

EVALUATION OF DIETS FOR FUTURE REARING JUNE SUCKER (*Chasmistes liorus*)

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Introduction

The June sucker (*Chasmistes liorus*) is an endangered fish species endemic to Utah Lake, Utah. A recovery program has been implemented with a goal of propagating June sucker for stocking into Utah Lake. Plans are in place to build a native species hatchery and it is necessary to develop proper culture techniques prior to start up.

A diet has not been established for June sucker. Various diets have been used at the Fisheries Experiment Station (FES), but due to lack of space, replication has not been available to properly evaluate these diets. In January 2002, a new facility at FES went online with the space required for the tanks to run studies with replication. The first feed study was started at this time and will be used to refine future feed studies (Routledge, 2001).

Methods

The feed study consisted of five diet treatments with three replicates per treatment. Treatment 1 used the Bio Kyowa diet. This diet was used to feed all of the fish in the lot prior to the feed study. Treatment 2 was the Razorback diet formulated by the Bozeman Fish Technology Center and manufactured by Nelson & Sons. Treatment 3 was the Silvercup Trout diet manufactured by Nelson & Sons; this diet has been used previously. Treatment 4 was the Bio Vita FF diet, manufactured by Bio Oregon. Treatment 5 was the Bio Flake diet, manufactured by Bio Oregon, and has been used by the Klamath Tribe for Short-nosed suckers (Routledge, 2001). All treatments, except for the Bio Kyowa diet, were fed the same ratios of Bio Kyowa along with the treatment diet for the first 21 days. The first 7 days a 3:1 ratio of Bio Kyowa to treatment diet was fed, from day 8 to 14 a 1:1 ratio was fed, and from day 15 to 21 a 1:3 ratio was fed. After 21 days 100% of the diet for each treatment was fed. Tanks 1-7 started with 290 fish each and tanks 8-15 with 291 fish each. One lot from eggs spawned on the Provo River was used in the study. The study started with fish at nine months of age and continued until the fish reached twelve months of age. Prior to starting the study, sample lengths and weights were measured to determine the condition factor, and a deformity index was taken. During the study, parameters (flow, density and % body weight fed) were kept consistent relative to the number of fish.

The health condition profile (HCP) described by Goede and Barton (1990) and a deformity index were used to compare the replicates and treatments upon completion of the study. Due to small fish size not all variables were quantified and some observations discontinued after examining several tanks. HCP variables measured or observed in each tank included: total length (TL), weight, condition factor ($\text{weight} \times 10^5 / \text{length}^3$) eye condition and deformities. Deformities were categorized as vertebral, mandible, cranial,

opercular, fin, gill rakers and other. Fin deformities were broken down into specific fin and left or right for applicable fins. Certain variables were made more specific to quantify observations in lots including: opercular (normal, sunken, shortened), hemorrhaging (none, fins, body) and nares (normal, enlarged).

The data was analyzed using SPSS. All variables, except percent mortality, used sample sizes of 60 fish were used on all treatments except for treatment 1 where a 47 fish sample was used. In percent mortality each tank was used as a sample, so the sample size was three for each treatment. Analysis of variance (ANOVA) was used to test for differences in length, weight, condition factor (K) and percent mortality. Post hoc tests using the least significant differences method was calculated on variables with a significant difference. Maximum likelihood ratios were used to analyze the deformity, hemorrhaging and nares variables. For the variables with a significant difference maximum likelihood ratios were calculated between paired treatments. The level of significance 0.05 was used for all tests. The eyes were “normal” in all treatments according to HCP criteria, so no statistics were required.

Results

The variables length, weight, condition factor (K) and percent mortality differed significantly among diet treatments (Table 1). The mean total (TL) of the diets ranged from 44.9mm to 51.1mm with the Razorback and Bio Vita diets being significantly longer than the other three diets. The mean (TL) of the Bio Flake diet was significantly longer than the shortest mean length in the Bio Kyowa diet but neither diet differed significantly from the Silvercup diet. The mean weight ranged from .61g to 1.10g, the Razorback and Bio Vita diets were significantly heavier with the lightest mean weights in the Bio Kyowa and Silvercup diets. The Razorback, Bio Vita and Bio Flake diets had a significantly higher condition factor (K) than the other two diets with a range of (0.6400 to 0.7973) $\times 10^5$. Percent mortality ranged from 2.9 to 57.8, the Razorback, Bio Vita and Bio Flake diets had significantly less percent mortality than the other two diets.

Table 1. Comparison of hatchery performance of June suckers fed five commercial diets. Matching subscripts among treatment means depict no significant difference between treatments for a given variable.

Treatment	1	2	3	4	5
Diet	Bio Kyowa	Razorback	Silvercup	Bio Vita	Bio Flake
Length (TL)	44.9 _Z	50.4 _Y	46.4 _{ZX}	51.1 _Y	47.8 _X
S.D.	4.8	3.4	6.1	5.2	4.2
Weight	0.61 _Z	0.99 _Y	0.69 _Z	1.10 _Y	0.80
S.D.	0.30	0.23	0.45	0.35	0.20
Condition Factor (K)	0.6400 _Z	0.7569 _{YX}	0.6077 _Z	0.7973 _{YW}	0.7265 _{XW}
S.D.	0.1611	0.0680	0.2031	0.0740	0.0940
Mortality (%)	57.8 _Z	8.6 _{YX}	48.3 _Z	8.4 _{YW}	2.9 _{XW}
S.D.	12.3	1.6	41.6	5.9	2.3

Using the maximum likelihood ratio tests, significant differences were found in the vertebral deformities, hemorrhaging fins and body (Table 2). No significant differences were found in the nares, sunken and shortened opercle variables. Vertebral deformities averaged from 0.0% to 3.1%, with fish on the Silvercup diet experiencing a significantly higher rate than the other four diets. Vertebral deformities were not found in treatments 2, 4 and 5. Hemorrhaging of the fins averaged from 0.0% to 4.5%, with a significantly higher occurrence in the fish on the Bio Kyowa and Silvercup diets. Hemorrhaging of the fins was not found in treatment 5. Hemorrhaging of the body averaged from 0.0% to 4.2%, with a significantly higher occurrence in the fish on the Bio Kyowa and Silvercup diets. Hemorrhaging of the body was not found in treatments 4 and 5.

Table 2. Comparison of the percentage of deformed vertebrae and hemorrhaging in fins of on the body of June suckers fed one of five commercial diets. Matching subscripts among treatment percentages depict no significant difference between treatments for a given variable.

Treatment	1	2	3	4	5
Diet	Bio Kyowa	Razorback	Silvercup	Bio Vita	Bio Flake
Vertebral Deformities	0.3% _{ZYX}	0.0% _{ZWV}	3.1%	0.0% _{YWU}	0.0% _{XVU}
Hemorrhaging Fins	4.5% _Z	0.7% _{YX}	4.5% _Z	0.3% _{YW}	0.0% _{XW}
Hemorrhaging Body	4.2% _Z	0.3% _{YX}	3.1% _Z	0.0% _{YW}	0.0% _{XW}

Conclusions

According to the results from the data analyzed, the Razorback diet and the Bio Vita FF diet were the best feeds for use with June sucker, the fish were significantly larger in length and weight with a significantly higher condition factor (K), and significantly lower in the percent occurrence of mortalities, vertebral deformities and hemorrhaging in the fins and of the body. Fish fed the Bio Flake diet were significantly lower in the length and weight categories but there was overlap in the standard deviations with the Razorback and Bio Vita diets, suggesting the Bio Flake diet worked well for June sucker. The Bio Flake diet had a significantly higher condition factor (K), and was significantly lower in the percent occurrence of mortalities, vertebral deformities and hemorrhaging in the fins and of the body than the Bio Kyowa and Silvercup diets. The Bio Kyowa and Silvercup diets were found to be inferior diets in comparison to the other treatments. These two diets have been used previously where similar problems occurred that were quantified with the variables measured in this study. The Bio Flake, Razorback and Bio Vita FF diets are currently being compared along with other diets in a second feed study, which began at the initial feeding.

Sources

Goede, R.W. & Barton, B.A. 1990. Organismic indices and an autopsy-based assessment as indicators of health & conditions of fish. p.93-108. Biological indicators of stress in fish. Adams, S.M. editor. American Fisheries Society Symposium 8, Bethesda, Maryland.

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