# Assessment of Genetic X Environmental Interactions on Growth Performance of Five Lines of Rainbow Trout Raised in Unique Environments

Beth Cleveland, Ph.D.

Aquaculture Innovation Workshop

NCTC, Shepherdstown, WV

08/15/2015

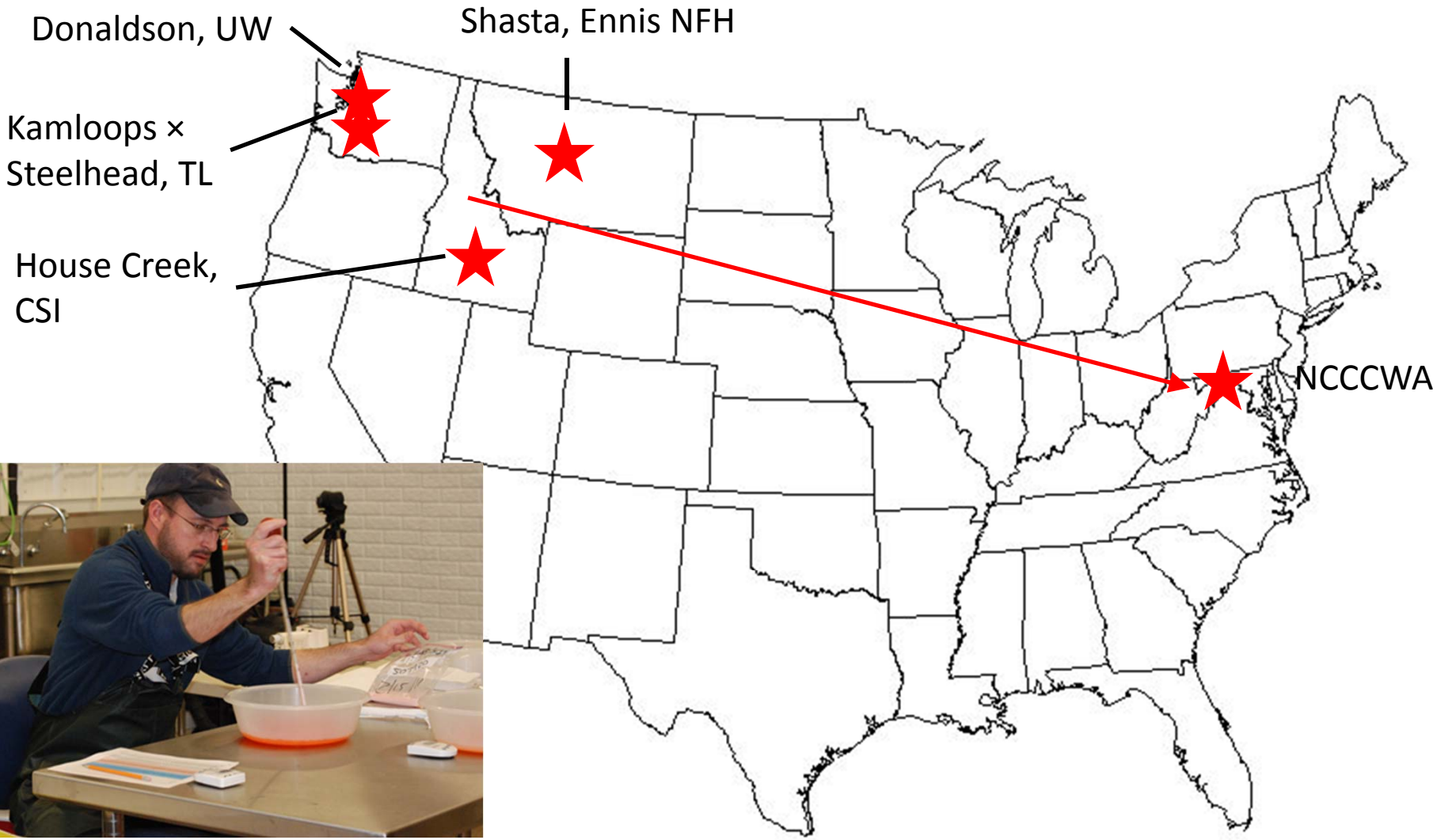
# National Center for Cool and Cold Water Aquaculture

**Mission: To support and enhance the Nation's cool and cold water aquaculture production through research and technology transfer**

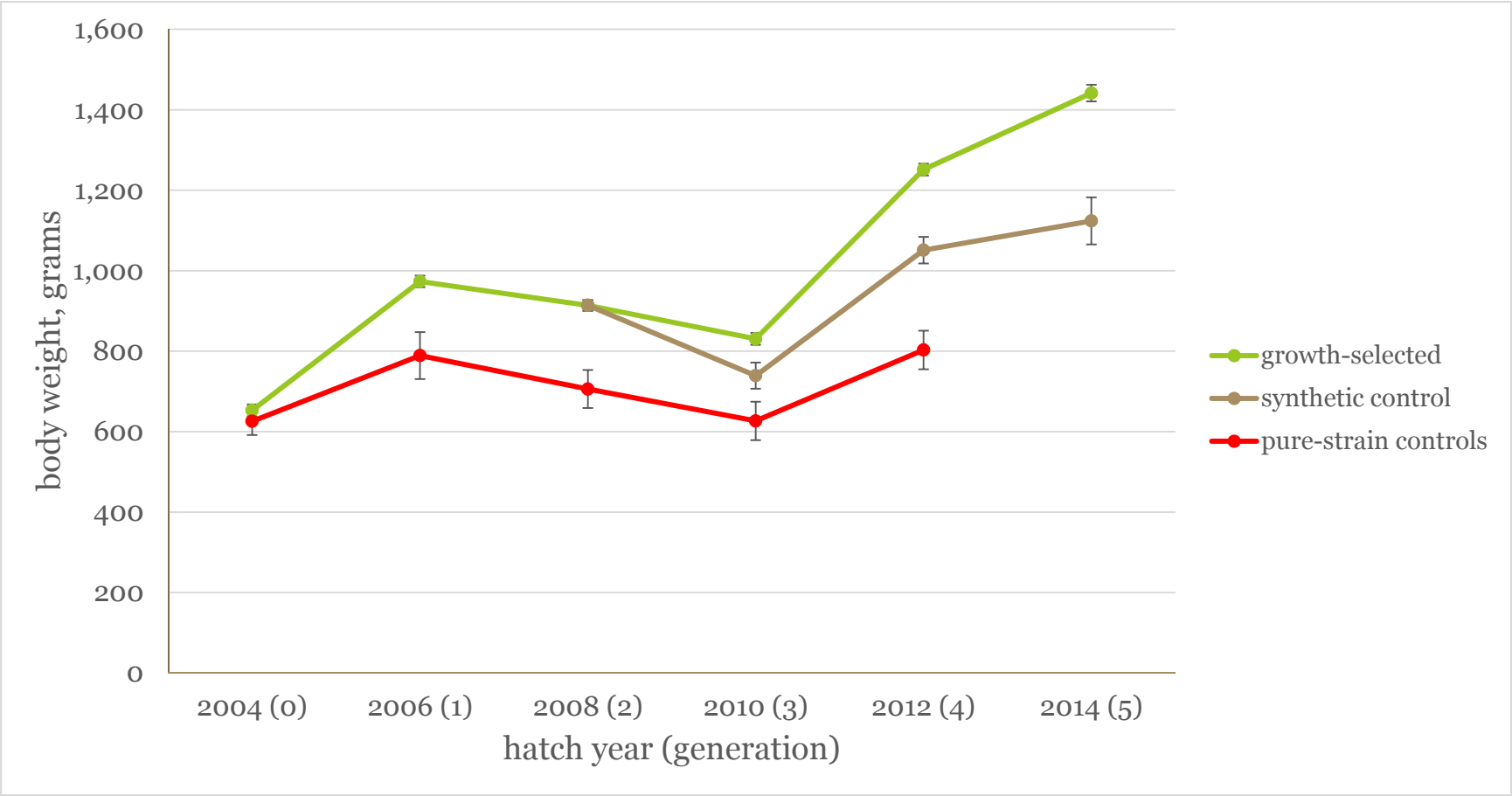
# Even Year Class

- Selection for improved growth rate to ~1 year of age (post hatch)
  - Growth line (~100 families/generation)
    - 5 generations of selection to date
  - Synthetic control line (~20 families/generation)
  - Pure-strain control lines (~15 families/line/gen.)

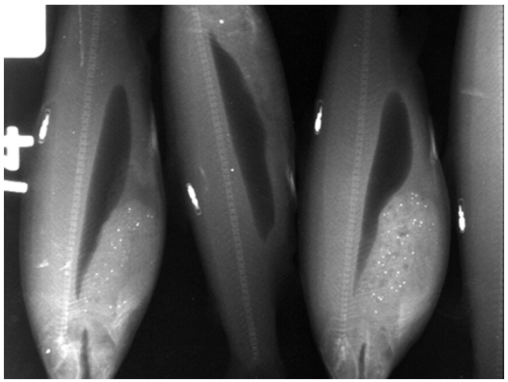
# Origins of NCCCWA Populations

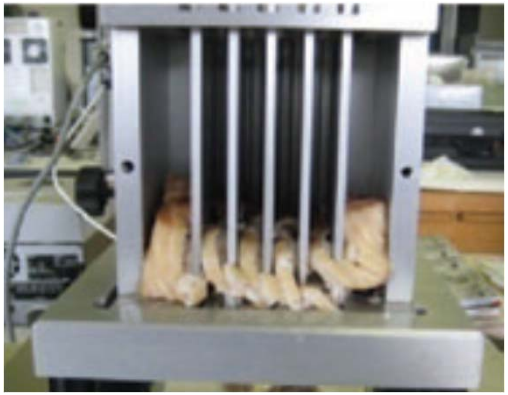


# Genetic trends for 13-month body weight

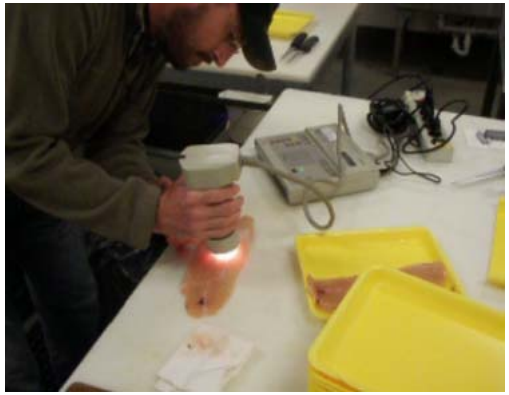


# Characterization of additional traits





| Trait | Heritability |
|---|---|
| 10-month BW | 0.47 ± 0.06 |
| Thermal growth coefficient | 0.19 ± 0.05 |
| Feed efficiency | 0.20 ± 0.13 |
| Fillet yield | 0.55 ± 0.26 |
| Shear force | 0.39 ± 0.15 |
| Belly flap thickness | 0.63 ± 0.27 |
| L* | 0.47 ± 0.26 |
| a* | 0.17 ± 0.17 |
| b* | 0.81 ± 0.28 |
| Fillet fat | 0.58 ± 0.17 |



# Specific Objectives:

- Evaluate performance of the Growth Line against commercially available rainbow trout
- Four unique environments
  - NCCCWA-USDA (Leetown, WV)
  - NCWMAC-USDA (Franklin, ME)
  - The Conservation Fund's Freshwater Institute (Shepherdstown, WV)
  - Casta Line Fish Farm (Goshen, VA)
- Characterize fillet quality attributes (WVU/TCFFI) and physiological response variables (NCCCWA)

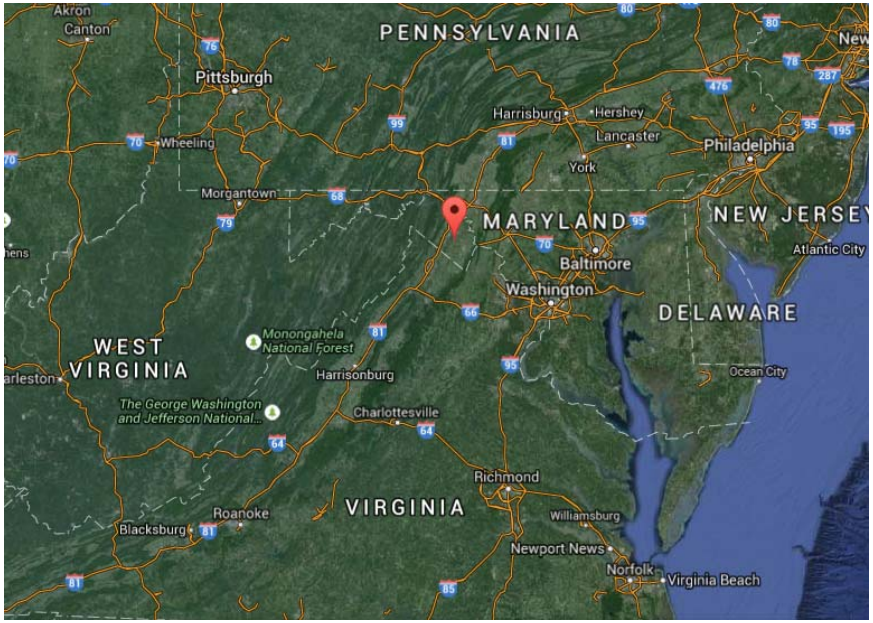
# Genetics

1. Growth Line (NCCCWA)
   - Selected for body weight at 10 mon, 13 mon
   - TGC from 10-13 mon
2. Synthetic Control (NCCCWA)
   - Randomly mated population
3. Commercial Strain A
   - Selected for body weight at 10 mon
4. Commercial Strain B
5. Commercial Strain C

# Environments

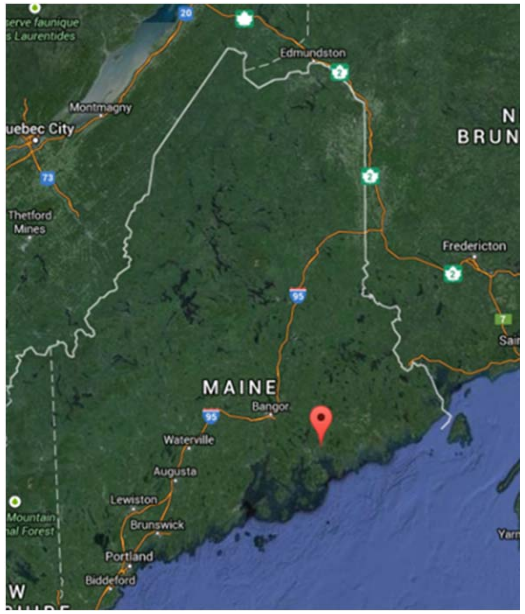
| | NCCCWA | TCFFI | NCWMAC | Casta Line |
|---|---|---|---|---|
| **Environment** | Indoor RAS | Indoor RAS | Indoor RAS | Outdoor raceways |
| **Water Temp. (deg C)** | 12.5-14.0 | 12.3-14.5 | 9.0-13.0 | 12.5-13.5 |
| **Tanks** | 4, 3 $m^3$ | 3, 10 $m^3$ | 3, 8 $m^3$ | 4, 10 $m^3$ |
| **Lighting** | Ambient | 24 hr | Ambient | Ambient |
| **Feeding** | Auto. feeders | Auto. feeders | Auto. feeders | Hand-fed to sat. 3x/day |
| **Comingled?** | Yes | Yes | Yes | No |
| **# of strains** | 5 | 5 | 2 | 2 |
| **Egg hatch** | NCCCWA | NCCCWA | NCWMAC | NCCCWA |
| **Diet** | Zeigler Bros., Inc. 42% Protein, 16% Fat | | | |

# National Center for Cool and Cold Water Aquaculture

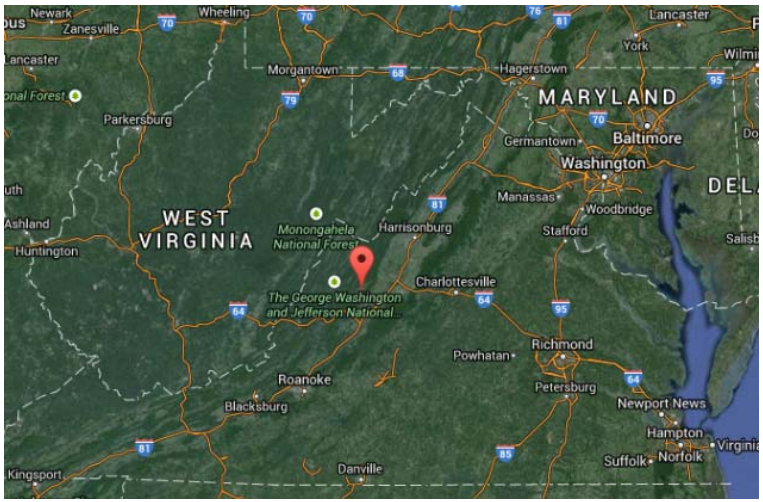


# The Conservation Fund's Freshwater Institute

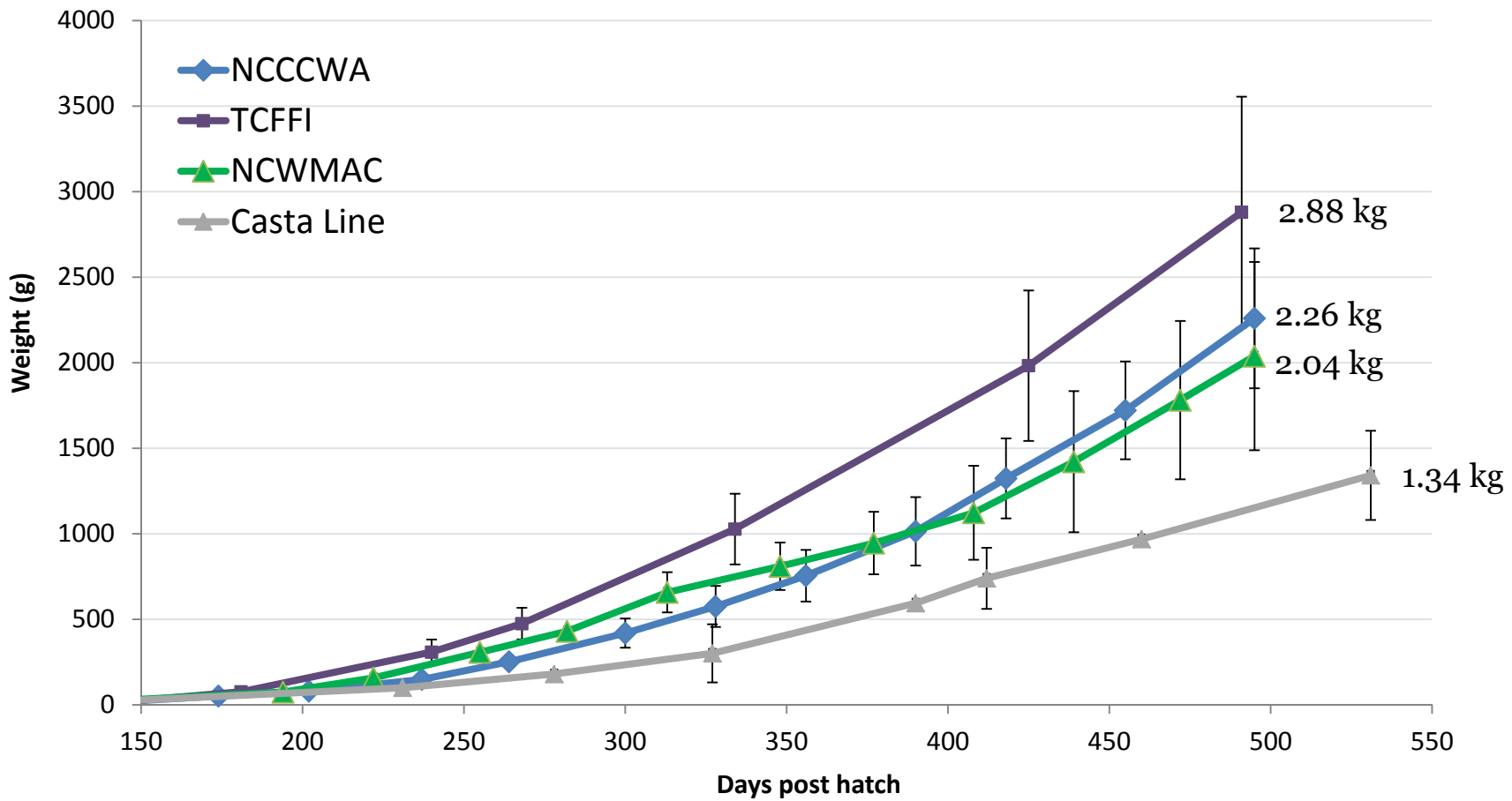
# National Cold Water Marine Aquaculture Center



# Casta Line Trout Farm

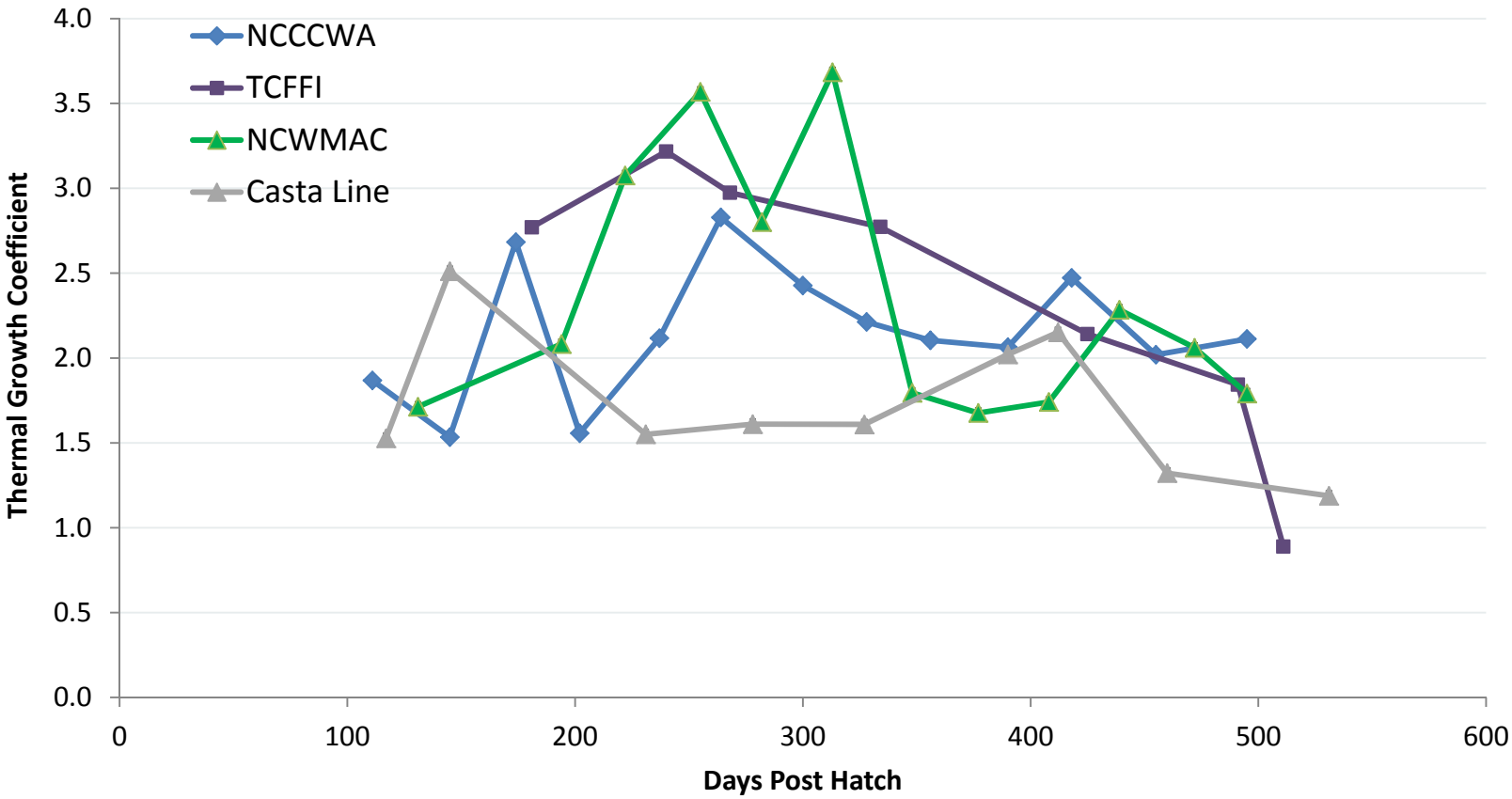


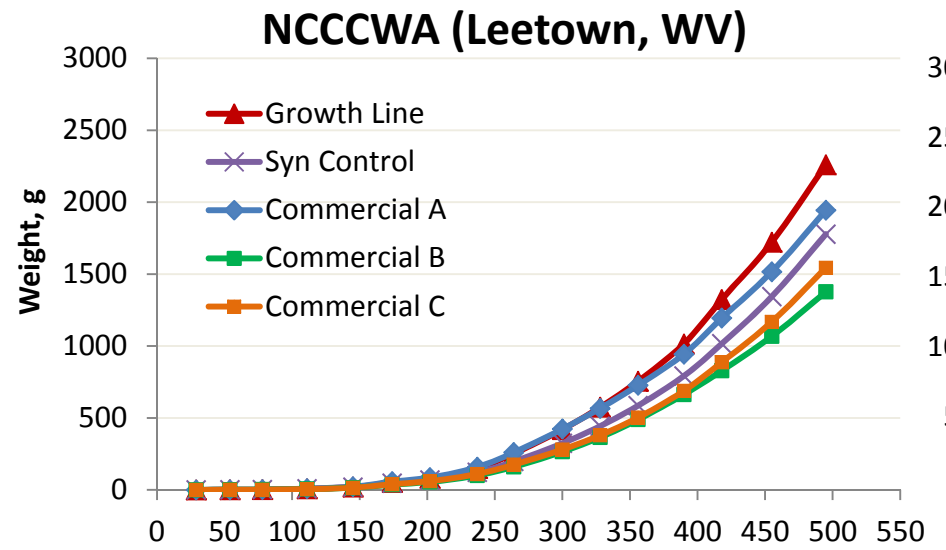
# Growth Line Performance Across All Locations

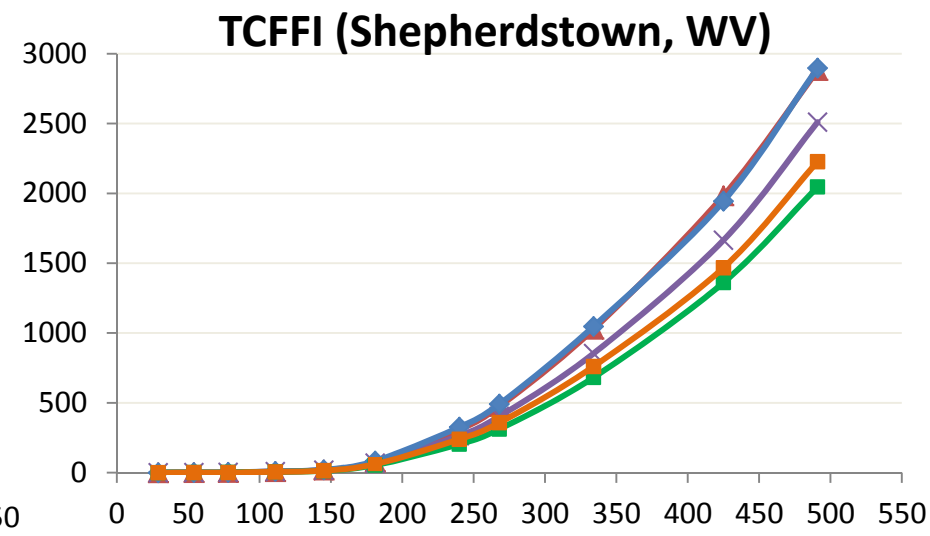


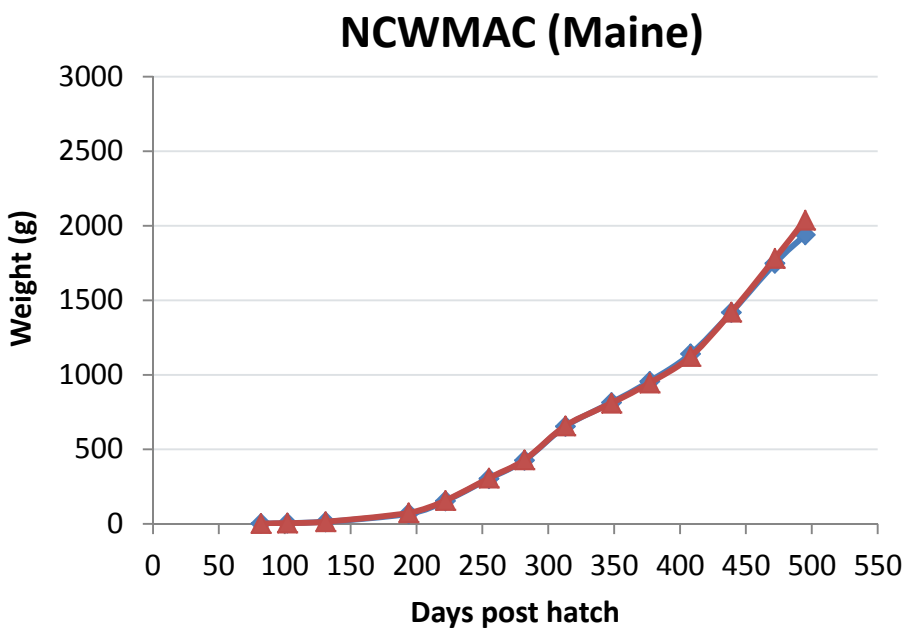

Mean ± StDev

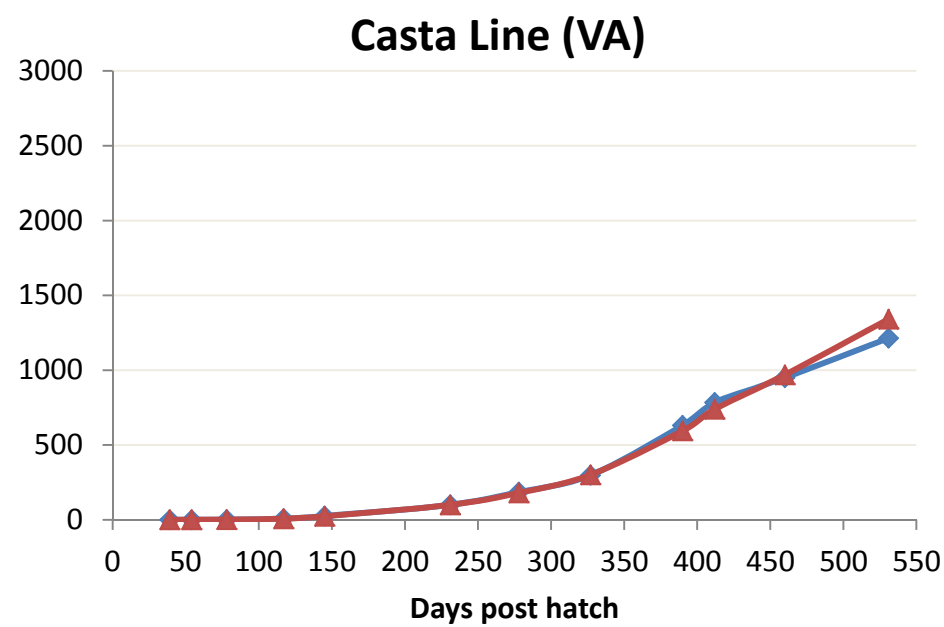
# TGC Across All Locations



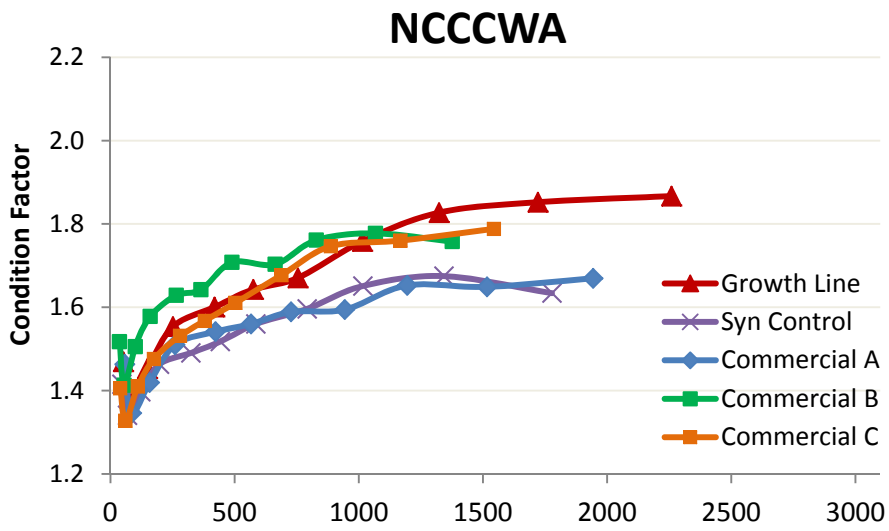

NCCCWA (Leetown, WV)
Weight, g
Growth Line
Syn Control
Commercial A
Commercial B
Commercial C
0
500
1000
1500
2000
2500
3000
0 50 100 150 200 250 300 350 400 450 500 550

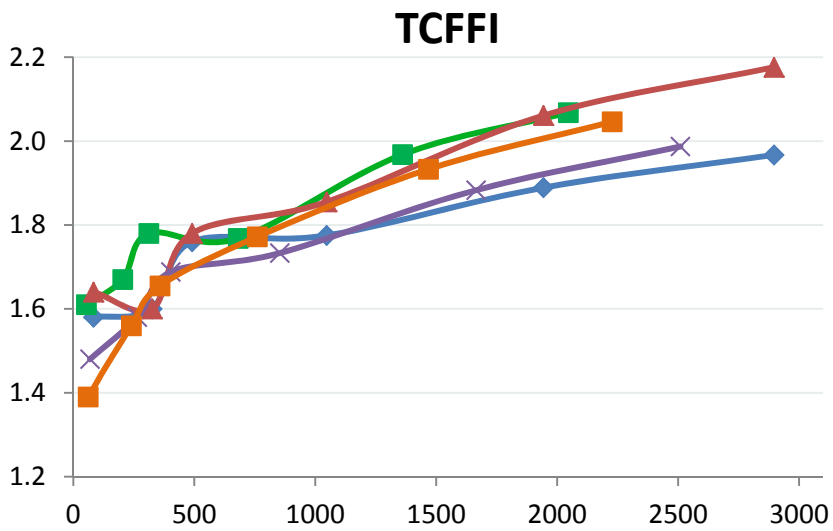

TCFFI (Shepherdstown, WV)
0
500
1000
1500
2000
2500
3000
0 50 100 150 200 250 300 350 400 450 500 550

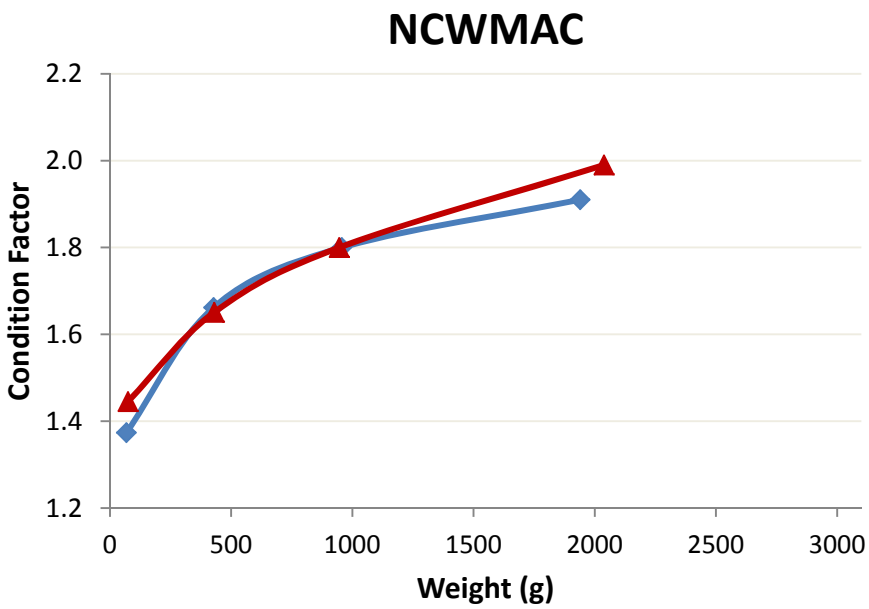

NCWMAC (Maine)
Weight (g)
0
500
1000
1500
2000
2500
3000
0 50 100 150 200 250 300 350 400 450 500 550
Days post hatch

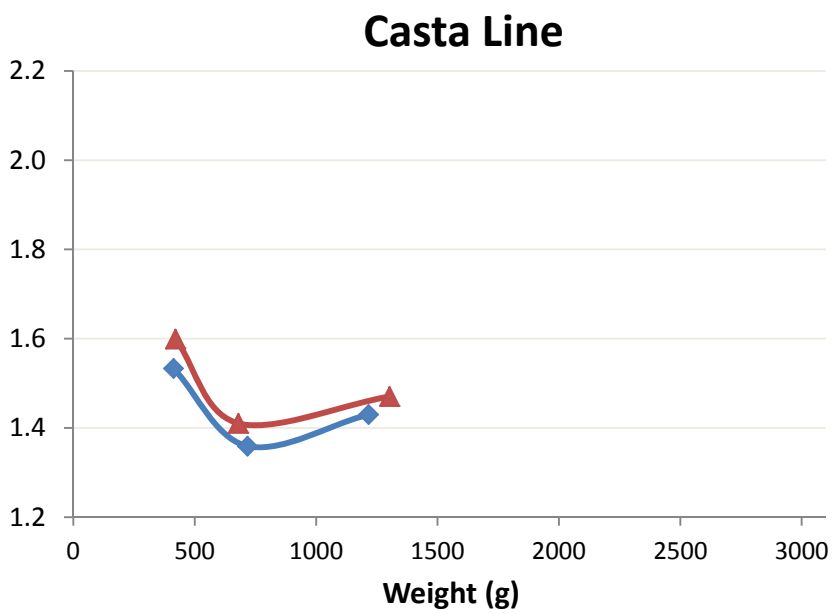

Casta Line (VA)
0
500
1000
1500
2000
2500
3000
0 50 100 150 200 250 300 350 400 450 500 550
Days post hatch

# Condition Factor

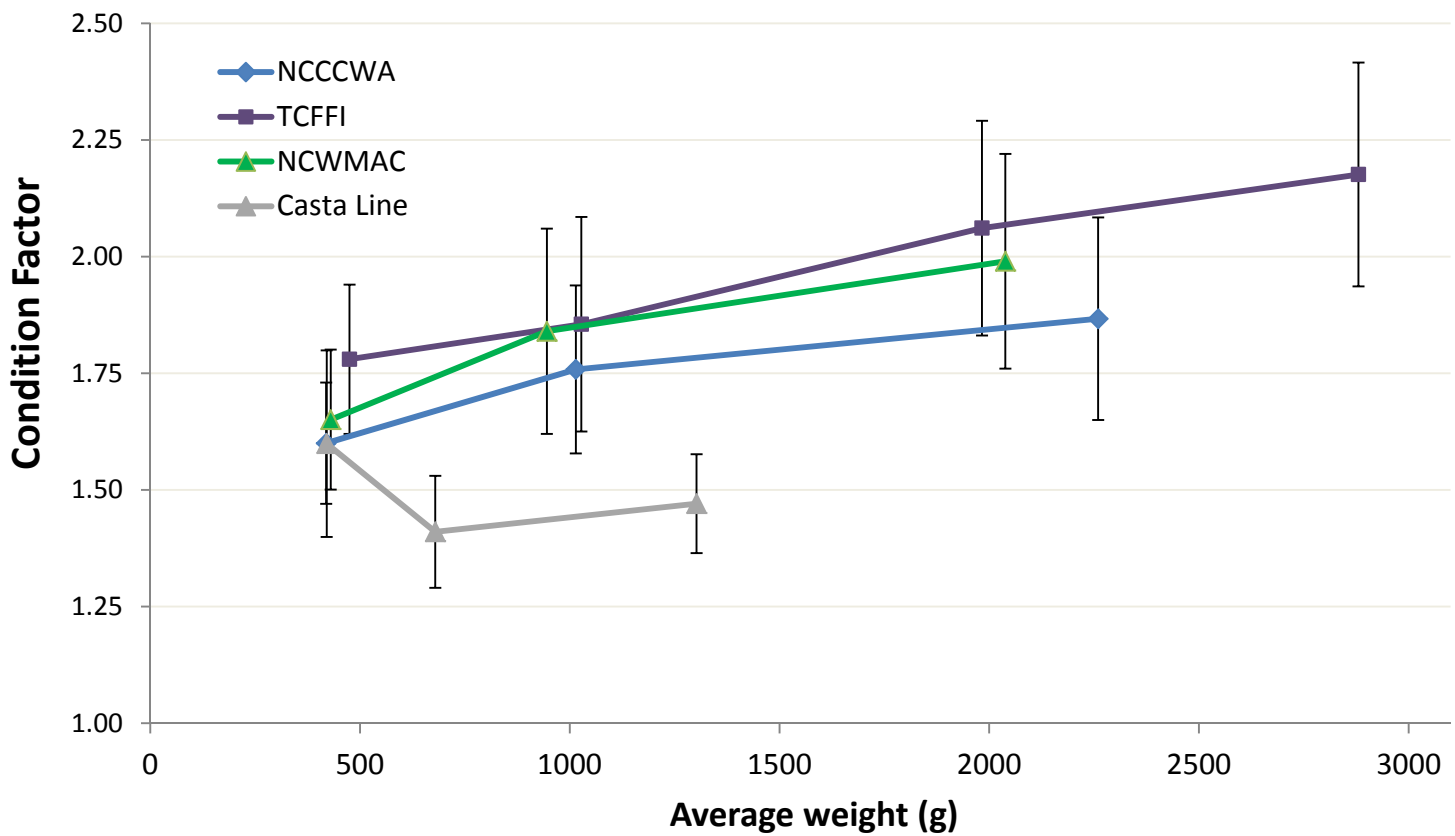


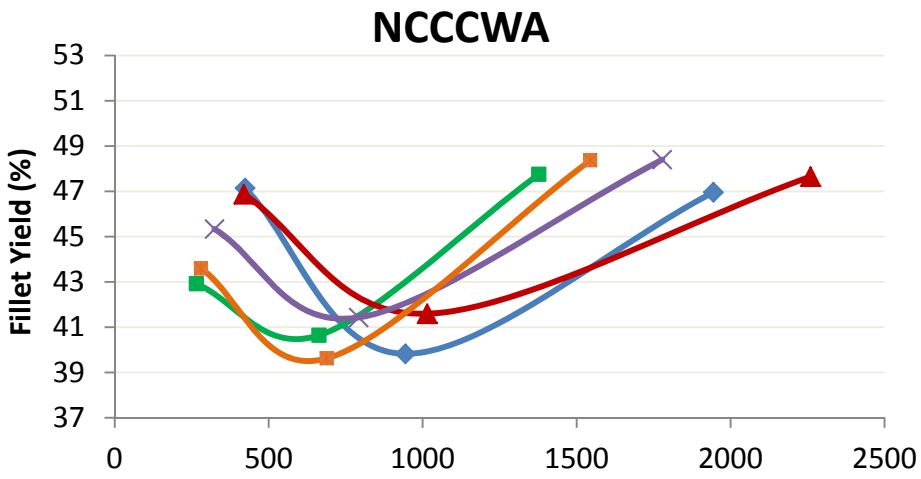



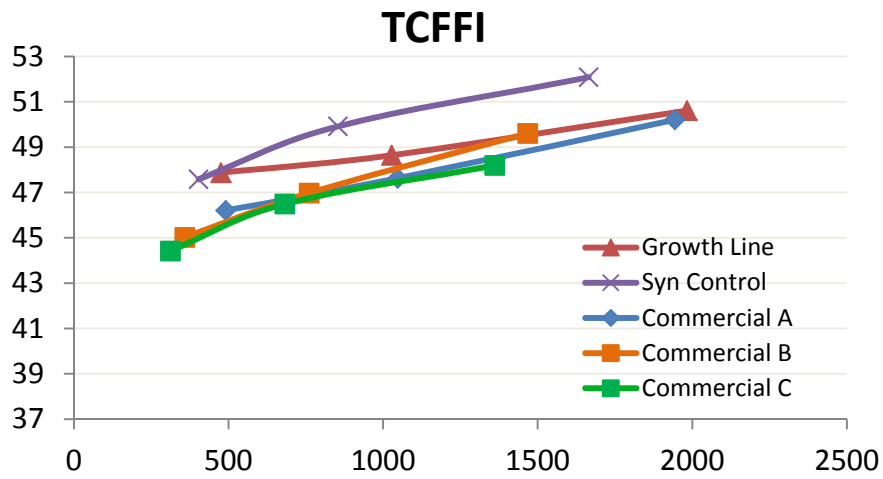
# Condition Factor Across All Locations

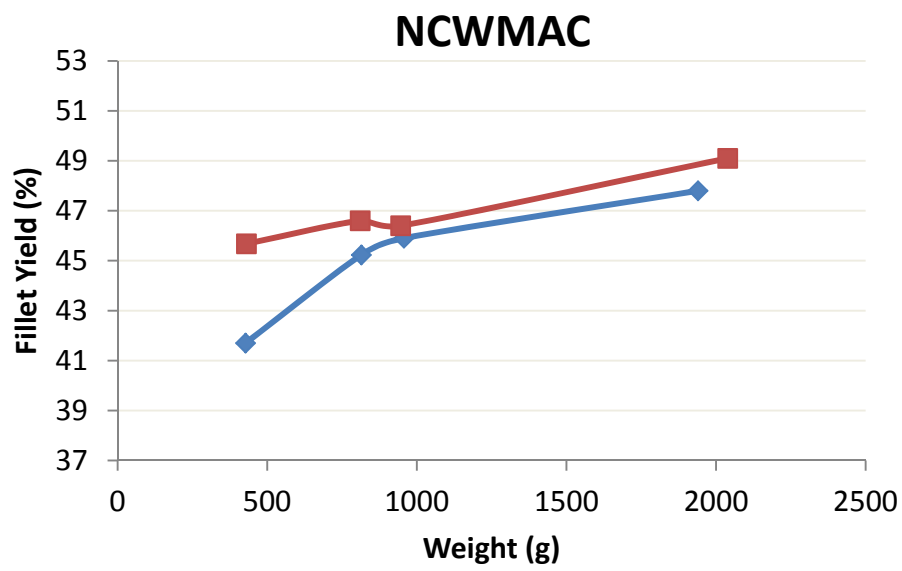


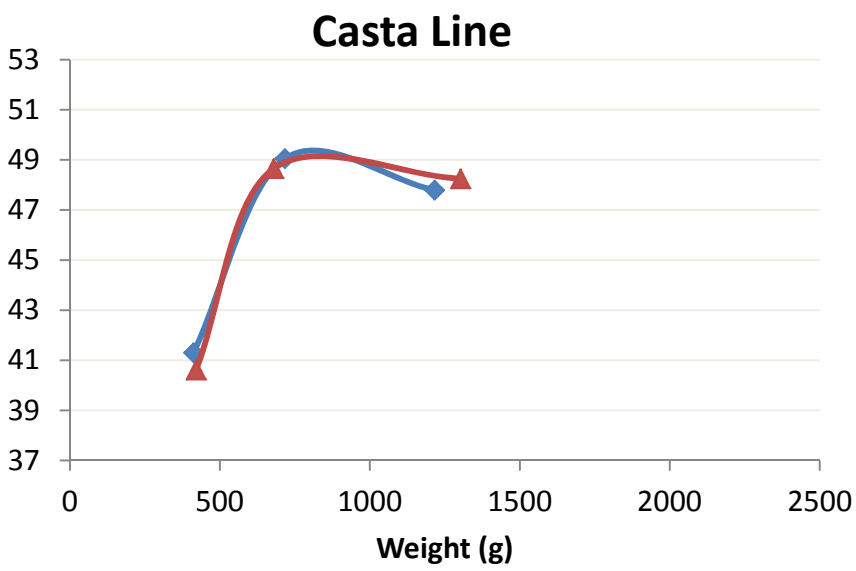

Mean ± StDev

# Fillet Yield

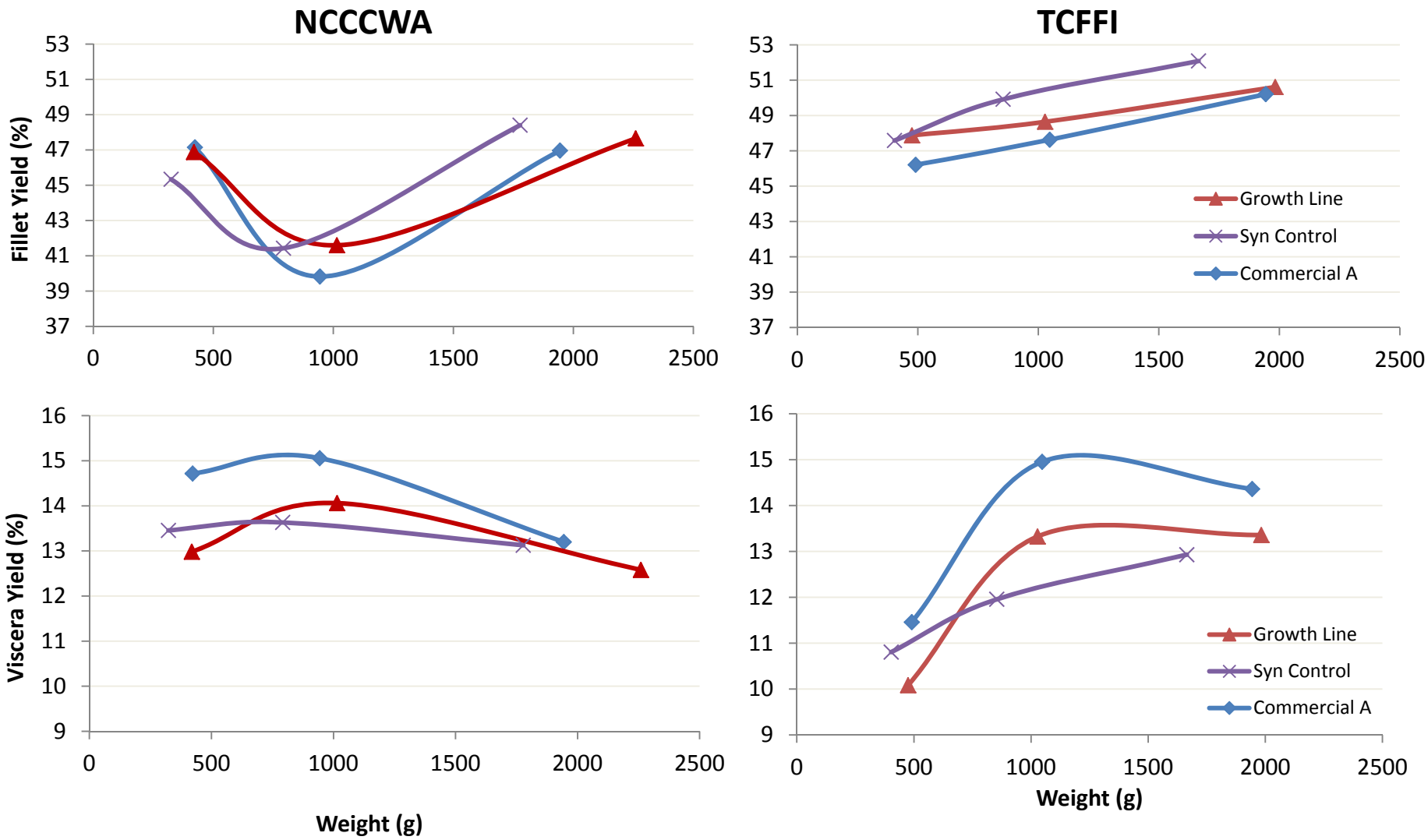


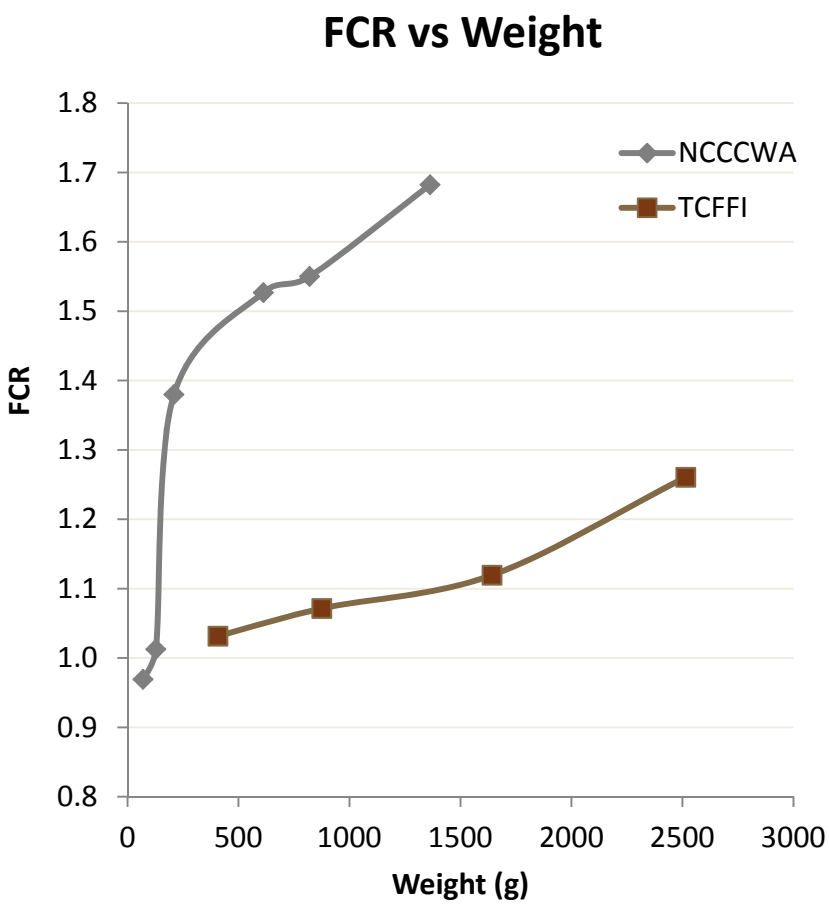



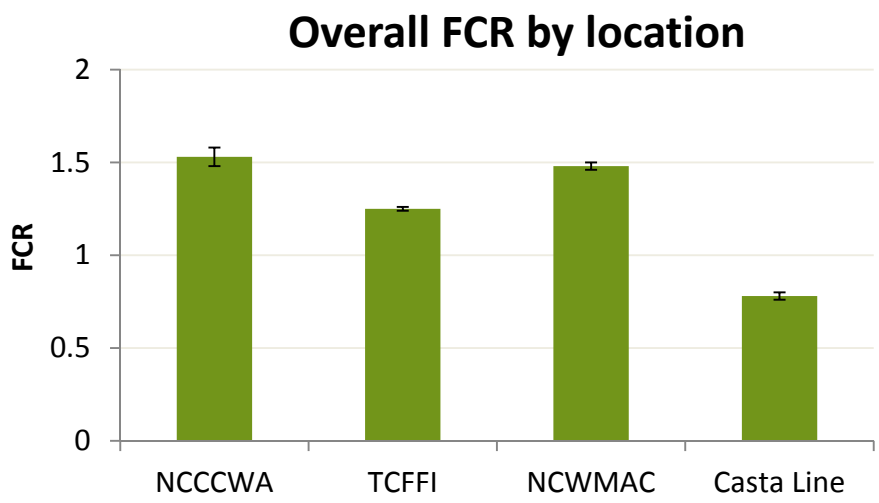



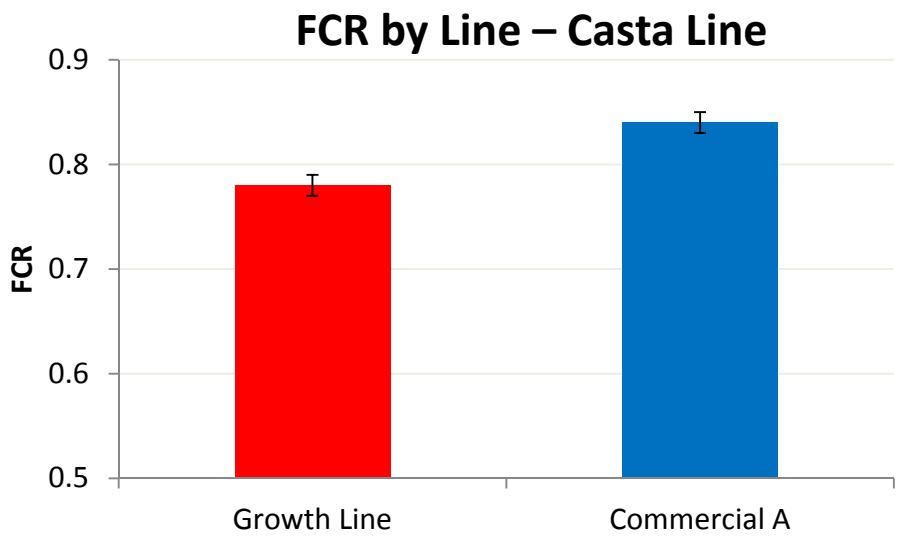
# Selection for Growth - Negative effects on fillet yield?



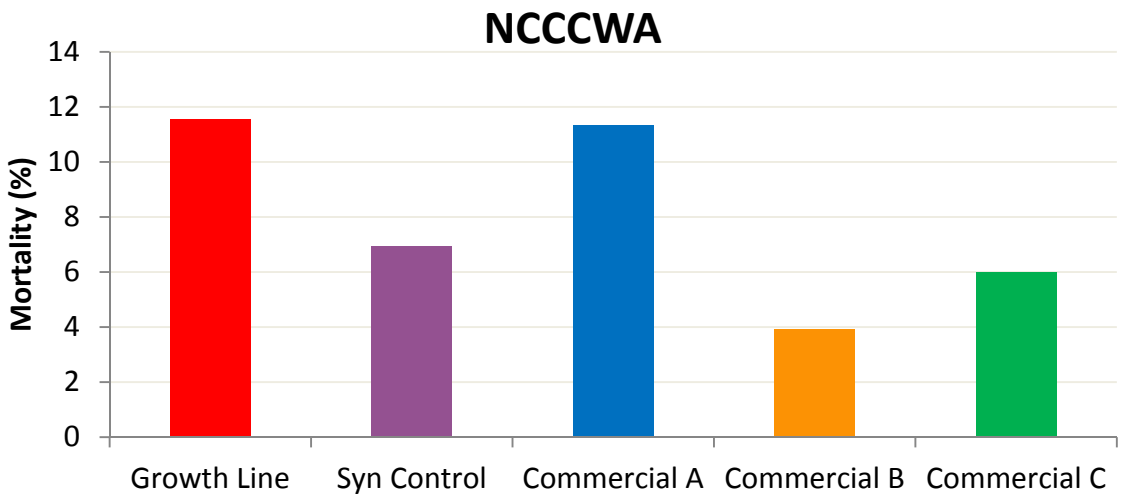
# Feed Conversion Ratio

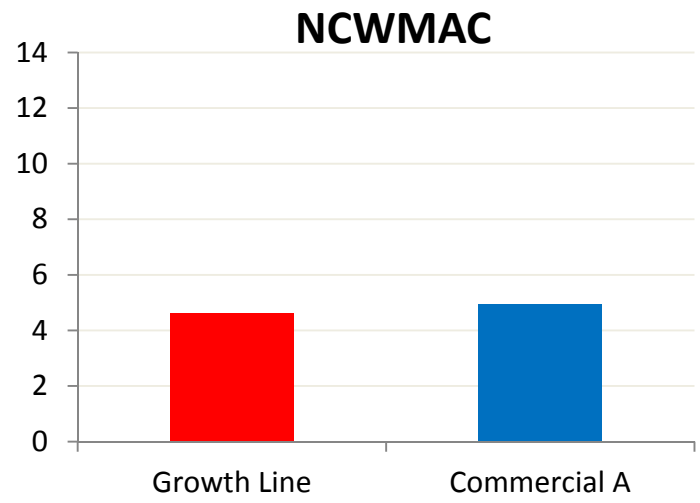


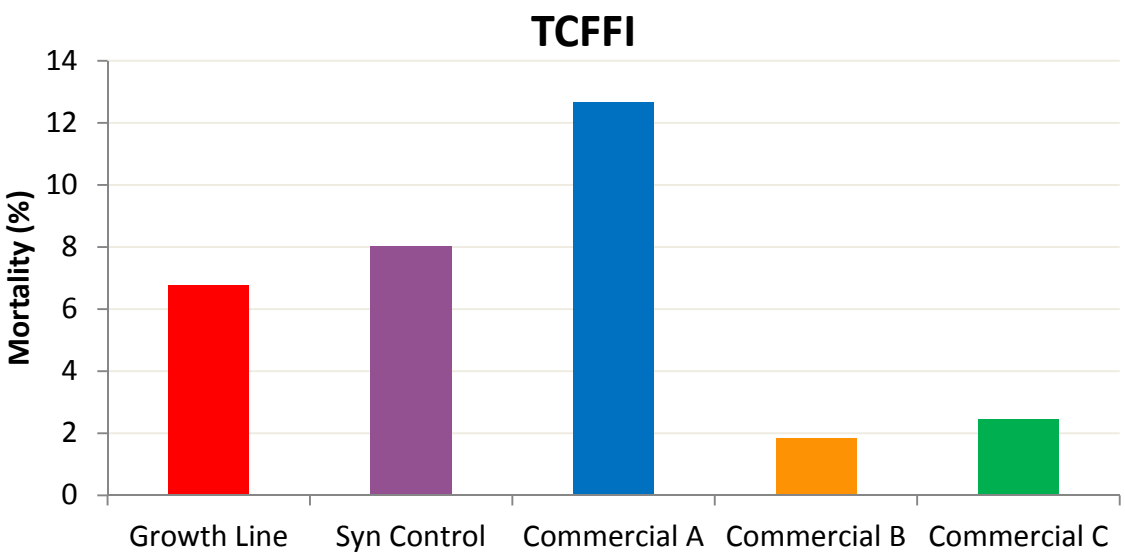



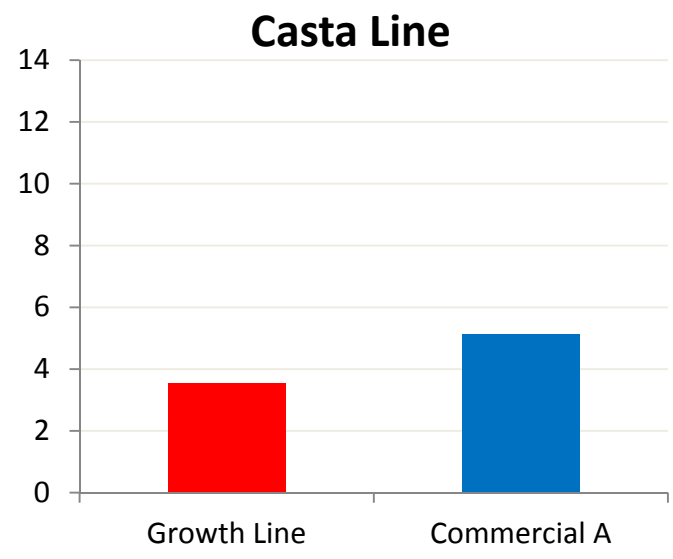



# Mortality

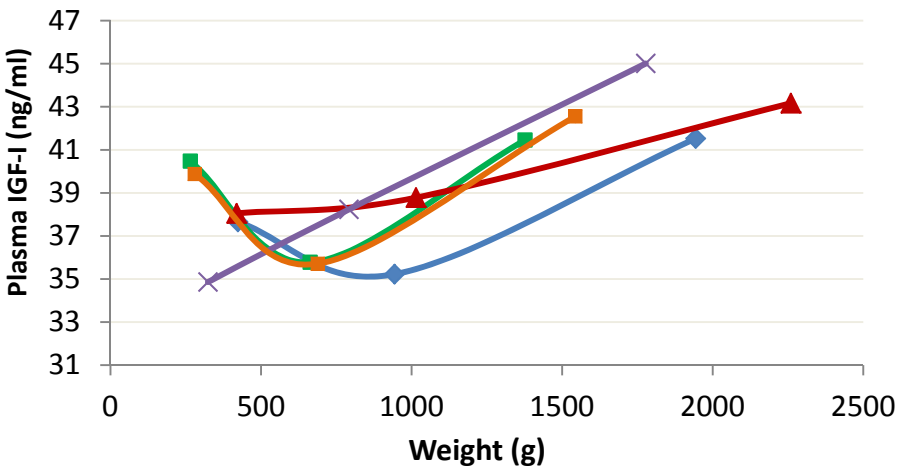

NCCCWA
Mortality (%)
14
12
10
8
6
4
2
0
Growth Line
Syn Control
Commercial A
Commercial B
Commercial C

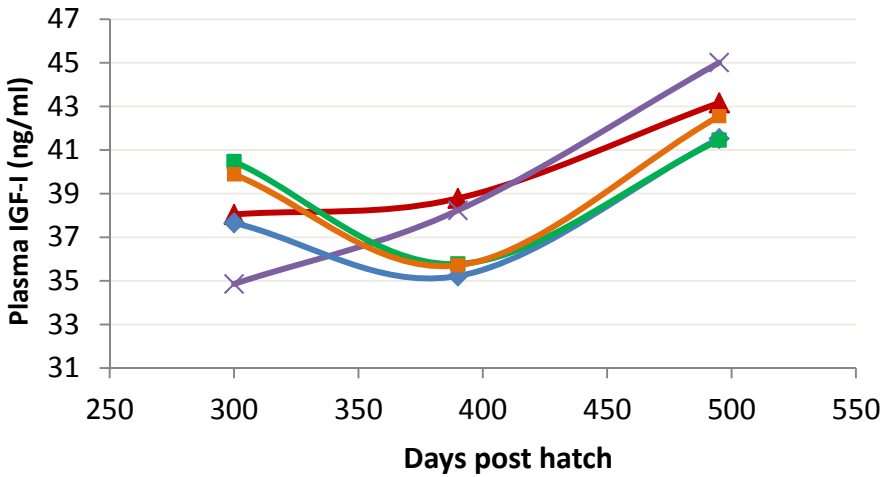

NCWMAC
14
12
10
8
6
4
2
0
Growth Line
Commercial A

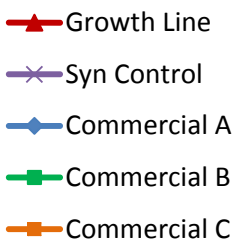

TCFFI
Mortality (%)
14
12
10
8
6
4
2
0
Growth Line
Syn Control
Commercial A
Commercial B
Commercial C

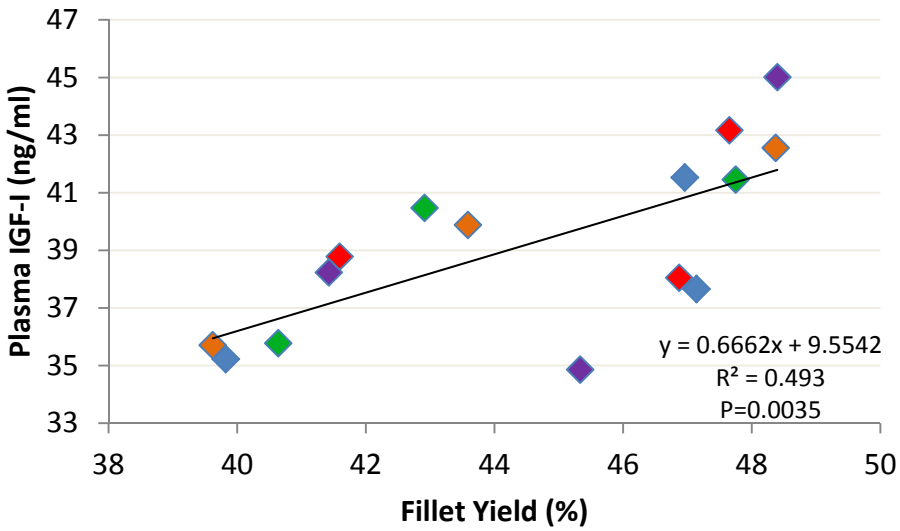

Casta Line
14
12
10
8
6
4
2
0
Growth Line
Commercial A

# Plasma IGF-I


Plasma IGF-I (ng/ml)
47
45
43
41
39
37
35
33
31
0
500
1000
1500
2000
2500
Weight (g)


Plasma IGF-I (ng/ml)
47
45
43
41
39
37
35
33
31
250
300
350
400
450
500
550
Days post hatch


Growth Line
Syn Control
Commercial A
Commercial B
Commercial C


Plasma IGF-I (ng/ml)
47
45
43
41
39
37
35
33
38
40
42
44
46
48
50
Fillet Yield (%)
y = 0.6662x + 9.5542
R² = 0.493
P=0.0035

# Conclusion

| | Main Effect | | |
|---|---|---|---|
| | Genetics | Environment | Interaction |
| Growth | ✓ | ✓ | ✓ (small) |
| Condition Factor | ✓ | ✓ | ✓ (small) |
| Fillet Yield | ✓ | ✓ | ✓ |
| Mortality | ✓ | ✓ | |
| FCR | ✓ | ✓ | N/A |

# Acknowledgements


- TCFFI
  - Dr. Steve Summerfelt, Dr. Chris Good, John Davidson, Travis May, Curtis Crouse, Chloe Raines
- WVU
  - Dr. Brett Kenney, Jeremy Everson, Susan Slider
- NCCCWA
  - Dr. Tim Leeds, Lisa Radler, Josh Kretzer, Ross Reid, Mark Hostuttler, Jenea McGowan, Kyle Jenkins, Taylor Brown
- NCWMAC
  - Dr. Bill Wolters, Melissa Milligan
- Casta Line
  - Bryan Plemmons, Junior Campbell, Casper Campbell

# Questions?