Hagerman Hatchery Evaluation Team

A Comparison of Dorsal Fin Indices of Summer Steelhead Fed a Restricted and Satiated Diet Indoors

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Abstract

The Hagerman Hatchery Evaluation Team compared the dorsal fin indices of fish reared indoors on a diet based on a Hatchery Constant (HC) and fish fed to satiation to those of fish reared in the raceways fed a diet based on a HC. Fish reared indoors on a HC diet had a dorsal fin index (DFI) of 3.9 which was statistically the same as those reared outdoors which had a DFI of 2.8. Fish fed to satiation indoors had a DFI of 5.1 which was significantly higher than those reared outdoors. This study further confirms that aggressive behavior caused by restricted feeding has a greater effect on DFI than exposure to sunlight.

Introduction

The Hatchery Review Team (USFWS 2009) recommended addressing the lack of shade covers over the raceways (HA10) at the Hagerman National Fish Hatchery (Hatchery). The HRT believes the lack of shade covers over the raceways increase crowding of fish, particularly during the summer months, potentially increasing stress and disease risks to steelhead juveniles. Dorsal fin erosion has commonly been associated with lack of shade covers (Pratt 1962, Warren 1967). The Hatchery has reported dorsal fin issues since the 1960's. Dorsal fin erosion is considered a precursor to soreback.

Soreback is a focal lesion occurring at the anterior base of the dorsal fin and progressing into the underlying muscle. There has been considerable research effort in the cause and cures of soreback and dorsal fin erosion. The Hagerman Hatchery Evaluation Team reviewed dorsal fin erosion research as well as current (2008) work (Hagerman Hatchery Evaluation Team 2009). Based on the literature reviewed and observations made on the Hatchery, soreback is induced by aggressive behavior due to feeding a restricted diet. Chemotherepeutants and raceway alterations including: shading, baffles, and substrate additions had limited success relieving fin erosion problems (Hagerman Hatchery Evaluation Team 2009). Based on observations made at the Hatchery and past published literature, the most practical option for reducing soreback may be to reduce aggression by increasing feeding rates during the period of the production cycle when soreback is most prevalent.

To assess benefits of shading, the Hatchery will compare fin indices of fish grown indoors at restricted and satiated diets. The Hatchery will use these results to further determine if shade covers would be beneficial to the fish raised outdoors.

Materials and Methods

Ad-clipped Sawtooth Stock (Raceway 94 originating from Tank 49) were used for this study. These fish were clipped and ponded on August 24, 2010. On August 25, 2010, 300 fish from raceway 94 were stocked into 2' x 2' x 2' fiberglass tanks in Hatchery II. These fish were split into two experimental groups, with three replicates of 50 fish per group. The first experimental group was fed a Hatchery Constant of 6.9 throughout the

year. This HC mirrored outside feeding rates to achieve a release size of 4.5 fish per pound (fpp) and final density index of 0.20. The second experimental group was fed to satiation. Feeding was twice the feeding rate of the first experimental group plus any additional feed they would eat.

On October 22nd, 2010, one fish was randomly grabbed from one of the indoor satiated diet and indoor restricted diet treatments and each placed in separate tanks. These fish were kept alone to observe the effect competition has on the dorsal fin index (DFI).

Fish in the indoor tanks were fed the same feed (Rangen's Extruded Floating Hagerman Diet) that was being fed to the fish in the outdoor raceways. Feed size was changed to match fish size as recommended by the manufacturer, which mirrored that of the outdoor raceways. Fish in the indoor tanks were fed daily; the fish fed in the raceways were fed daily until November 15th, and then were fed a week's ration split on two days of that week via demand feeders.

Ten fish were randomly grabbed from each tank and thirty fish were randomly grabbed from raceway 94 and measured for right pectoral fin, left pectoral fin, and dorsal fin lengths to the nearest millimeter with a ruler. Total fork length (millimeters) and weight (grams) was measured by the digitizer (GSE Scale System Model 655). Sampling occurred every two months post ponding for the study and just prior to fish hauling for distribution. Dorsal fin index was calculated as: (dorsal fin length X 100)/total length. Pictures of the dorsal fins were taken with a Nikon Cool Pix 4600 during each sampling period to illustrate the condition of those fins.

Dorsal fin indices of the three treatments were compared using a single factor ANOVA test and were considered significant if $p < 0.05$. The ten fish samples per tank were pooled so that each treatment had a mean value obtained from thirty samples. Variance among the dorsal fin indices were compared using an F-Test. Multiple comparisons among the variances were done using a Tukey-type multiple comparison test (Zar1999).

Results

Size

Fish were approximately 152 fpp when they were split up into the experimental tanks for this study. The last sampling date was March 29, 20011 due to the withdrawal time of MS-222 before release. At this time, fish that were fed to satiation indoors were 3.71 fpp, fish fed a restricted diet were 5.51 fpp, and fish in raceway 94 were 5.10 fpp (Figure 1). There was no significant difference ($p > 0.05$) in mean fish size of fish fed a restricted diet indoors compared to those in raceway 94. However, both those treatments were significantly smaller ($p < 0.05$) than the fish fed to satiation indoors.

Rearing Conditions

Rearing conditions in the indoor rearing tanks were very similar to those in the outdoor raceways as illustrated by Table 1. However, feed conversions did vary between treatments. Fish on the indoor restricted diet had a feed conversion ratio (FCR) of 0.87, compared to the fish in the outdoor raceways which had a FCR of 1.07, and fish that were fed to satiation which had a FCR of 3.28.

Dorsal Fin Indices

Fish fed a restricted diet indoors had a DFI of 3.91 that was the same ($p > 0.05$) as the fish in raceway 94 with a DFI of 2.77 at the conclusion of the study (Figure 2). Fish fed to satiation indoors had a DFI of 5.13, which was not significantly different ($p > 0.05$) then fish fed a restricted diet indoors, but was greater ($p < 0.05$) than the fish in raceway 94. The two fish that were grown in tanks individually had DFI that were significantly greater ($p < 0.05$) than the DFI of all other fish in the study. The fish taken from the restricted feed diet treatment had a DFI of 7.17 at the conclusion of the study compared to 8.26 DFI of the fish taken from the satiated diet treatment. There was no significant difference ($p > 0.05$) between the mean DFI of these fish throughout the sampling periods. Photographs of the dorsal fins throughout the sampling periods are illustrated in the Appendix.

Discussion

During the indoor feeding trial, the conditions that fish are reared in outdoors were successfully mimicked indoors in regards to flow, density, and growth. Growing smolts indoors did not significantly increase the dorsal fin indices of fish compared to those grown outdoors. The amount of food fed to fish had a greater effect on DFI. Fish fed to satiation indoors had a greater DFI than those in the raceways. This study confirmed past results found by the Hagerman HET (Hagerman Hatchery Evaluation Team 2009) that feeding rate is a large component of dorsal fin condition. The closer fish are fed to satiation, the less aggressive they become resulting in less nipping and better fin condition. This is also confirmed by the two fish that were reared in separate tanks. These fish had large dorsal fins and DFI closest to wild steelhead of similar size which have a DFI of 11.6 (Kindschi 1986).

Although there was no benefit of growing smolts indoors in regards to find condition, there may be other benefits to shade covering not examined in this study. During Brood Year 2010, smolts grown on the top deck of the steelhead raceways were diagnosed with sunburn by the Idaho Fish Health Center. This was confirmed with histology methods. Fish with sunburn would lose the top layer of skin which would lead to infection, then death. Mortality rates reached up to 1% of the population in production during the sunburn occurrence.

References

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Tables and Figures

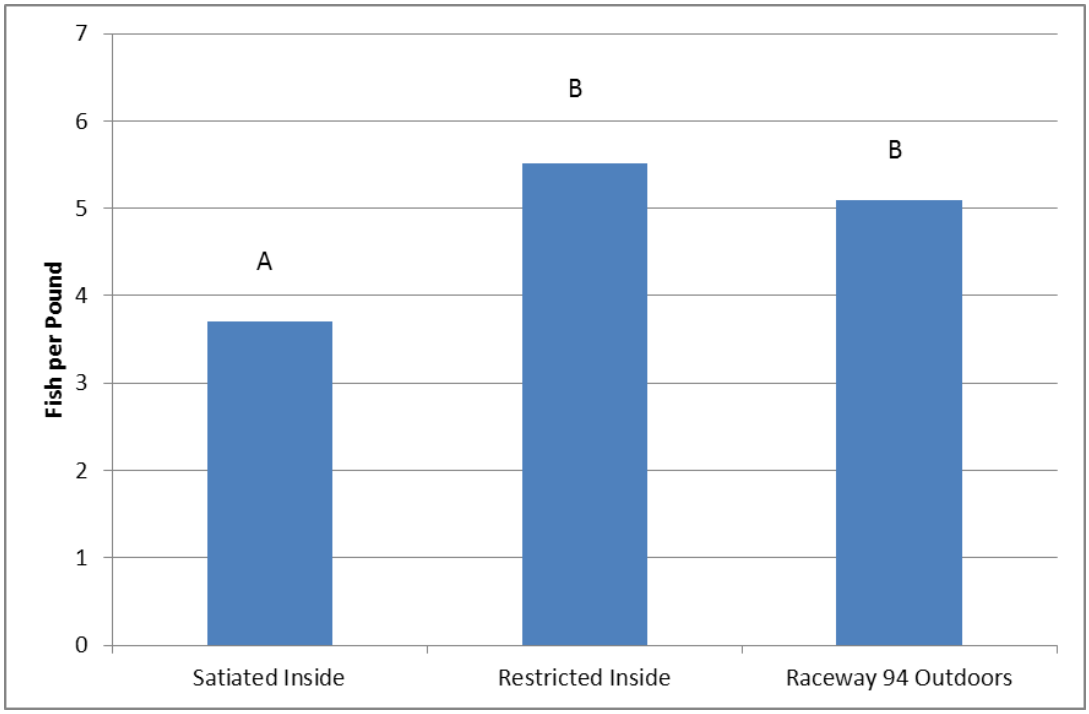


Figure 1. Average Size (Fish per Pound) of Fish Fed Restricted and Satiated Diets Indoors Compared to Raceway 94, BY2010 Hagerman National Fish Hatchery. Columns with different letter indicate a significant difference at p value of 0.05.

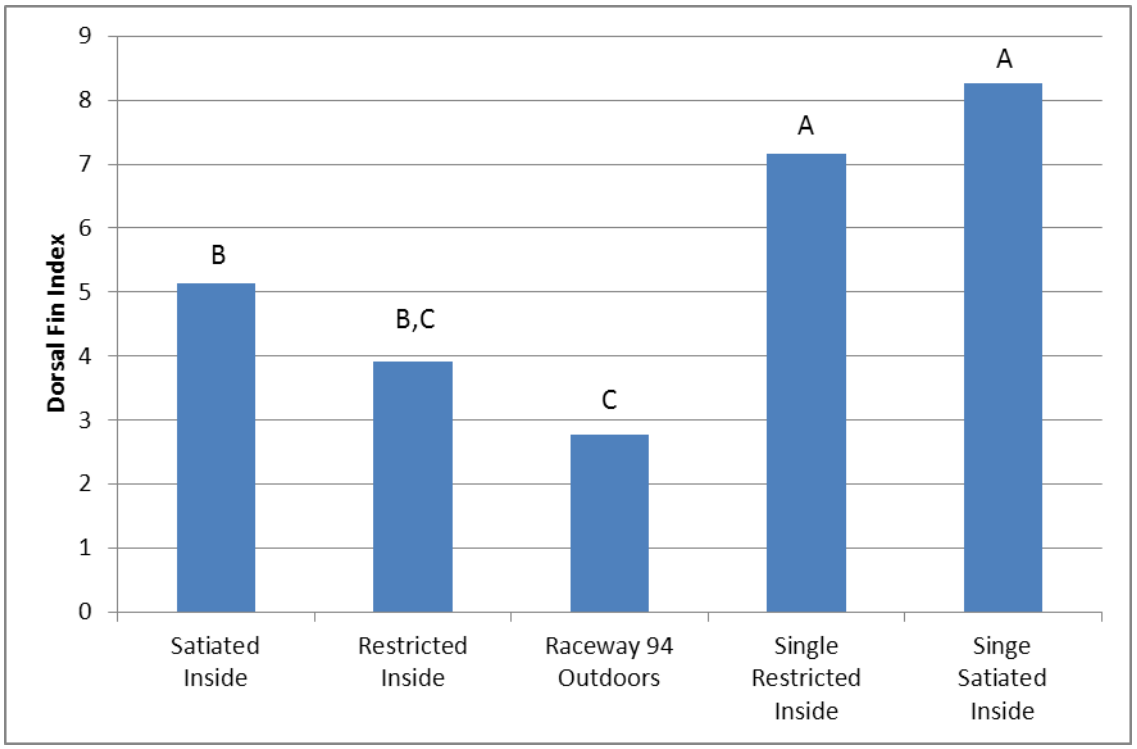


Figure 2. Average Dorsal Fin Index of Fish Fed Restricted and Satiated Diets as a Group and Individually Indoors Compared to Raceway 94 Outdoors, BY2010 Hagerman National Fish Hatchery. Columns with different letter indicate a significant difference at p value of 0.05.

Treatment	Density Index	Flow Index	Feed Conversion Ratio	Final Weight of 150 fish/treatment (lb)	Final Length (in)
Satiated Inside	0.26	0.43	3.28	41.0	8.51
Restricted Inside	0.20	0.32	0.87	27.2	7.60
Raceway 94 Outdoors	0.17	0.41	1.07	29.4	7.92
Single Satiated Inside	0.002	0.002	n/a	0.2	8.63
Single Restricted Inside	0.001	0.002	n/a	0.2	7.33

Table 1. Final production characteristics of treatments and control group (raceway 94) during the last sampling date on March 29, 2011.

Appendix

Note: The following photographs represent fish that have a dorsal fin index at or nearest to the mean dorsal fin index for that treatment during that sampling period.

Satiated Diet Indoors
10/26/10

Satiated Diet Indoors
12/17/10

Satiated Diet Indoors
2/25/11

Satiated Diet Indoors
3/29/11

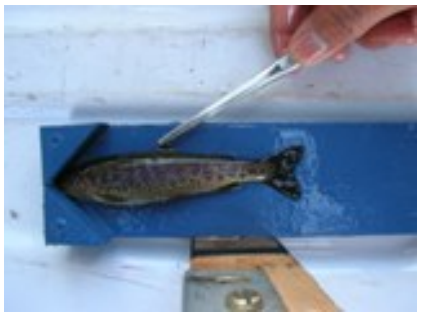
Restricted Diet Indoors
10/26/10

Restricted Diet Indoors
12/17/10

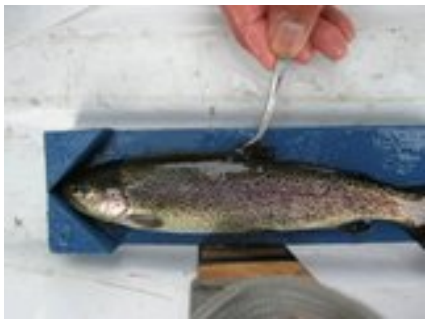
Restricted Diet Indoors
2/25/11

Restricted Diet Indoors
3/29/11

Raceway 94
10/26/10



Raceway 94
12/17/10



Raceway 94
2/25/11

Raceway 94
3/29/11

Single Fish, Restricted Diet
10/26/10

Single Fish, Restricted Diet
12/17/10

Single Fish, Restricted Diet
2/25/11

Single Fish, Restricted Diet
3/29/11

Single Fish, Satiated Diet
10/26/10

Single Fish, Satiated Diet
12/17/10

Single Fish, Satiated Diet
2/25/11

Single Fish, Satiated Diet
3/29/11