

THE EFFECTS OF SPECIFIC GRAVITY ON INVENTORY METHODS FOR HATCHERY RAINBOW TROUT

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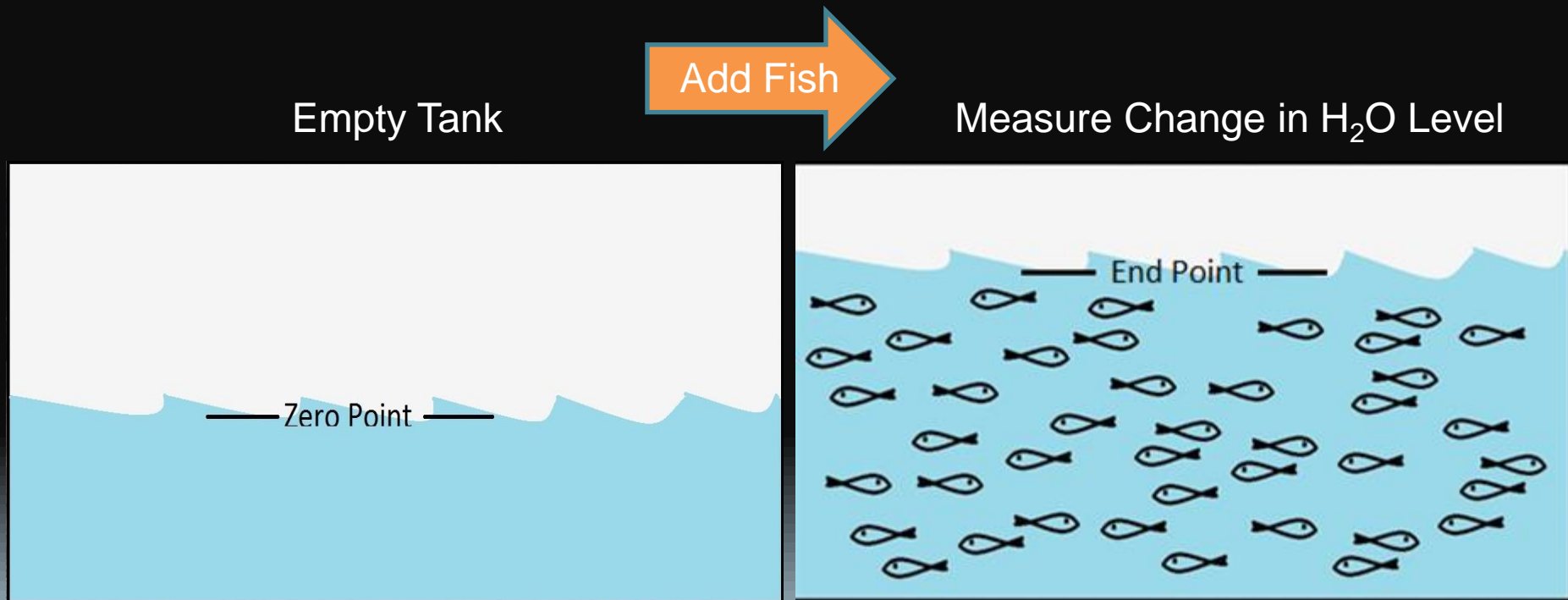
What is Specific Gravity?

- AKA Relative Density
- $SG = \frac{\rho_{\text{substance}}}{\rho_{\text{H}_2\text{O}}}$
- Simplified as the ratio of the mass of a substance to the mass of an equal volume of water

$$SG_{\text{substance}} = \frac{\rho_{\text{substance}}}{\rho_{\text{H}_2\text{O}}} = \frac{M_{\text{substance}} / \cancel{V_{\text{substance}}}}{M_{\text{H}_2\text{O}} / \cancel{V_{\text{H}_2\text{O}}}} = \frac{M_{\text{substance}}}{M_{\text{H}_2\text{O}}}$$

How Does This Relate to Aquaculture?

- Displacement of H_2O used to calculate fish biomass
- Commonly used for inventory, transport & stocking



How Does This Relate to Aquaculture?

- Many RBT production facilities assume SG value of 1.00
- A constant SG value is commonly assumed across all size classes
- Literature varies on the accuracy of SG values
(Lewis et al. 1994, NC State 2012)
- Targeting actual SG values could improve fish inventory accuracy & reduce potential error

Purpose of this Research

Attempt to answer 2 key questions

1. Do actual SG values vary significantly from the assumed SG of 1.00?
2. Do SG values vary significantly between size class?

Methods

- 3N RBT sampled @ 3", 6" and 10" in length
(*typical IDFG stocking sizes*)
- Sample groups = 50 fish samples w/ 5 replicates per group (*250 fish total*)
- 6 total sample groups :
 - 2 groups of Grace Fish Hatchery (GFH) 3"
 - 2 groups of GFH 6"
 - 1 group of Nampa Fish Hatchery (NFH) 10"
 - 1 group of Hagerman State Fish Hatchery (HSFH) 10"

Methods cont'd

- Total length and weight taken for each fish
- H₂O displacement measurement then taken for each fish
- Single factor ANOVA used to test for statistical significance

Fish anesthetized one at a time



Total length taken to nearest mm

Fish lightly dried to remove excess H₂O



Total weight (g) to most accurate graduation possible

Collect H_2O
displaced by fish

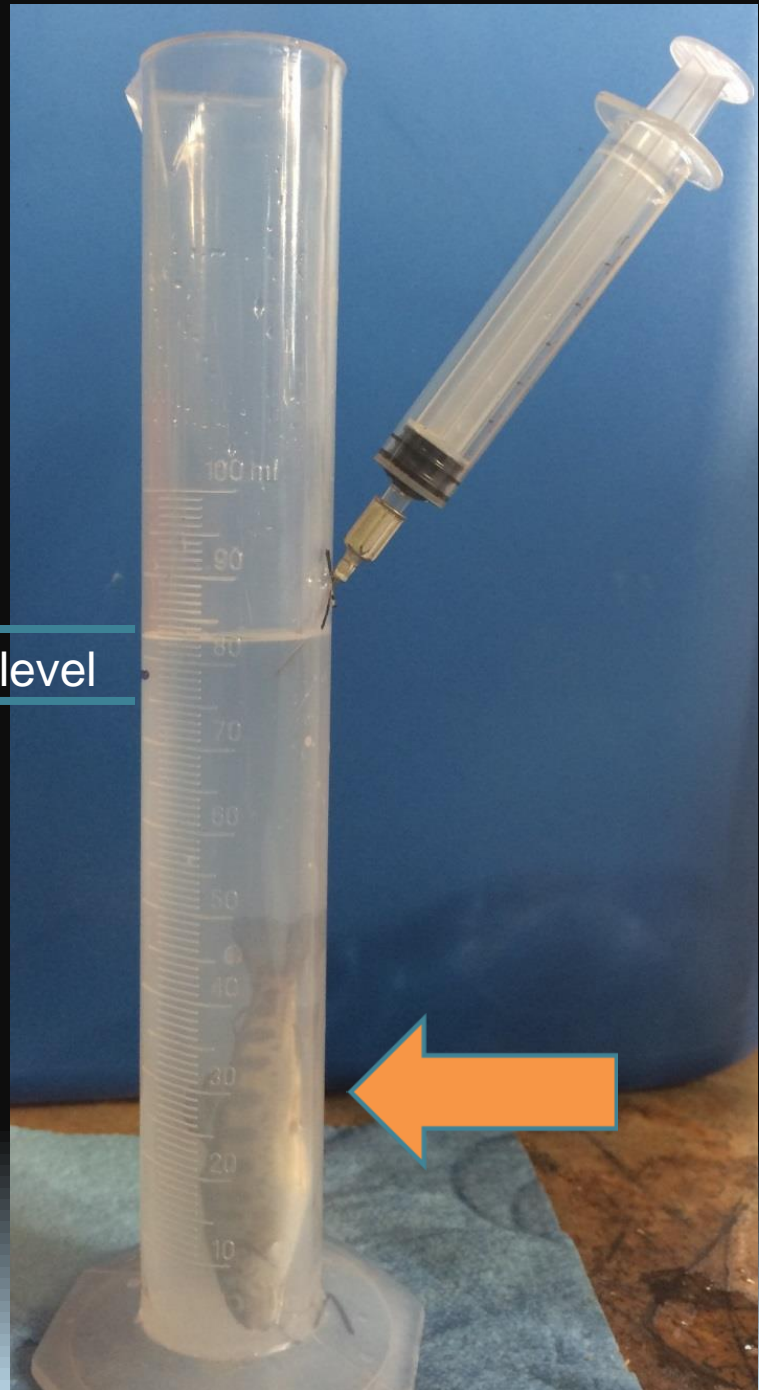
Step 1:
Zero the
displacement
collection cylinder

Zero point



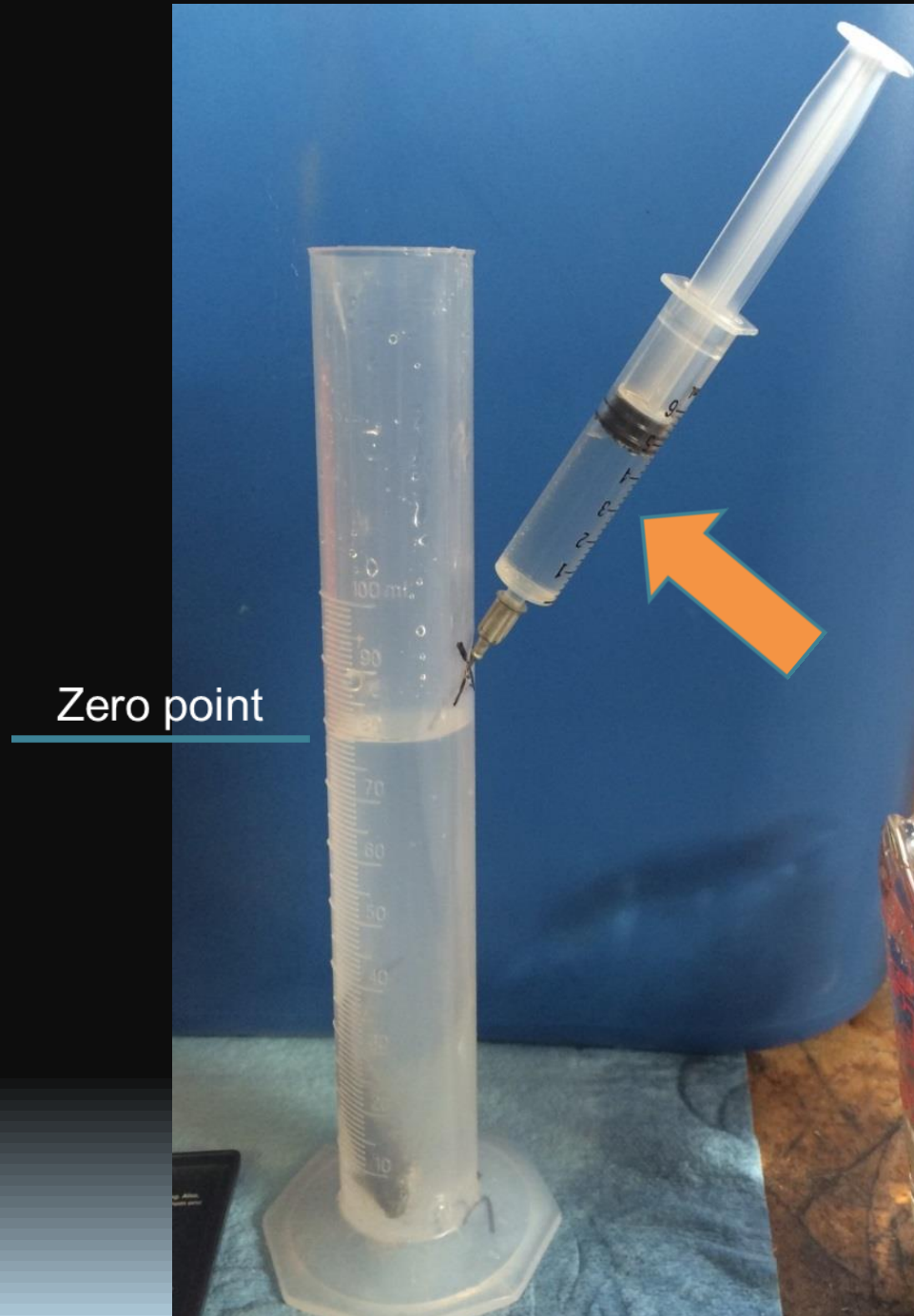
Step 2:
Add fish to
displacement
collection cylinder

↑ ΔH_2O level

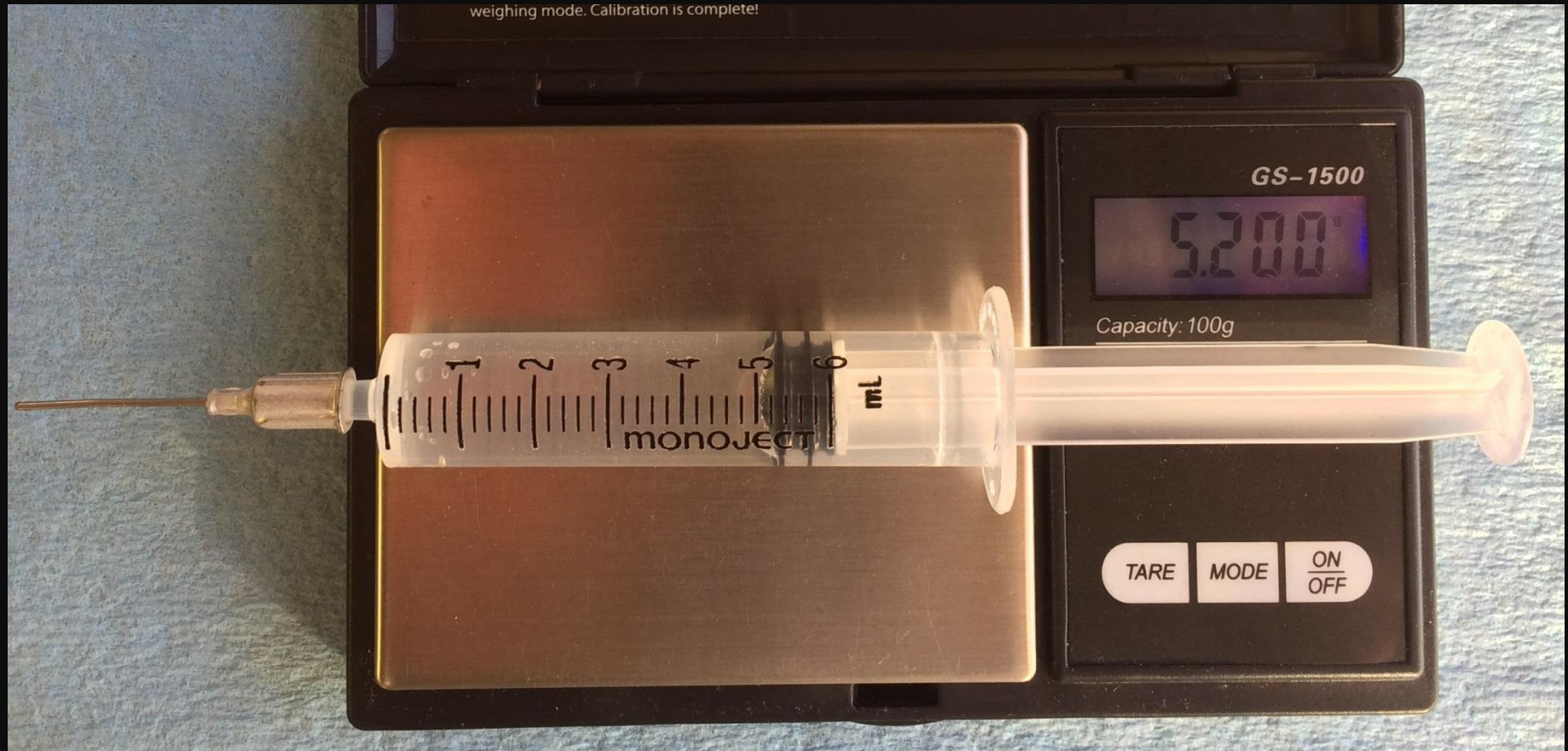


Step 3:

Draw H_2O into syringe until no more H_2O can be drawn (i.e. back to the zero point)



Weigh the H₂O displaced by fish



$$SG = \text{weight of fish} / \text{weight H}_2\text{O displaced}$$

Refining the accuracy of our displacement samples



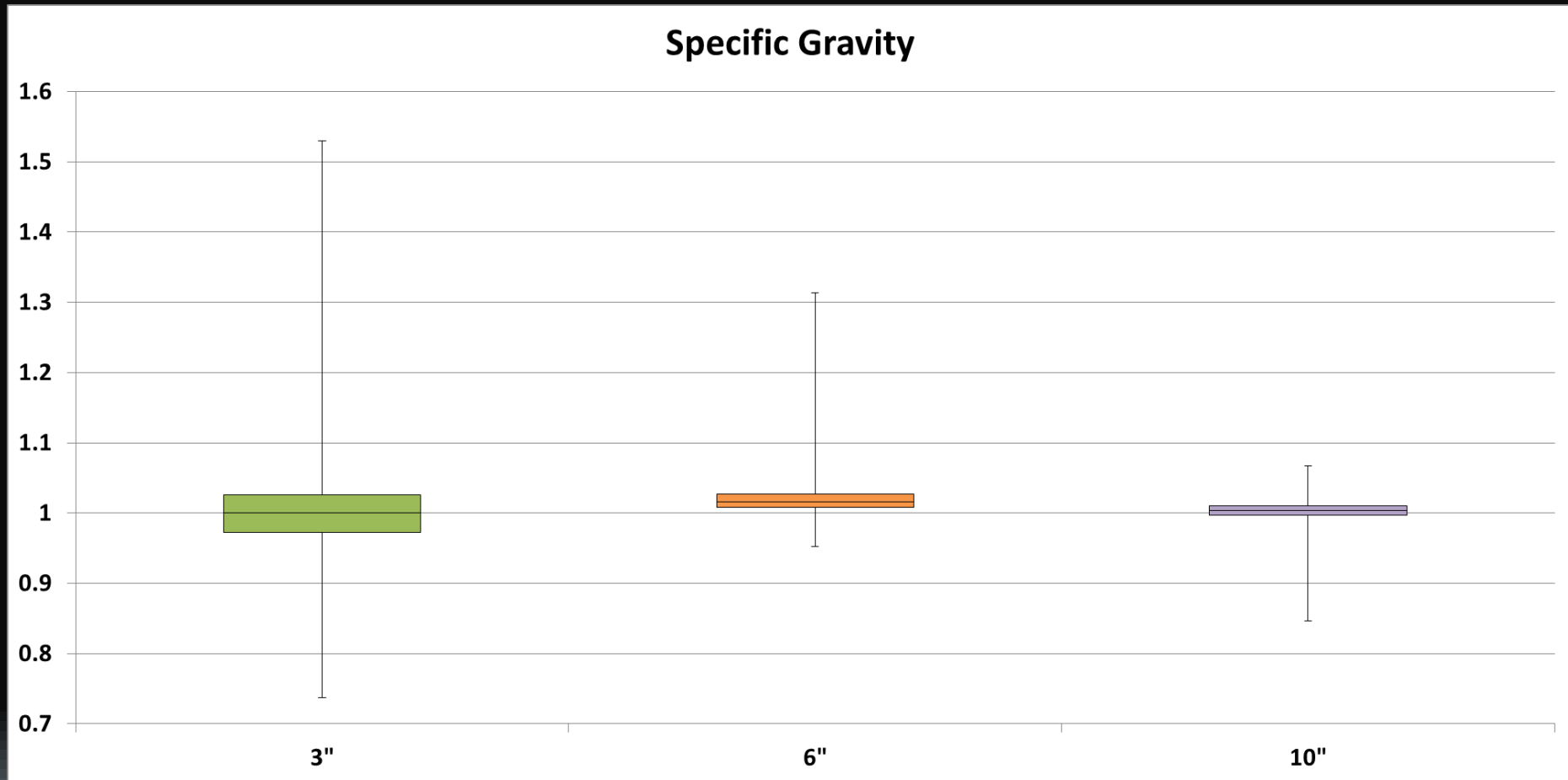
Grouping Trials by Size Class

SG Comparisons by Trial w/in Size Classes ($\alpha = 0.05$)

*statistically significant variations are highlighted ($p < 0.05$)

Treatment Comparison	Mean SG Values	P-Value
GFH 3" (1) : GFH 3" (2)	0.997 : 1.005	0.088
GFH 6" (1) : GFH 6" (2)	1.017 : 1.020	0.0921
NFH 10" : HSFH 10"	1.004 : 1.003	0.691

Results



Statistical Significance

Comparison of Actual SG to Assumed SG of 1.00 ($\alpha = 0.05$)

***statistically significant variations are highlighted ($p < 0.05$)**

Treatment	Mean (\pm SE)	P-Value
3"	1.000 \pm 0.002	0.835
6"	1.019 \pm 0.001	1.1E-78
10"	1.003 \pm 0.001	6.8E-06

Statistical Significance

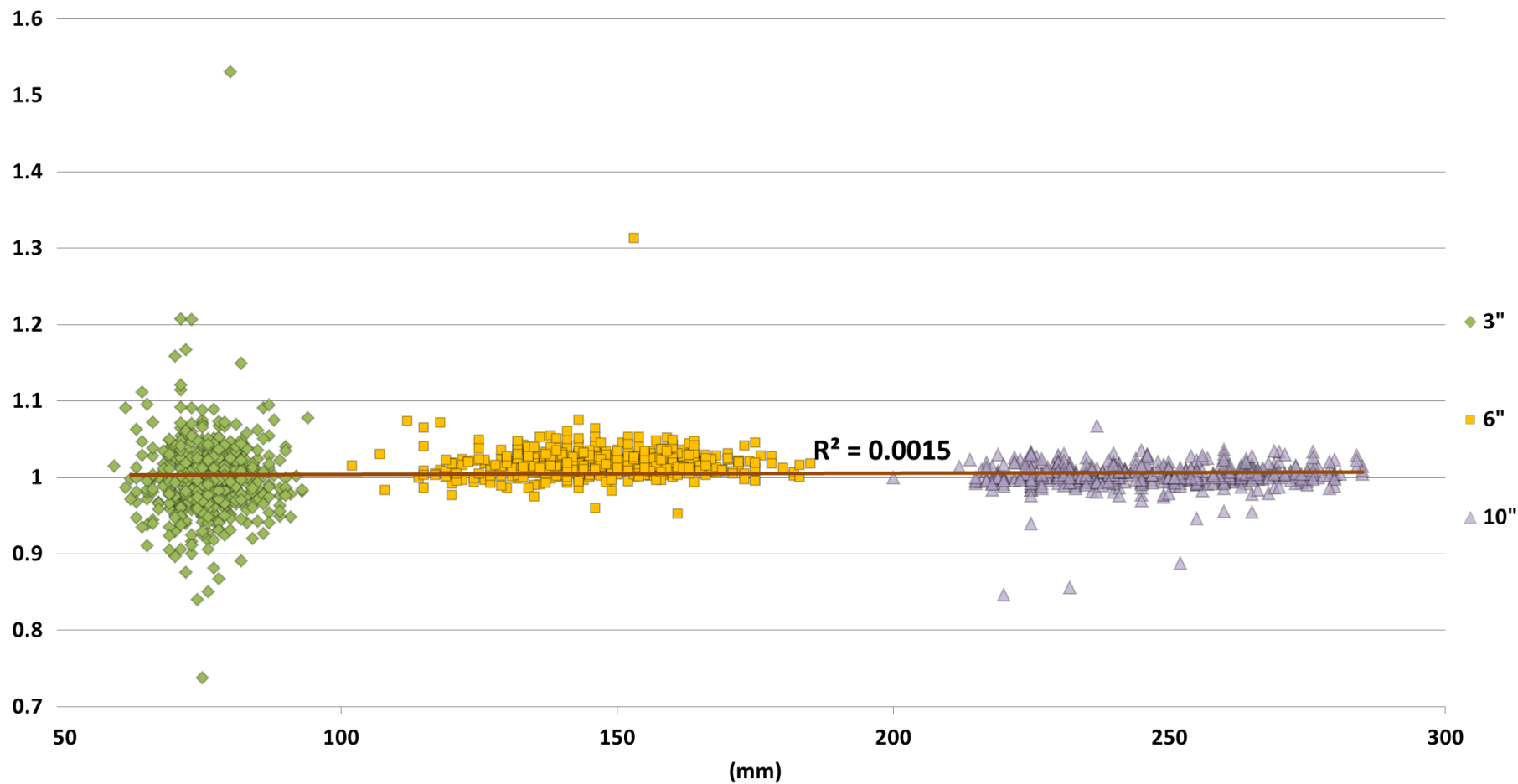
SG Comparisons by Size Class ($\alpha = 0.05$)

***statistically significant variations are highlighted ($p < 0.05$)**

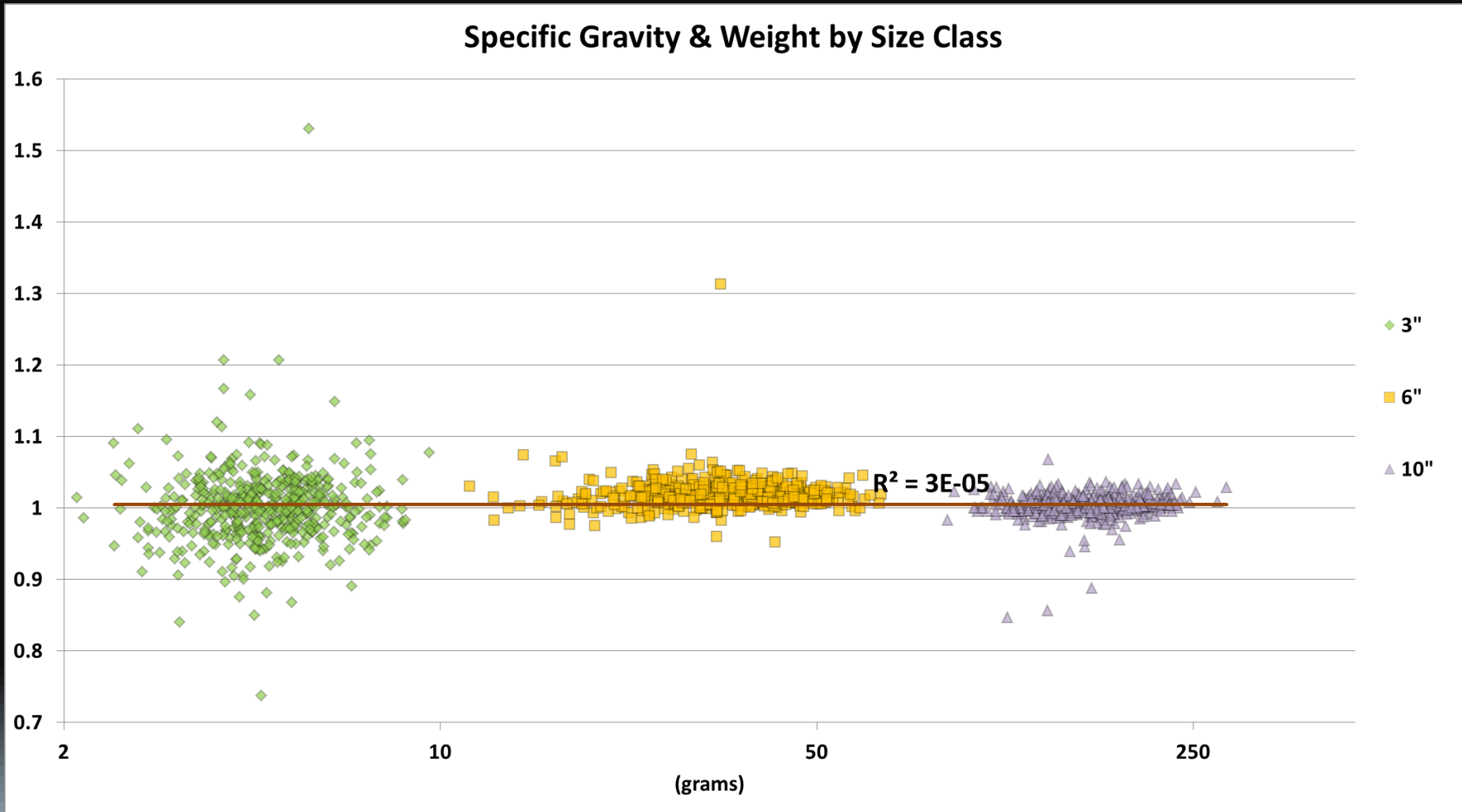
Treatment Comparison	Mean SG Values	P-Value
3" : 6"	1.000 : 1.019	9.9E-13
3" : 10"	1.000 : 1.003	0.240
6" : 10"	1.019 : 1.003	9.1E-36

Data Trends

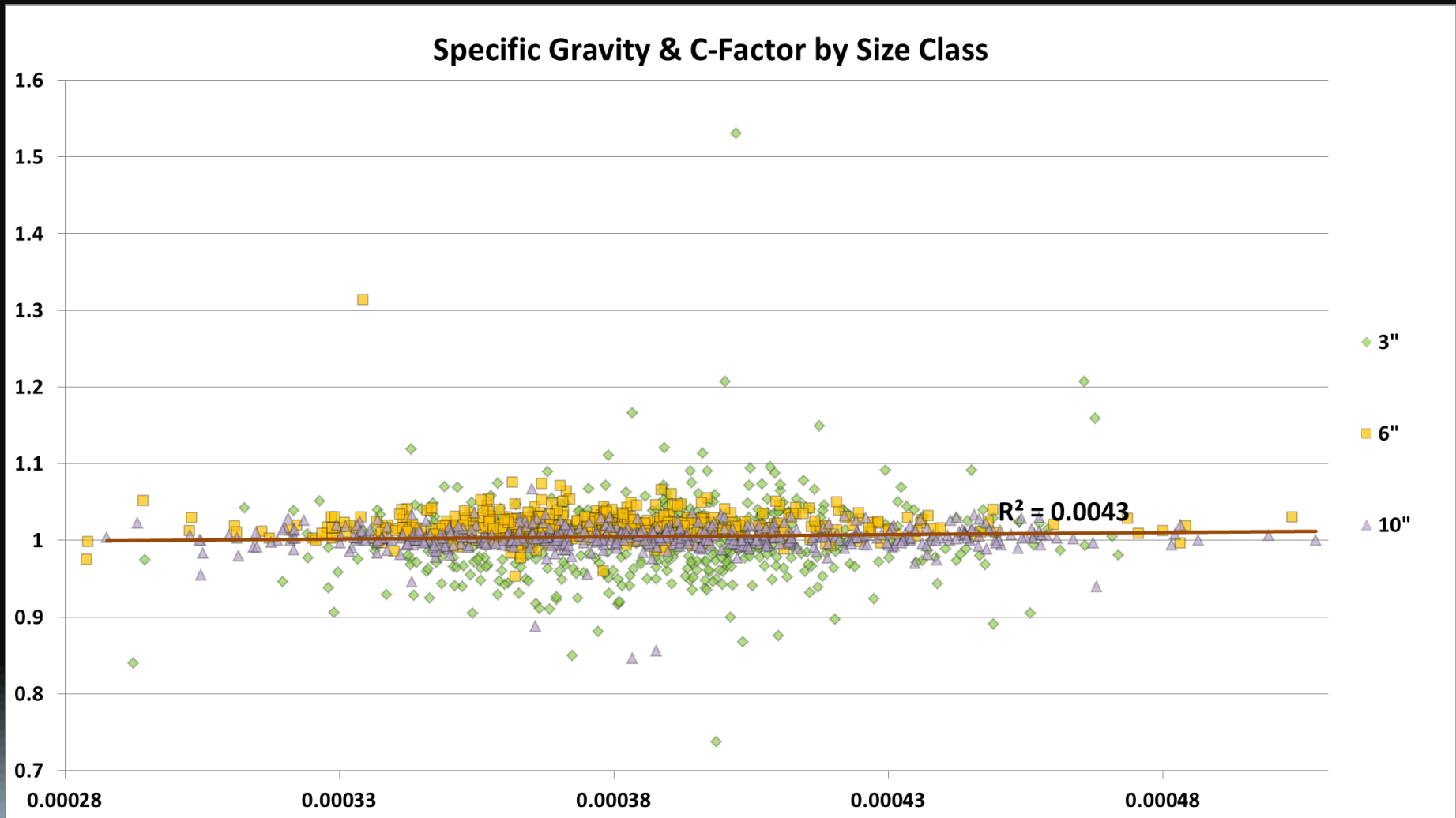
Specific Gravity & Length by Size Class



Data Trends cont'd



Data Trends cont'd



Implications

- We were concerned w/ hatchery specific data
- Other factors can influence SG:
 - Species, Swim bladder inflation, body fat content, etc.
(Taylor 1922)

Our bottom line:

What is the potential influence of SG on RBT displacement measurements?

- Actual SG < assumed SG = underestimate
- Actual SG > assumed SG = overestimate

Implications cont'd

Potential RBT Production Influence

Assuming SG = 1.00

Treatment	Mean SG	Equates to
3"	1.000	=
6"	1.019	1.9% ↑
10"	1.003	0.3% ↑

Further Investigations

Additional work is needed from Fish Production professionals to investigate and determine the Mean SG for other species reared at our Idaho hatcheries (ex. Chinook Salmon, steelhead, kokanee).

Acknowledgements

Thank you to the Grace Hatchery, Nampa Hatchery, Hagerman State Hatchery, IDFG Southeast Region staff, Bryan Grant (IDFG Eastern Hatchery Complex Mgr.) and Dr. Ken Rodnick (Idaho State University) for all their help.

Citations

- Lewis, M.A., T.R. Walters and R. D. Ewing. 1994. Evaluation of Inventory Procedures for Hatchery Fish. III. Variation in Specific Gravities of Pacific Salmonids during Rearing, *The Progressive Fish-Culturist*, 56: 160-168.
- Taylor, H. F. 1922. Deductions Concerning the Air Bladder and the Specific Gravity of Fishes, *Bulletin of the Bureau of Fisheries*, 38: 121-126.
- NC State University, A&T State University Cooperative Extension. 2012. Weighing Trout by Water Displacement, Haywood County Center Bulletin, North Carolina. Available: <http://haywood.ces.ncsu.edu/> (March 2012).