

Effects of Diet and Housing Density on Zebrafish Reproduction and Progeny Development

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Background/Experimental Design

DIET (3)

- Zeigler™ Irradiated Zebrafish – pellet
- New Life Spectrum Algaemax™ – wafer
- Enviroflight™ Insect – meal

HOUSING DENSITY (2)

- LGH (3.3 fish/liter)
- DGH (6.6 fish/liter)

HYPOTHESES

- Fish fed diets high in protein and fat (especially polyunsaturated fatty acids (PUFA)), and housed densely will gain more weight.
- Housing density will also affect embryo and larvae size.

METHODS

- Casper EKK assigned a foreign diet (**ZEIGLER**, **ALGAE**, OR **INSECT**) and housing density (LGH or DGH)
 - Fed 5% average body weight for 3 weeks
 - Re-calibrated ration each week after weighing fish to account for growth
- Breed each group (**ZEIGLER**, **ALGAE**, **INSECT**; LGH, DGH)
 - Eggs collected, monitored/imaged over 10 days



Zebrafish Nutrient Requirements

what we know so far

- **Crude Protein – 45-55%**
- **Lipids/Fats – 12-15%**
 - **n-6 and n-3 polyunsaturated fatty acids (PUFA)**
 - **eicosapentaenoic acid (EPA)**
 - **arachidonic acid (AA)**
- 10 essential amino acids
- Crude Carbohydrates
- Crude Fiber
- Zinc Boron, Copper, Manganese
- Iron
- Vitamins A, D, E
- Carotenoids

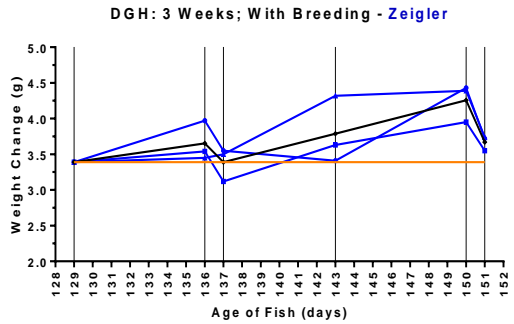
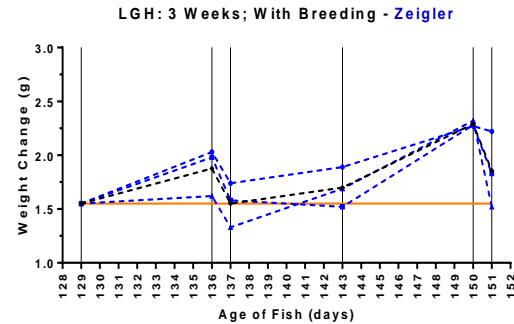
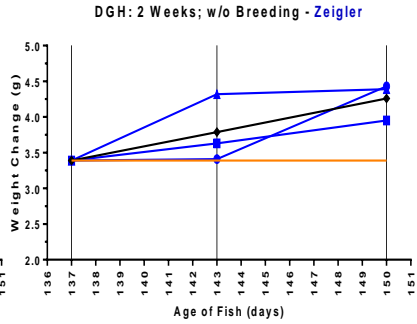
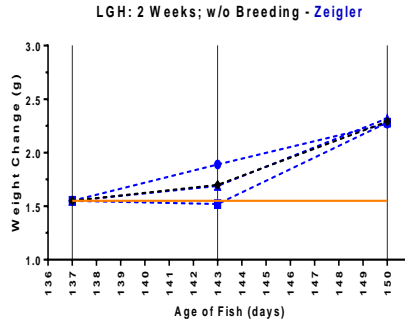
Proximate Nutrient Analysis

Diet	Gemma™	Zeigler™	New Life Spectrum™	Enviroflight™
Type of Food	Pellet	Pellet	Wafer	Meal
Type of Protein	Fish-meal	Fish-meal	Algae	Insect
Moisture (%)	8	8.39	7.02	2.66
Dry Matter (%)	92	91.61	92.98	97.34
Crude Protein (%)	59	54.92	36.98	52.19
Crude Fiber (%)	0.2	0.71	4.18	7.34
Crude Carbohydrates (%)	5.9	11.10		10.55
Fat (%)	14	14.95	11.51	15.40
Total Digestible Nutrients (TDN) (%)		79.98		77.32

Proximate Nutrient Analysis – with PUFA

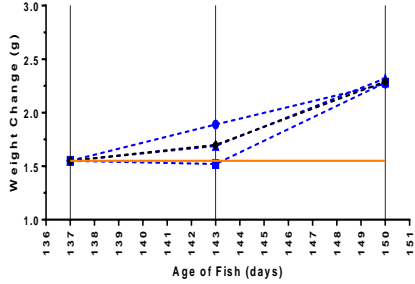
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PUFA (%)	5.18	2.691	1.3812	3.08
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Adult Weight Change Over Time

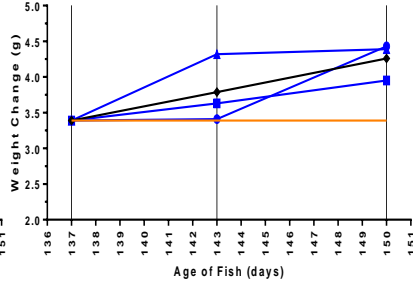


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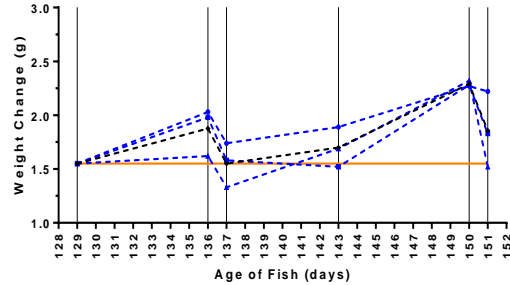
LGH: 2 Weeks; w/o Breeding - Zeigler



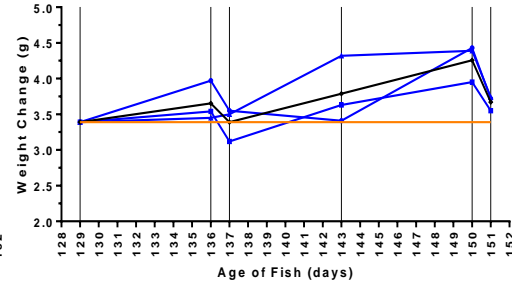
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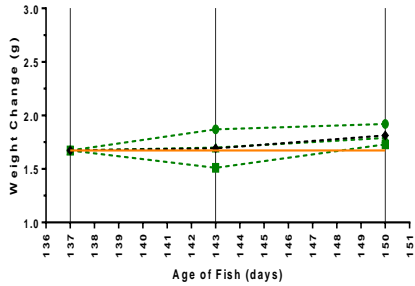
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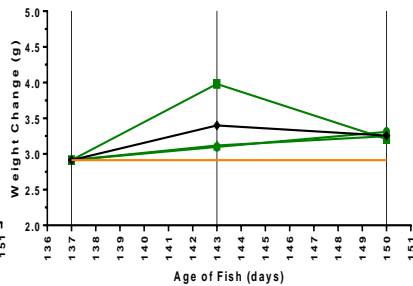
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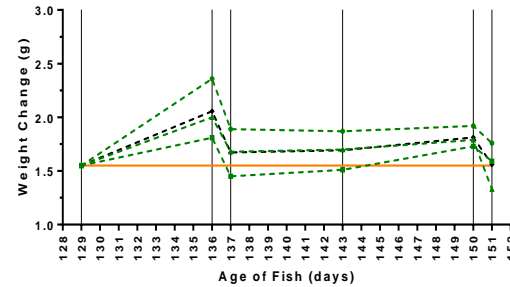
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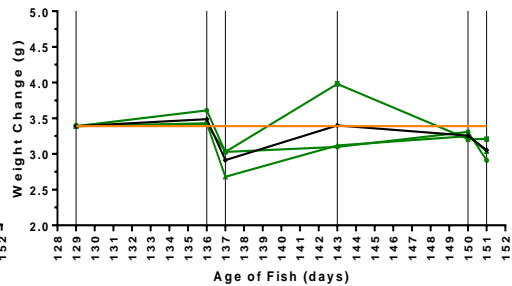
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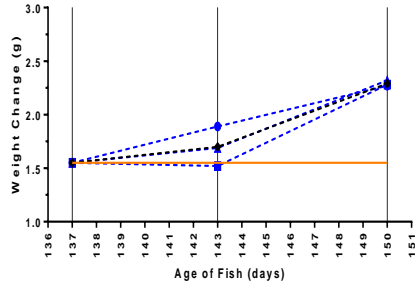


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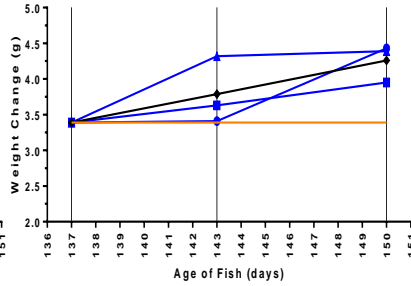


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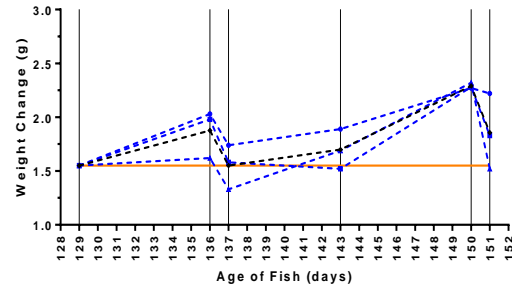
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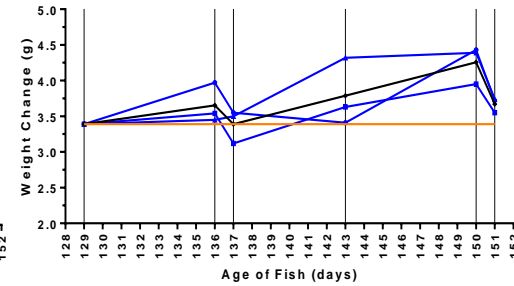
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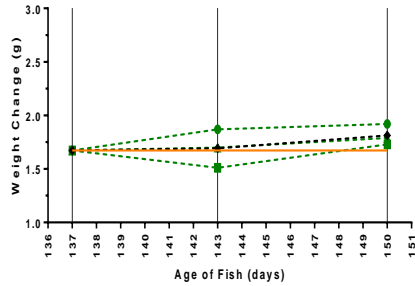
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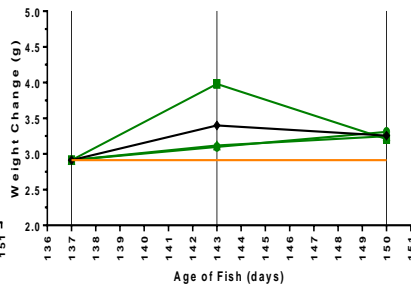
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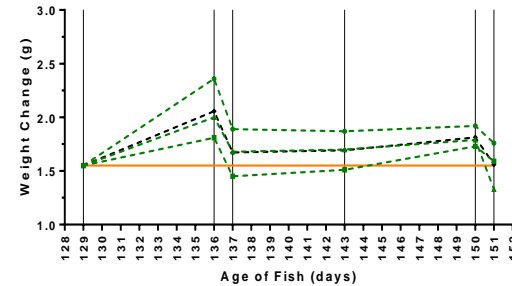
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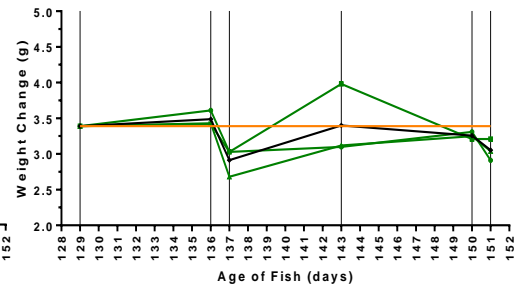
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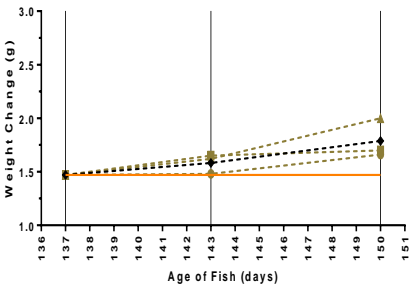
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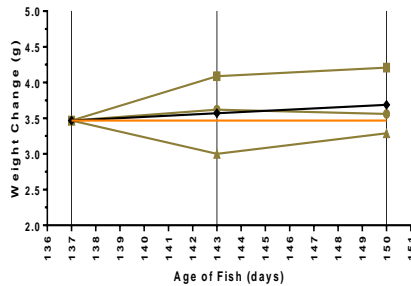
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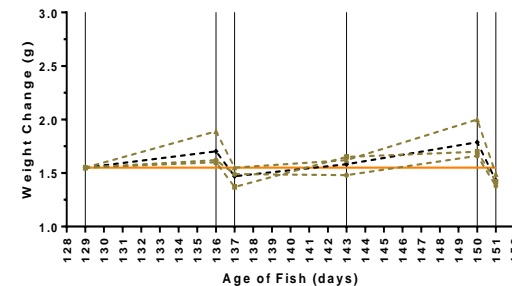
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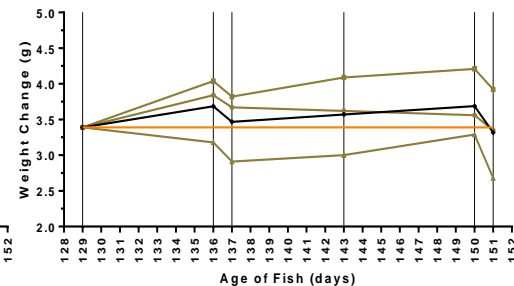
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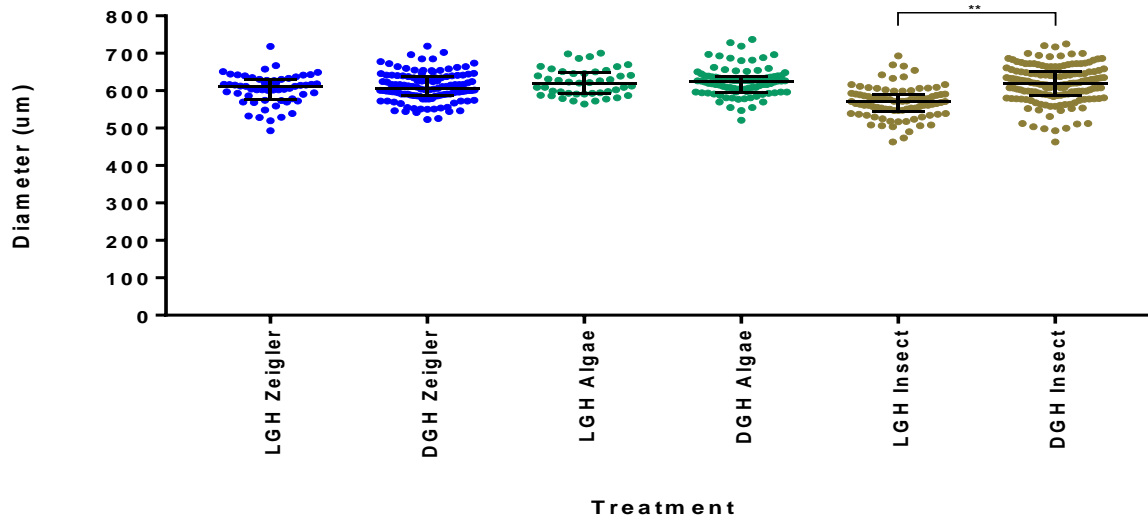


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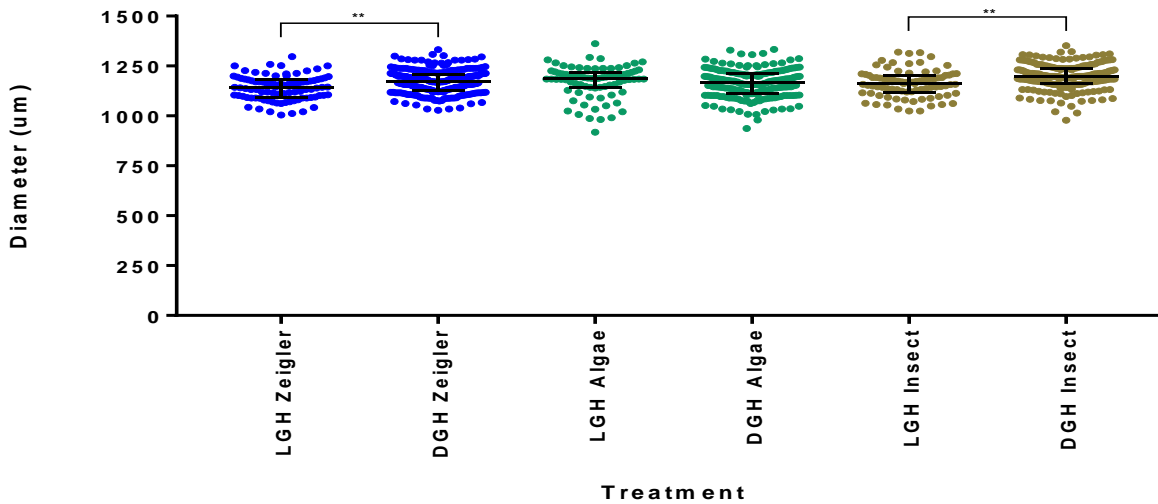


Progeny Embryo Size

1 dpf - Yolk Sac Diameter

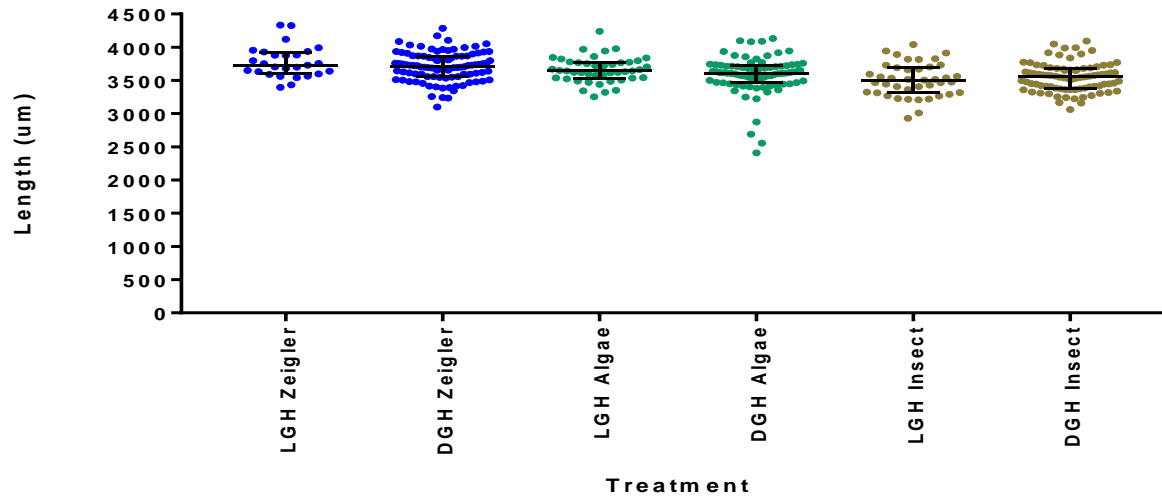


1 dpf - Chorion Diameter

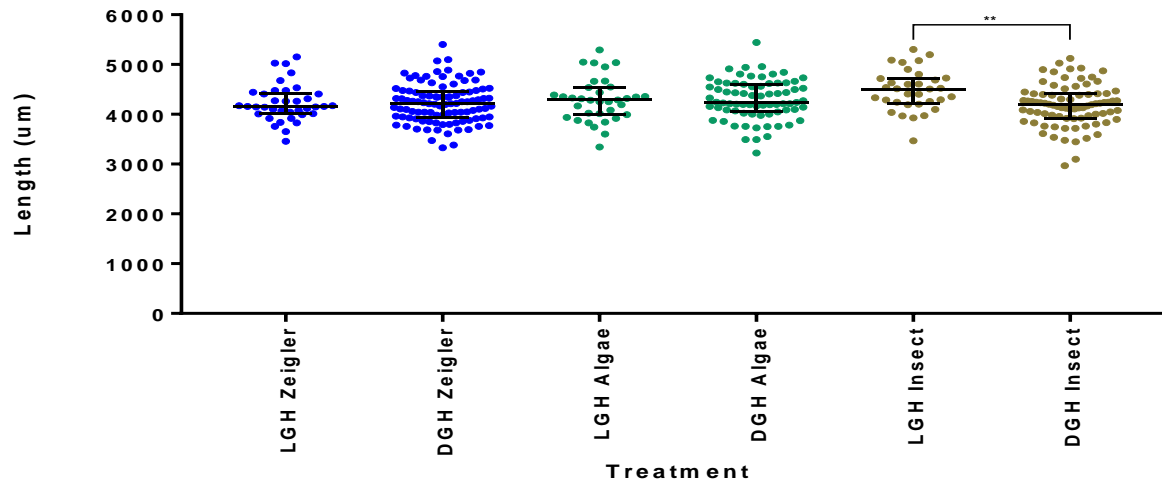


Progeny Larvae Length

5 dpf - Total Length

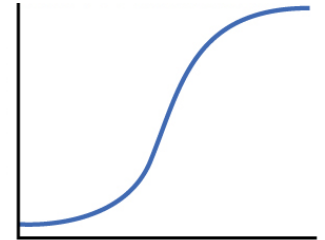


10 dpf - Total Length



Conclusions

- Fatty acid percentages are low in **algae**; could help explain low growth of adults and lack of significant relationship in progeny size
- Lower density causes fish to gain more weight than higher density
 - Reduced hierarchy?
 - Fish were still young – they may have been using energy towards growth instead of reproduction
 - Longer feeding trials are needed to further investigate homeostasis/reproduction energy curve
- Modified diet causes short-term effects on fish weight change
 - **Zeigler**: gained weight
 - **Algae**: lost weight
 - **Insect**: stayed the same
- **Insect** meal solidifies its candidacy as a staple zebrafish diet
 - Higher fat content than fishmeal diets, but lower in PUFA content
 - High variability in weights of densely housed fish – hierarchy playing a major role?
 - Differing effects on embryos vs. larvae development
 - **LIGHT** group-housing promotes larger embryos – *better for CRISPR*
 - **DENSE** group-housing promotes larger larvae (at 10 dpf) – *better for survival curves, etc.*



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