

An Evaluation of Rangen ® EXSL 470 diet vs. Standard Hagerman Steelhead Diet
at the Hagerman National Fish Hatchery, BY2008

Final Report

By the

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Abstract

The Hagerman National Fish Hatchery (Hatchery) compared the Rangen[®] EXSL 470 diet to the specially formulated “Hagerman Steelhead Diet” in Brood Year 2008. The diets were fed to Dworshak B steelhead smolts from December 2008 to April 2009. There were no significant differences in growth, Feed Conversion Rate, fish health, or survival between the diets. However, the experimental diets were suspended twice for 10-day Aquaflor (Florenfenicol) treatments for Frunculosis and Coldwater epizootics. These epizootics may have affected the results. The Hatchery does not have further evaluation plans in Brood Year 2009 since the Dworshak B smolts were transferred to Magic Valley Fish Hatchery and no fish production benefit was realized.

Introduction

The Hagerman National Fish Hatchery (Hatchery) feeds a specially formulated extruded diet named “Hagerman Steelhead Diet”. This diet has been used successfully to rear steelhead smolts for over 10 years. For the past several brood years, Magic Valley Fish Hatchery and Niagara Springs Fish Hatchery have been rearing steelhead in similar conditions using extruded Rangen[®] EXSL 470 diets. Both hatcheries have had success with this feed and, in the case of Magic Valley, have avoided February and March mortality in the Dworshak B stock (HHET 2006a). The EXSL 470 diet is a “hotter” diet with higher protein and lipid levels. The manufacturer claims the EXSL 470 diet is more efficient, has less fines, and produces less pond waste while producing better fish growth than conventional pellet diets.

The Hatchery tested the EXSL 470 diet versus the standard “Hagerman Steelhead Diet” in BY2008. The parameters studied included: growth, on-station survival, fish health, and feed conversion rates. The results will guide future feed purchasing decisions.

Methods

The experiment was conducted with the Dworshak B stock steelhead. The Dworshak B stock was chosen because: all the Brood Year 2008 eggs originated from one lot; both release groups (East Fork and Little Salmon River) were fed at the same feeding rates throughout rearing; and the Hatchery wanted to improve on-station performance of the Dworshak B stock. The Dworshak B stock was released at the East Fork (EF) and Little Salmon River (LSR) release sites. Control raceways were EF 94 & 95 and LSR 99 & 100. EXSL 470 experiment raceways were EF 96 & 97 and LSR 101 & 102. Each raceway was PIT tagged with approximately 1250 tags to evaluate downstream survival rates.

The Hatchery began the experiment on December 15th, 2008 coinciding with the switch from hand feeding to demand feeders. The Hatchery purchased 15,000 pounds of bulk EXSL 470 for

the experimental raceways. The total added feed cost for the experiment was approximately \$1,800. The “Hagerman Steelhead Diet” was purchased in 21,000 pound bulk lots according to Standard Operating Procedures.

Feed parameters for diet study, Hagerman NFH, BY2008

	Rangen ® EXSL 470	Hagerman Steelhead Diet
Protein	47%	45%
Lipid	20%	14%
Ash	<9%	<15%
Fiber	<2%	n/a
Moisture	n/a	<10%
Price (FY2009)	\$0.550/lb	\$0.434/lb

The treatment and control groups were fed at equal Hatchery Constants using demand feeders to meet the size at release requirement of 4.5 fish per pound. Each group was fed on Thursdays and Sundays on an intermittent feeding schedule. The intermittent feeding schedule is explained in more detail in HHET 2006b. The anticipated Feed Conversion Ratio (FCR) was 1.0 for the “Hagerman Steelhead Diet” and the EXSL 470 diet. The FCR’s were anticipated from previous brood years at Hagerman National Fish Hatchery and Magic Valley Fish Hatchery. Both groups were fed at equal feeding rates throughout the experiment.

Data Collection

Production Data

Fish growth was determined by truck loading weights. Feed Conversion Rates were determined by final truck loading weights and total weight fed. Mortalities were removed and enumerated daily. Twenty-one days prior to scheduled release, 200 pooled fish from Raceways 101 and 102 (EXSL 470) and raceways 99 and 100 (Hagerman Diet) were anesthetized with MS-222 and sampled for length and weight. During this sample, a subsample of 20 fish from each raceway was measured for Fin Indices. Dorsal Fin Index (Kindschi, 1986) was determined by:

$$\frac{\text{Dorsal Fin Length (mm)} * 100}{\text{Total Length (mm)}}$$

Phosphorus Discharge

The Hatchery hypothesized that waste and subsequent phosphorus discharge would be lower with the EXSL 470 diet. To test this hypothesis, samples were taken from each raceway according to Standard Operating Procedures for collecting National Pollution Discharge Elimination System samples.

Proximate Analysis

To evaluate any differences in energy content and as an indirect measure of growth, ten smolt samples from each raceway were sent to Abernathy Fish Technology Center before the study (160 fish total) to determine carcass proximate analysis. The proximate analysis examined protein, lipid, ash, and moisture levels. Samples of both diets were also sent to Abernathy for proximate analysis. Proximate analysis at the end of the study was cancelled due to outbreaks of Coldwater and Furunculosis.

Fish Health

Fish health followed standard procedures. Twenty were pooled monthly out of each treatment and were examined to determine fish health through basic necropsy. Samples of skin mucus and gill filaments were examined for external parasites or the presence of other abnormalities. The fish were opened and examined for visual signs of parasites or other indications of bacterial or viral disorders. Kidney imprints were taken from fish that exhibited signs that varied from 'normal' (swollen and inflamed hindgut, pink fat, anemia, swollen kidney). Imprints, when gram stained, showed the presence of *N.Salmonis* spores and/or bacteria. Kidney samples were collected and then combined into two-fish pools in tissue lysis buffer for Polymerase Chain Reaction (PCR) assays. Individual kidneys were streaked onto Tryptic Soy Agar and Tryptone Yeast Extract plus Salts Agar to isolate bacteria, primarily *Flavobacterium psychrophilum* (causes Coldwater Disease) and *Aeromonas salmonicida* (causes Furunculosis).

Results

Production Data

There were no significant differences in growth, on-station survival, and feed conversion rates between treatments fed Rangen EXSL 470 diet and the standard Hagerman diet (Table 1).

Average length in raceways 101 and 102 (EXSL 470) was significantly larger than average length in raceways 99 and 100 (Figure 1). Raceways 94-97 were not sampled because they were within the 21-day withdrawal period from MS-222. However, the condition factors for raceway 101 and 102 were not different from 99 and 100.

Dorsal Fin Index was significantly ($p < 0.05$) greater for the Hagerman diet (3.6) compared to the EXSL 470 Diet (2.8).

Phosphorus Discharge

There were no significant differences in phosphorus discharge between treatments (0.09 vs 0.09 mg/l).

Proximate Analysis

The initial proximate analysis was similar for both groups (Table 2). However, the initial ash content of steelhead in the Hagerman Diet raceways was significantly higher (0.1%) than the EXSL 470 study raceways ($p < 0.05$). Moisture, lipid, and protein composition was not different between groups.

Fish Health

There were no significant differences in survival between treatments (Table 1). Survival was significantly lower in the experimental Dworshak B raceways than the one non-experimental raceway (Raceway 98 with 88% survival). There were no notable differences between treatments during fish health exams (Table 3).

Both treatments tested positive for Coldwater disease in January and were subsequently treated with 908g/ton Aquaflor[®] at 1% daily feeding rate in demand feeders from 1/24-2/2/2009 to control mortality. Both treatments tested positive for Frunculosis in late February and were treated with 1816g/ton Aquaflor[®] at 0.5% daily feeding rate by hand from 3/4-13/2009 to control mortality.

Downstream Survival

Downstream survival will be reported by Idaho Department of Fish and Game in a separate document.

Discussion

There was no difference between the two feed treatments based on the parameters measured. Treatment Dworshak B survival was lower than the Sawtooth stock (94% survival) and the one non-experimental, untagged (PIT or CWT) Dworshak B stock raceway. The poorer survival was likely a combination of the more difficult rearing of the Clearwater Stock (HHET 2006), the effect of tagging on survival (Hagerman 2007), and the Frunculosis and Coldwater epizootics.

Low survival affected Feed Conversion Rates (FCR) which were about 20% higher than Sawtooth FCR's (1.0). Average lengths were slightly higher in the EXSL 470 raceways 101 and 102 than Hagerman Diet raceways 99 and 100. However, average release size (fpp) was not different between the two treatments. Raceways 101 and 102 may have been slightly larger because of an undetermined quantity of wasted feed that accumulated periodically. Raceways 101 and 102 are prone to floating debris and feed accumulation because of the hydrodynamics of the bottom deck headbox system. Future feeding studies should avoid these raceways.

Despite claims of better feed conversion and assimilation, the EXSL 470 diet did not improve phosphorus discharge rates. Instantaneous phosphorus discharge was very close to the NPDES permit concentration limitation of 1.0 mg/l.

Fish Health was generally poor for both groups. This may have affected the results of the trial.

Future Research

The Dworshak B smolts were transferred to Magic Valley Fish Hatchery in Brood Year 2009. The Hatchery will not continue this study in BY2009 with alternative stocks since no benefits were realized during the BY2008 trial. The Hatchery will focus experimental efforts on Hatchery rearing densities in BY2009 in response to draft recommendations from the Hatchery Review Team. The Hatchery may want to re-evaluate the EXSL 470 diet in future Brood Years with an alternative stock given the fish health issues in the BY2008 Dworshak B stock.

References

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Figures and Tables

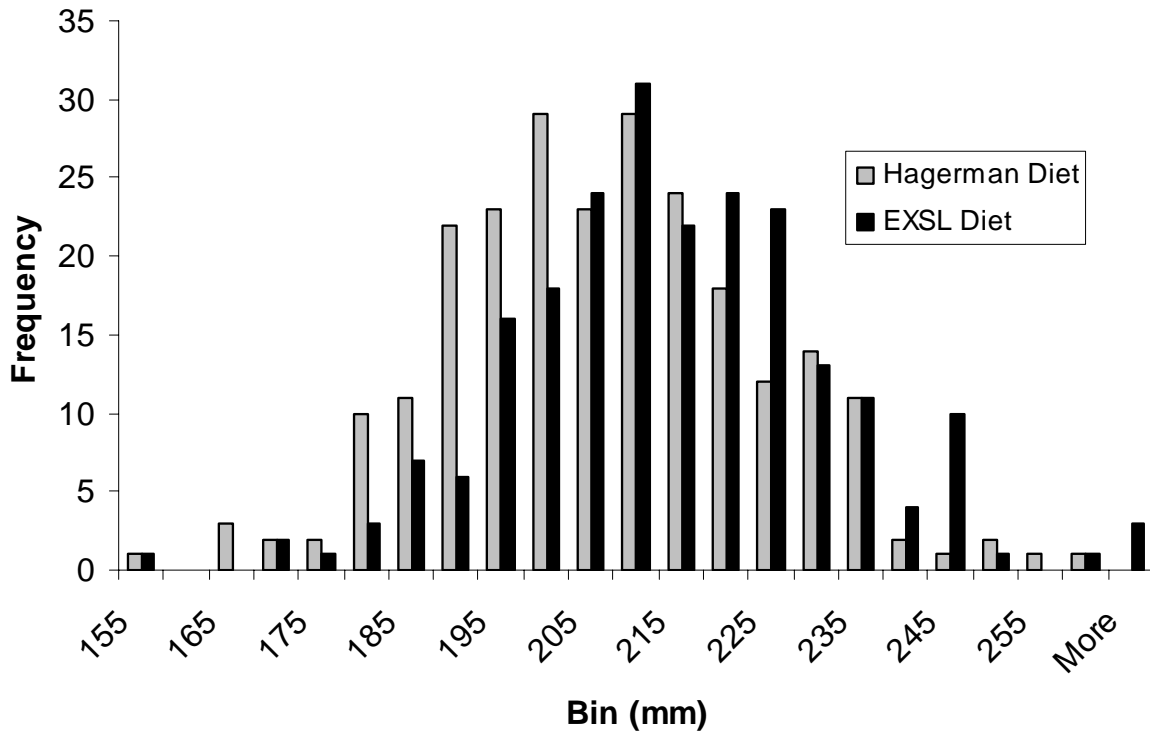


Figure 1. Comparison of length frequency (mm) of Hagerman and EXSL Diets on Dworshak B Stock Steelhead, BY2008 Hagerman National Fish Hatchery

Table 1. Comparison of EXSL 470 diet versus Hagerman Diet on Dworshak B stock steelhead, Hagerman National Fish Hatchery Brood Year 2008

Treatment	Feed Fed (lbs)	Smolts Released (lbs)	Feed Conversion Ratio	Beginning Inventory (12/15/09)	Smolts Released (#) (4/8-14/09)	Fish Per Pound	On-Station Survival	Condition Factor
EXSL 470	19,527	16,745	1.17	91,237	76,393	4.56	83.7%	0.000323
Hagerman	19,961	16,685	1.20	91,581	76,882	4.61	83.9%	0.000328

Table 2. Whole Fish Body Proximate Analysis for Comparison of EXSL 470 diet versus Hagerman Diet on Dworshak B stock steelhead, Hagerman National Fish Hatchery Brood Year 2008

Diet	Sample	Raceway	Moisture	Ash	Lipid	Protein
EXSL 470	Initial	96	73.4	2.4	5.8	65.2
EXSL 470	Initial	97	73.2	2.4	6.6	64.0
EXSL 470	Initial	101	72.3	2.4	7.7	62.4
EXSL 470	Initial	102	73.2	2.3	7.2	64.4
Hagerman	Initial	94	72.9	2.5	6.7	64.9
Hagerman	Initial	95	72.8	2.5	6.9	64.4
Hagerman	Initial	99	72.1	2.4	7.2	64.1
Hagerman	Initial	100	71.9	2.5	7.6	62.4

Table 3. Results Fish Health Exams of BY08 Dworshak B summer steelhead for EXSL 470 vs Hagerman Diet comparison

Obs.	December		January		February		March	
	EXSL	Hag	EXSL	Hag	EXSL	Hag	EXSL	Hag
						Act		
	Act	Act	Act	Act		d.e.;		
	d.e.;	d.e.;	d.e.;	d.e.;	Act	b.e.;		
	s.b.;	s.b.;	b.e.;	t.f.;	d.e.;	pe;	b.e.;	b.e.;
External	Gyro	Gyro	Gyro	Gyro	b.e.; t.f.	Gyro	d.e.	d.e.
							Slight	Slight
Gills	Pale	Pale	Norm	Norm	Norm	Norm	Pale	Pale
Internal	N. sal.	N. sal.	N. sal	N. sal	N. sal.	N. sal.	N. sal.	N. sal
Bacterial	n/a	n/a	n/g	n/g	CWD	CWD	n/g	n/g
			CWD	CWD				
PCR	N. sal.	N. sal.	N. sal.	N. sal.	N. sal.	N. sal.	N. sal.	N. sal.

Abbreviations

<i>N. sal.</i> =	<i>Nucleospora salmonis</i>	Act =	Active	CWD =	Coldwater Disease
	No				
ng =	Growth	d.e. =	Dorsal Fin Erosion	pe =	popeye
neg =	Negative	t.f. =	Tail fraying	ss =	swollen spleen
Norm =	Normal	Amb =	Ambiphysa	s.b. =	soreback
Mod =	Moderate	Gyro =	Gyrodactylus	b.e. =	bad eyes

* Treated for CWD with 908g/ton Aquaflor at 1% daily feeding rate from 1/24- 2/2/2009

** Treated for CWD with 1816g/ton Aquaflor at 0.5% daily feeding rate from 3/4-3/13/2009

*** PIT tagging occurred January 6-8th, 2009