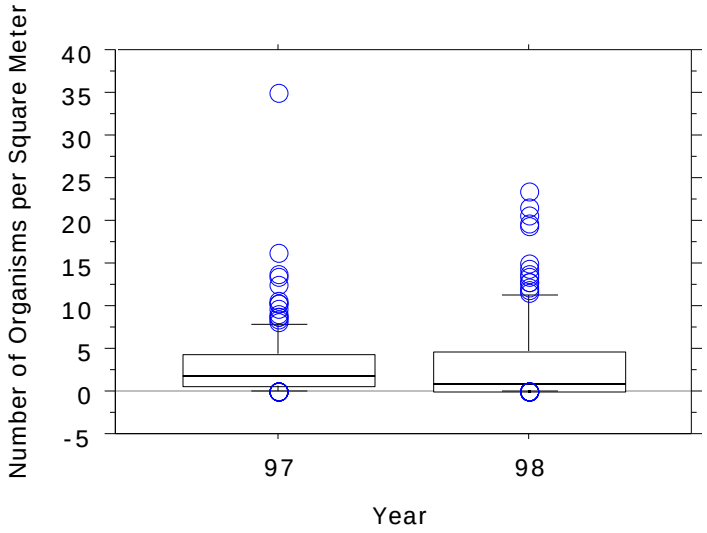

Figure 2. Mean number of organisms per square meter, in all rivers surveyed, grouped by year.

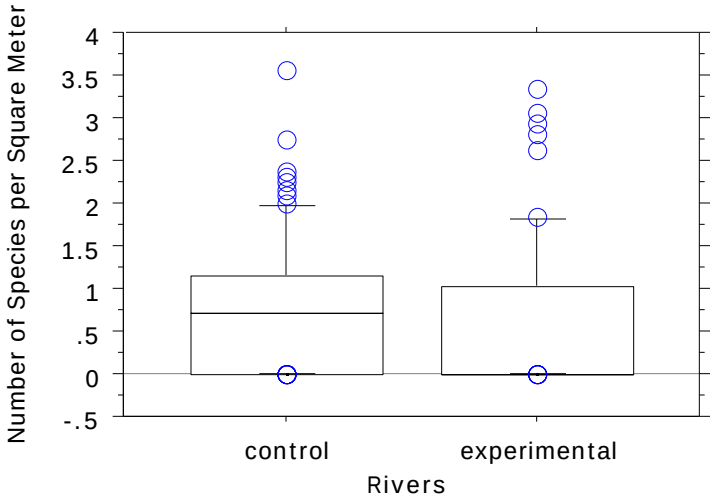

Figure 3. Mean number of species per square meter grouped by rivers. Experimental rivers are located above Fena Reservoir.

DISCUSSION

Mean species density was significantly lower for all rivers combined in FY98 than in FY97. This may be due in part to the effects of Supertyphoon Paka, which discharged 22 inches of rain in approximately 12 hours on 16 December 1997. This excessive rainfall caused flooding in most of Guam's rivers. The increased water volume and velocity may have flushed organisms out of the rivers. Covich, et al. (1991) reported that shrimp densities decreased by an average of 50 percent in the headwaters of a Puerto Rican stream one month after the passing of Hurricane Hugo. Our river surveys were conducted in February and March of 1998. The species surveyed may have been the first to recruit back up the

rivers. Conversely, total density did not differ significantly between years. This may reflect that fewer species present are able to occur in higher numbers due to decreased competition.

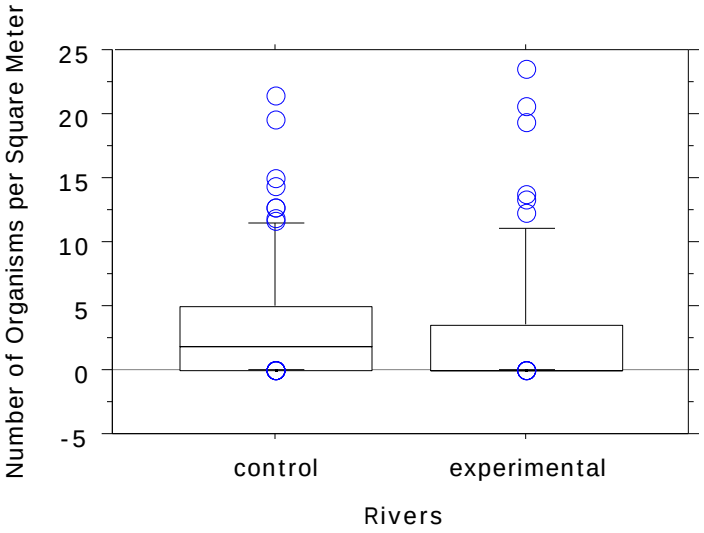

Figure 4. Mean number of organisms per square meter grouped by rivers. Experimental rivers are located above Fena Reservoir.

Densities for a majority of species did not differ significantly between experimental and control streams. Two species occurred only in control streams. The dam probably excludes *K. rupestris*, because it is not morphologically adapted for climbing. It is also absent above natural waterfalls in most streams of Guam. *Anguilla marmorata* was seen above the reservoir but not in surveyed sites. Eels were certainly underrepresented in our daytime surveys due to their nocturnal activity. *Oreochromis mossambicus* was found only in experimental rivers. It was introduced into Fena Reservoir in 1956 (Nelson and Eldredge, 1991), but has not been restricted to areas above the dam. It was also seen in control rivers but not within quadrats surveyed.

Previous studies have shown that species of *Awaous* and *Stiphodon* are found more frequently on certain substrate types (Kinzie, 1988; Parham, 1995). In this study, there was no significant difference between substrate types associated with either *A. guamensis* or *S. elegans.* This is difficult to explain because the substrate types normally associated with these fish are suited to their mode of feeding and escape behavior. These species may have been able to exploit a greater variety of substrate types due to the presence of fewer potential predators or competitors.

RECOMMENDATIONS

This study continues to suggest that dams and reservoirs in tropical streams may not have severe effects on most species. However, these ecosystems are complex and there can be high variability between streams and between years. Annual monitoring of these watersheds should continue in order to clarify ambiguous results seen so far.

A stock assessment will be implemented in FY99. The assessment should include the search for unknown species as well as the determination of densities of known species.

Discussion with the U.S. Navy will be required in FY99, in order to reestablish public access to fishing at Fena Reservoir.

Literature compiled for the freshwater field guide should be condensed into a practical form. Digital technology should be explored for production of the guide.

This project should move towards integrating freshwater monitoring with coral reef protection. This entails investigating the rate of erosion and sediment loading in our streams in order to obtain a clearer understanding of depositional rates on adjacent coral reefs.

PROJECT COST

The estimated cost is $72,000.

LITERATURE CITED

Covich, A.P., T.A. Crowl, S.L. Johnson, D. Varza, and D.L. Certain. 1991. Post-Hurricane Hugo increases in atyid shrimp abundances in a Puerto Rican montane stream. Biotropica 23: 448-454.

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