

South River Science Team Poultry Study Update

May 13, 2015



Human Exposure Evaluation

The key objectives:

- **better identify potential exposure,**
- **define potential risks and uncertainties,**
- **communicate information to the public.**

Human Exposure Evaluation

Exposure Team Members

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AECOM: Dana McCue

Human Exposure Evaluation

Exposure scenarios evaluated

- ✓ Fish Consumption
- ✓ Recreational Use of River
- ✓ Potential Drinking Water exposures
- ✓ Contact with soils on the floodplain
- Potential dietary exposures
 - Domestic consumption, e.g., Garden crops, Beef, Poultry
 - ✓ Hunting consumption, e.g., waterfowl, small game

Communicating to public on these issues

Poultry Study

Evaluate potential exposure to mercury in poultry raised in the South River floodplain and from background locations within the Shenandoah Valley that have not been impacted by mercury.

- Sample eggs and poultry (specifically chicken) muscle to determine the potential for chickens reared on the South River floodplain to accumulate mercury.
- The information will be used to inform decisions about exposure through potential food consumption of eggs and chickens reared on the floodplain.
- Determine whether blood and feather data can provide a non-invasive form of biomonitoring for mercury, and can inform the elimination of mercury from the birds, respectively.

Sample Summary Original Flock

Approximate Date Event #	June (1 st) T=1 (baseline)	July (15 th) T=2	Aug (31 st) T=3	Oct (15 th) T=4	Dec (1 st) T=5
Mercury-Impacted Area (Area 1) T = 0; animals (Barred Rocks and Red Star) are 5 months; Individual eggs will be collected from pool of eggs distinguished by breed, if possible.	6 – 12 Individual Eggs (from pool of eggs) 2 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood
Control Area (Area 3) T = 0; animals (Barred Rocks and Red Star) are 5 months; Individual eggs will be collected from pool of eggs distinguished by breed, if possible.	6 – 12 Individual Eggs (from pool of eggs) 2 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: 2 Muscle (breast, leg) - Liver and Gizzard 2 Feathers 2 Blood
Background - Polyface Farm, - Two local area markets	6 – 12 Individual Eggs at each location 3 Birds at each location; For each bird: 2 Muscle (breast, leg); Liver and Gizzard (if available) This is a single event				
Supplemental Feed	- Supplemental feed will be required. This will be obtained from local area suppliers consistent with methods in the area. - Feed will be analyzed at the start and end of the study as well as if the source of the feed is changed during the study.				

Sample Summary New Flock

Approximate Date Event #	July (last week) T=1 (baseline)	Aug (31 st) T=2	Oct (15 th) T=3	Dec (1 st) T=4
Mercury-Impacted Area (Area 1) T = 0; new laying animals (White Leghorns) added; Individual eggs will be collected from pool of eggs distinguished by breed. Leghorns lay white eggs.	6 – 12 Individual Eggs (from pool of eggs) 2 Birds sacrificed Each bird: • 2 Muscle (breast, leg) • Liver and Gizzard • 2 Feathers • 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: • 2 Muscle (breast, leg) • Liver and Gizzard • 2 Feathers • 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: • 2 Muscle (breast, leg) • Liver and Gizzard • 2 Feathers • 2 Blood	6 – 12 Individual Eggs (from pool of eggs) 3 Birds sacrificed Each bird: • 2 Muscle (breast, leg) • Liver and Gizzard • 2 Feathers • 2 Blood
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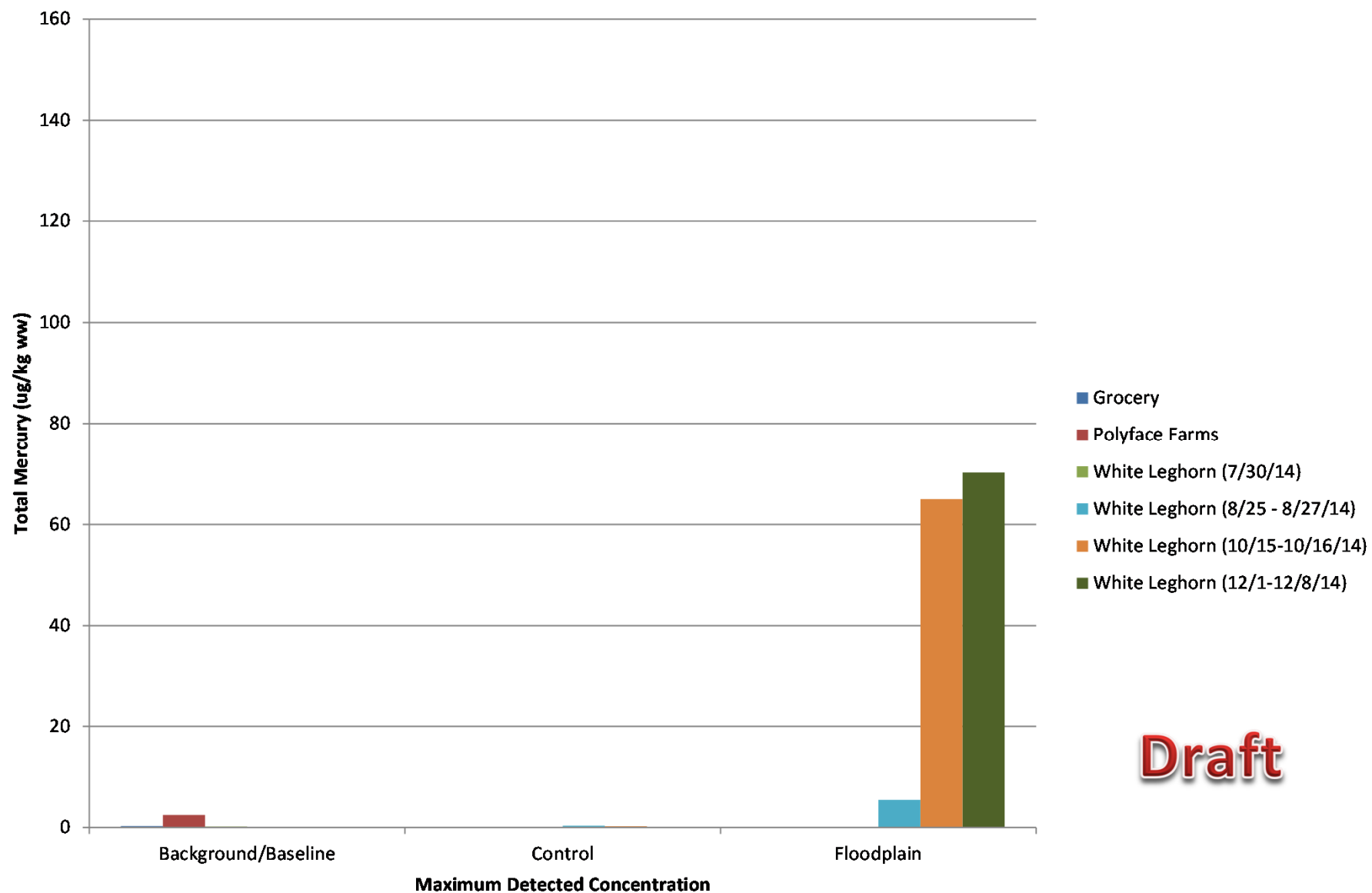


Poultry Study

Status

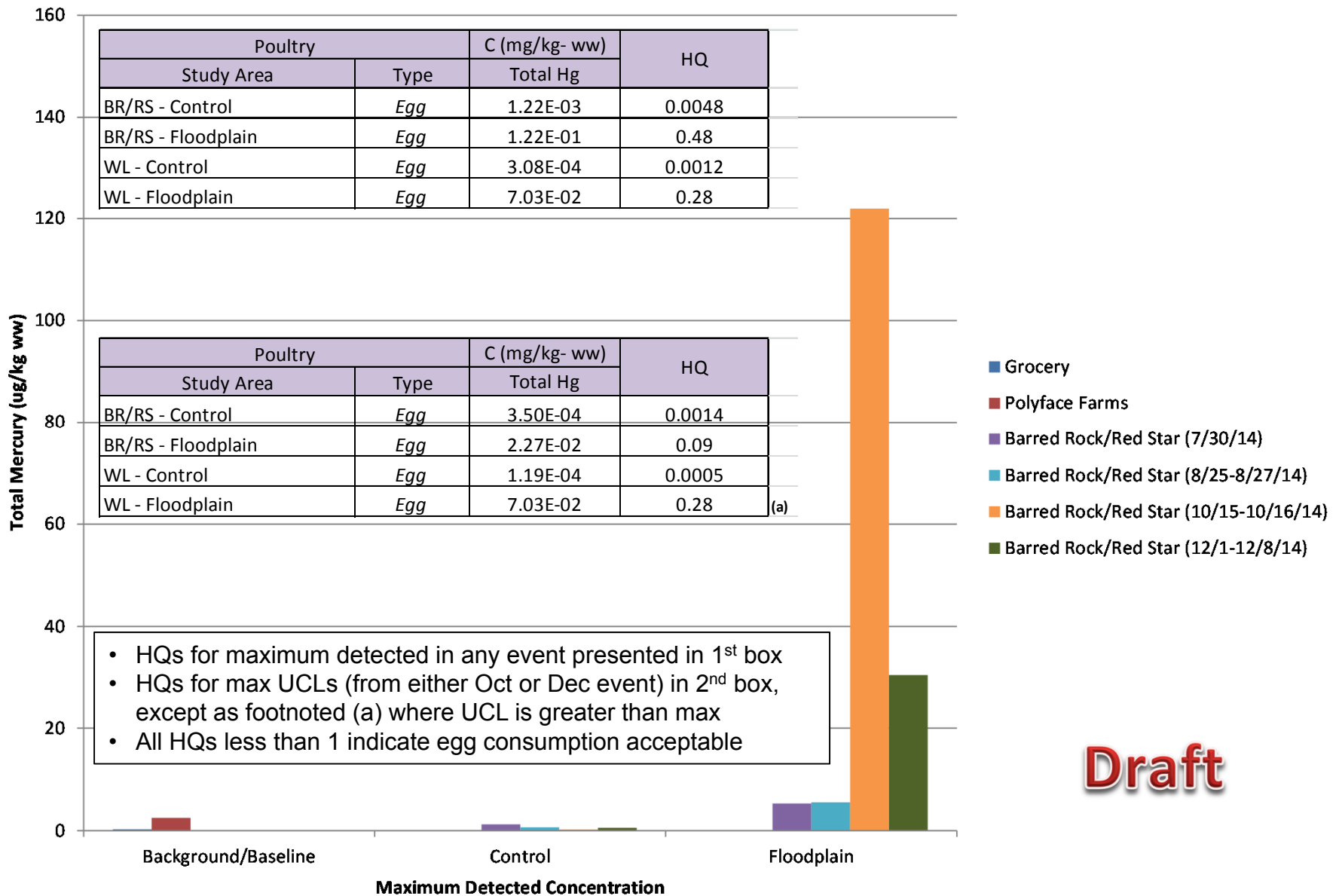
- Study completed in December
- Analysis of samples for all sample events now completed
- Results for all sample events are now available
- In process of evaluating results
 - Egg, muscle, liver and gizzard data have been evaluated previously (Annette)
 - Blood and feather data are available for discussion today

Hg in Egg Tissue - White Leghorn



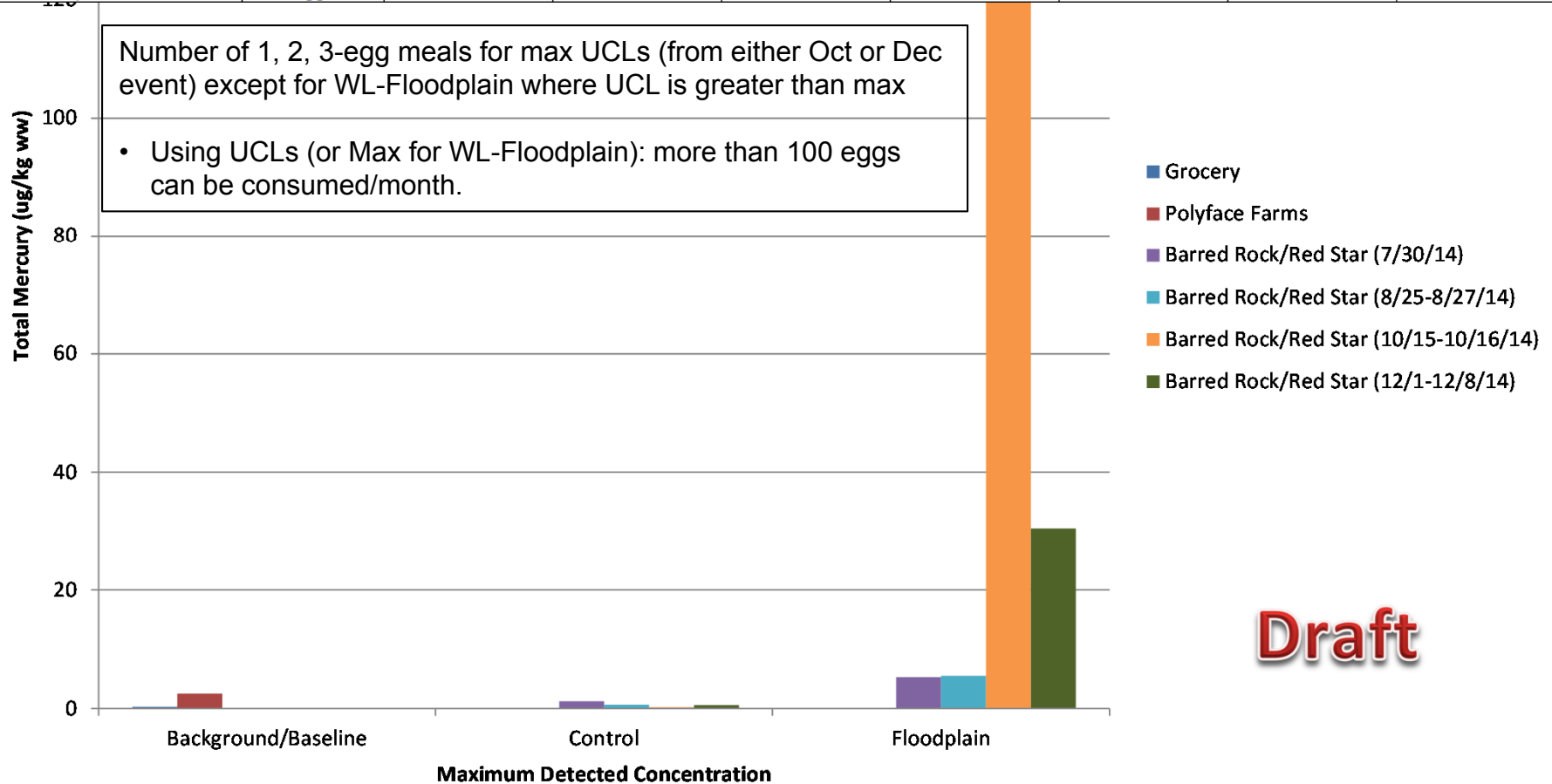
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Hg in Egg Tissue - Barred Rock/Red Star



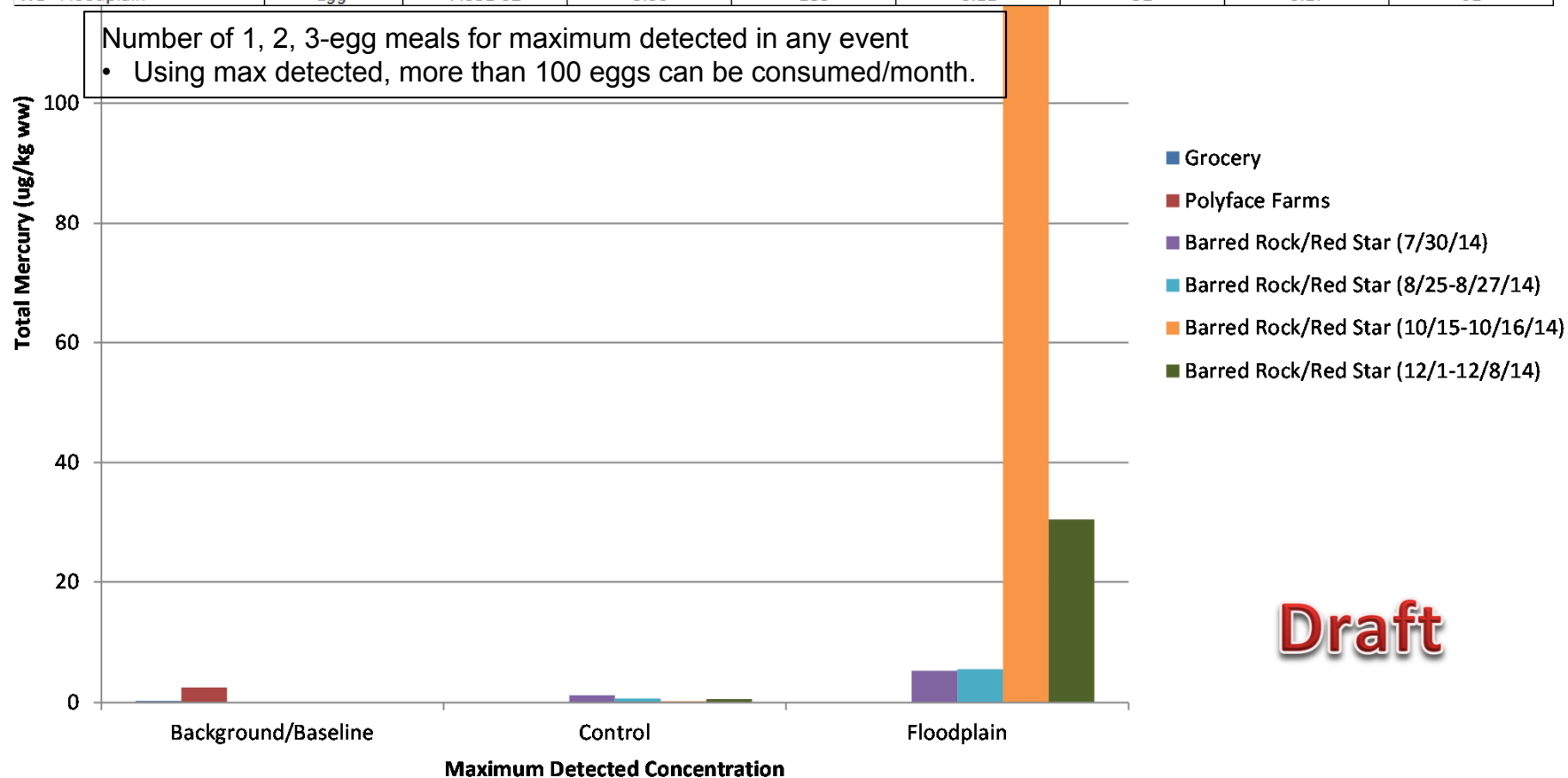
Hg in Egg Tissue - Barred Rock/Red Star

Species		C (mg/kg ww)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)
Poultry		Total Hg						
Study Area	Type							
Grocery - Background	Egg	2.73E-04	0.06	47239	0.11	23619	0.17	15746
Polyface Farm - Background	Egg	2.49E-03	0.06	5180	0.11	2590	0.17	1727
BR/RS - Control	Egg	3.50E-04	0.06	36814	0.11	18407	0.17	12271
BR/RS - Floodplain	Egg	5.96E-02	0.06	216	0.11	108	0.17	72
WL - Control	Egg	1.19E-04	0.06	108276	0.11	54138	0.17	36092
WL - Floodplain	Egg	7.03E-02	0.06	183	0.11	92	0.17	61



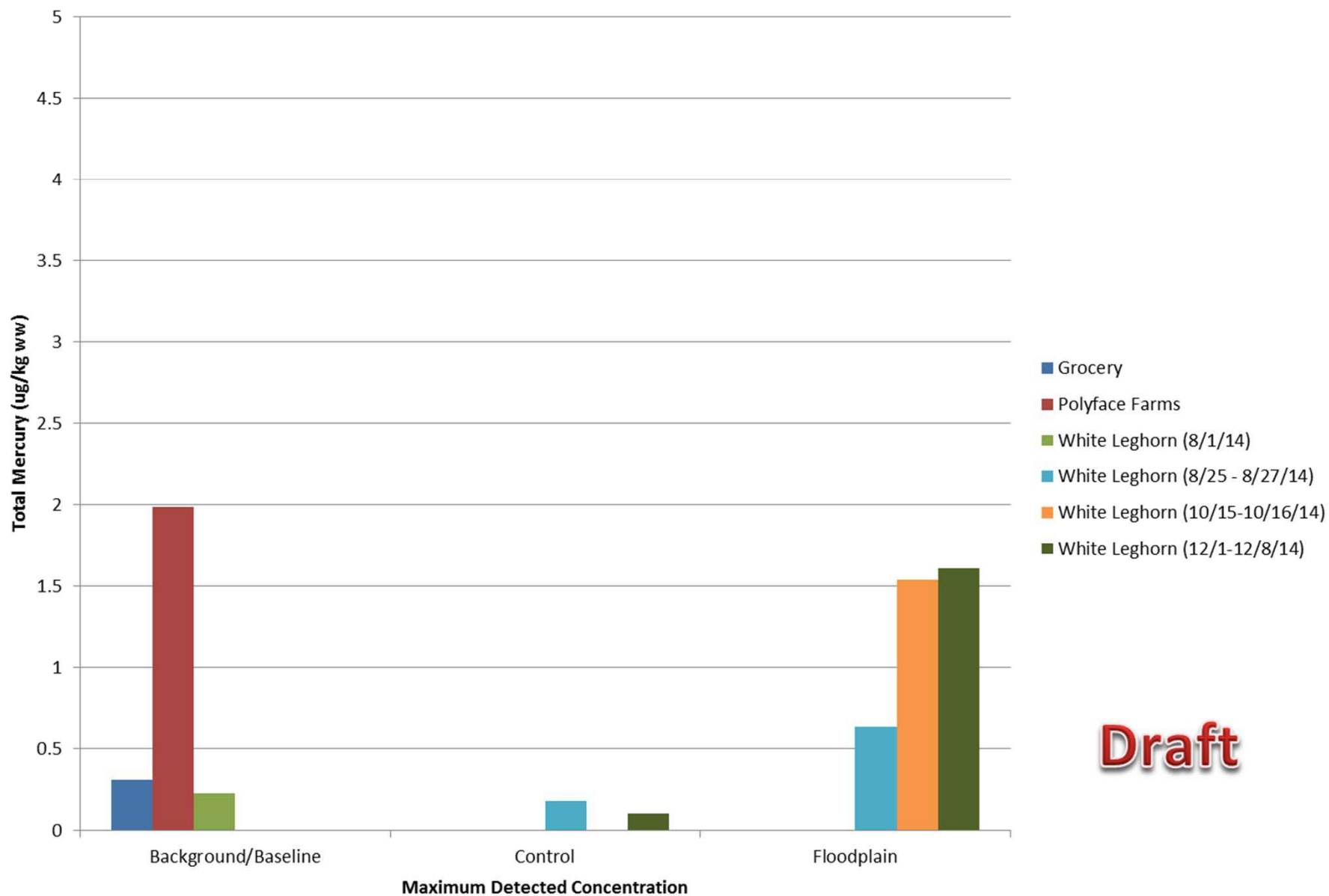
Hg in Egg Tissue - Barred Rock/Red Star

Species		C (mg/kg ww)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)
Poultry		Total Hg						
Study Area	Type							
Grocery - Background	Egg	2.73E-04	0.06	47239	0.11	23619	0.17	15746
Polyface Farm - Background	Egg	2.49E-03	0.06	5180	0.11	2590	0.17	1727
BR/RS - Control	Egg	1.22E-03	0.06	10532	0.11	5266	0.17	3511
BR/RS - Floodplain	Egg	1.22E-01	0.06	106	0.11	53	0.17	35
WL - Control	Egg	3.08E-04	0.06	41845	0.11	20922	0.17	13948
WL - Floodplain	Egg	7.03E-02	0.06	183	0.11	92	0.17	61



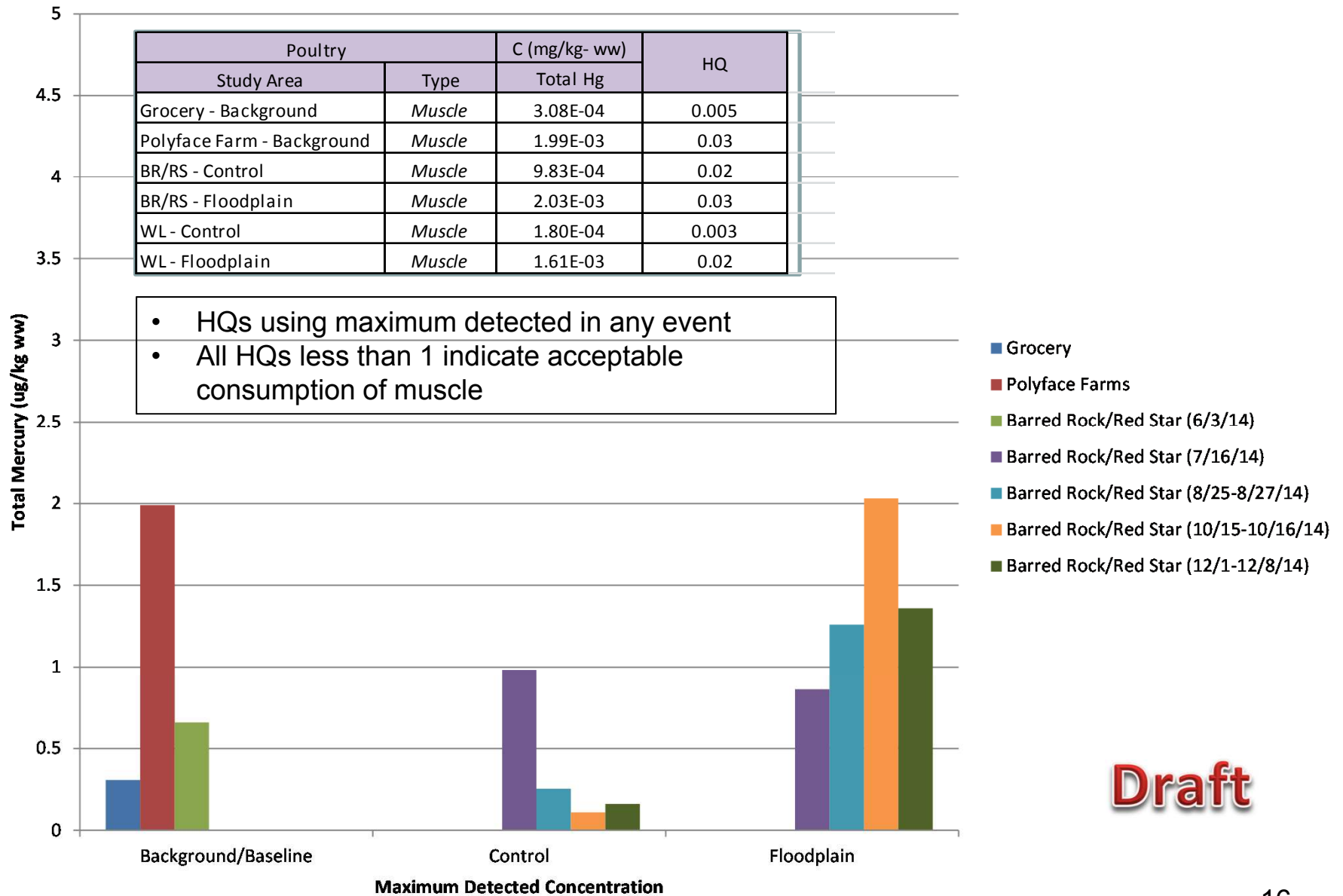
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Hg in Muscle Tissue - White Leghorn



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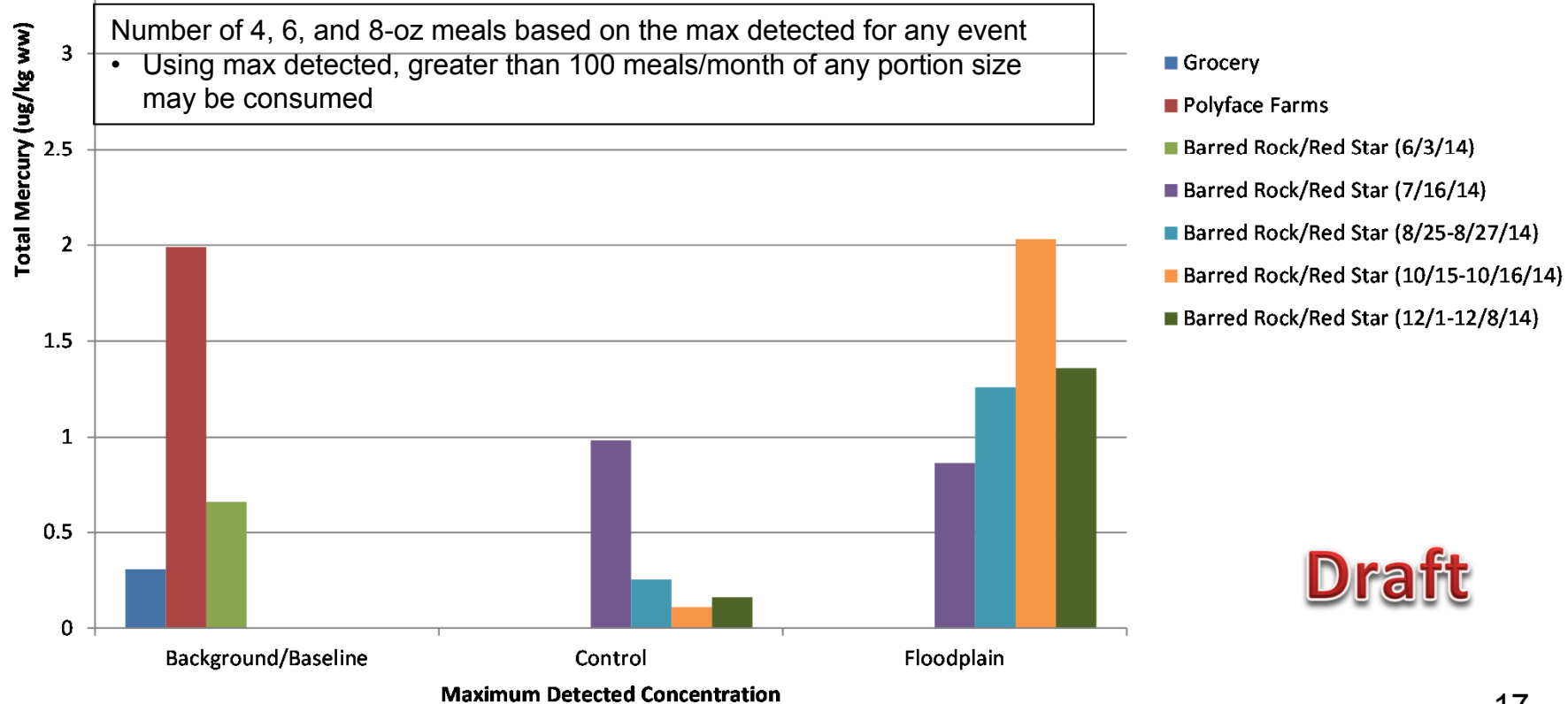
Hg in Muscle Tissue - Barred Rock/Red Star



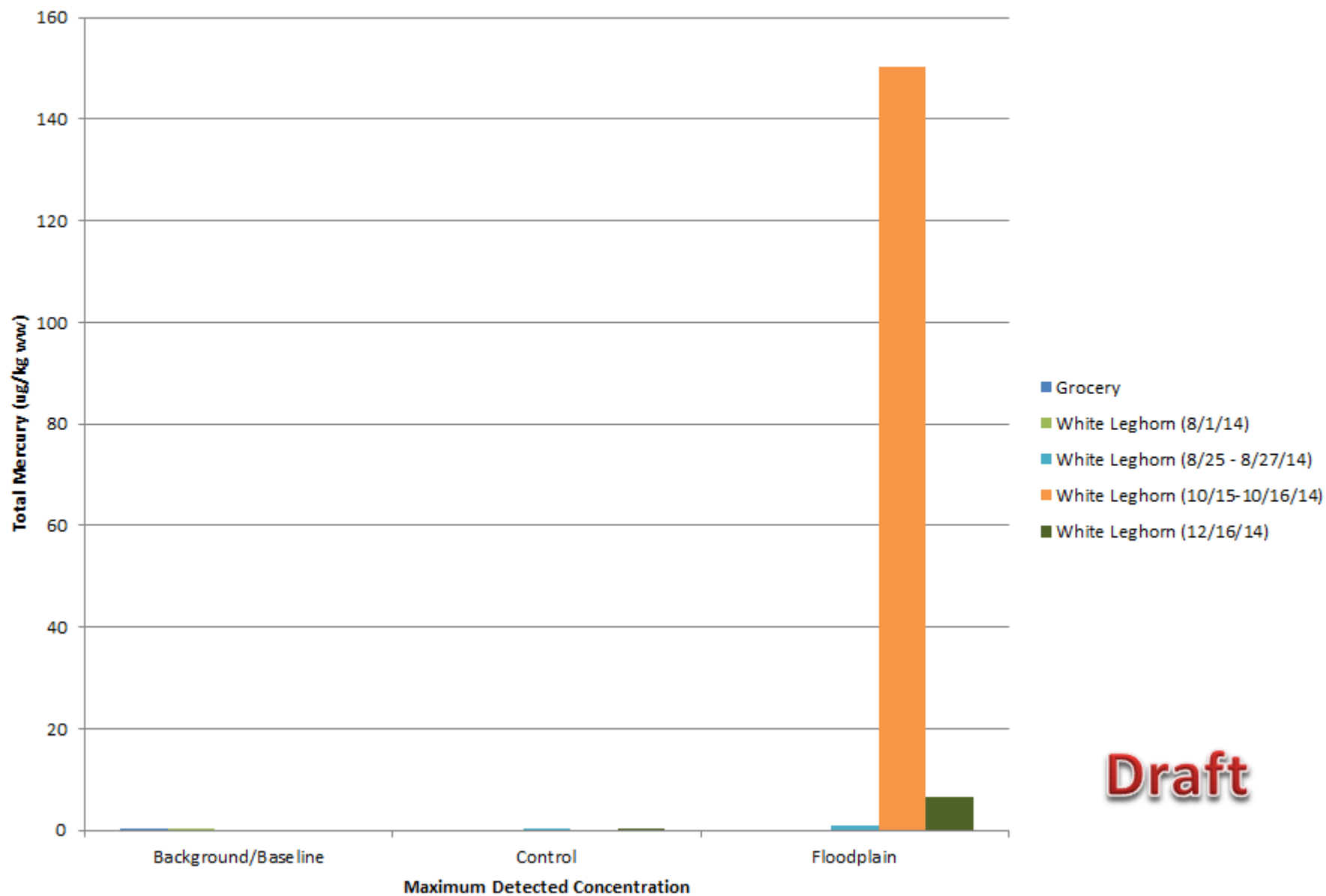
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Hg in Muscle Tissue - Barred Rock/Red Star

Species		C (mg/kg ww)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)
Poultry		Total Hg						
Study Area	Type							
Grocery - Background	Muscle	3.08E-04	0.11	20938	0.17	13959	0.23	10469
Polyface Farm - Background	Muscle	1.99E-03	0.11	3240	0.17	2160	0.23	1620
BR/RS - Control	Muscle	9.83E-04	0.11	6554	0.17	4369	0.23	3277
BR/RS - Floodplain	Muscle	2.03E-03	0.11	3173	0.17	2115	0.23	1587
WL - Control	Muscle	1.80E-04	0.11	35834	0.17	23890	0.23	17917
WL - Floodplain	Muscle	1.61E-03	0.11	4005	0.17	2670	0.23	2003

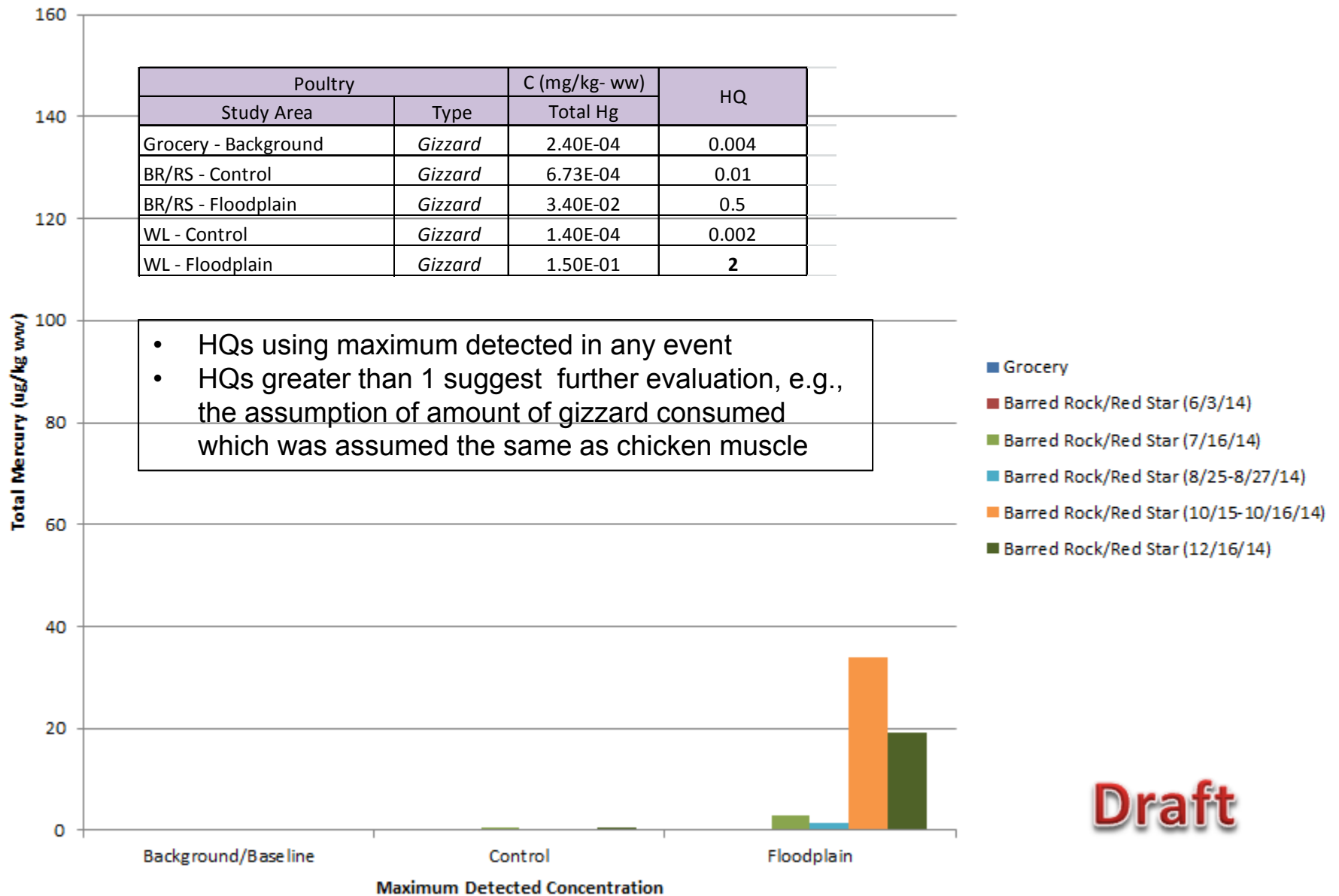


Hg in Gizzard Tissue - White Leghorn



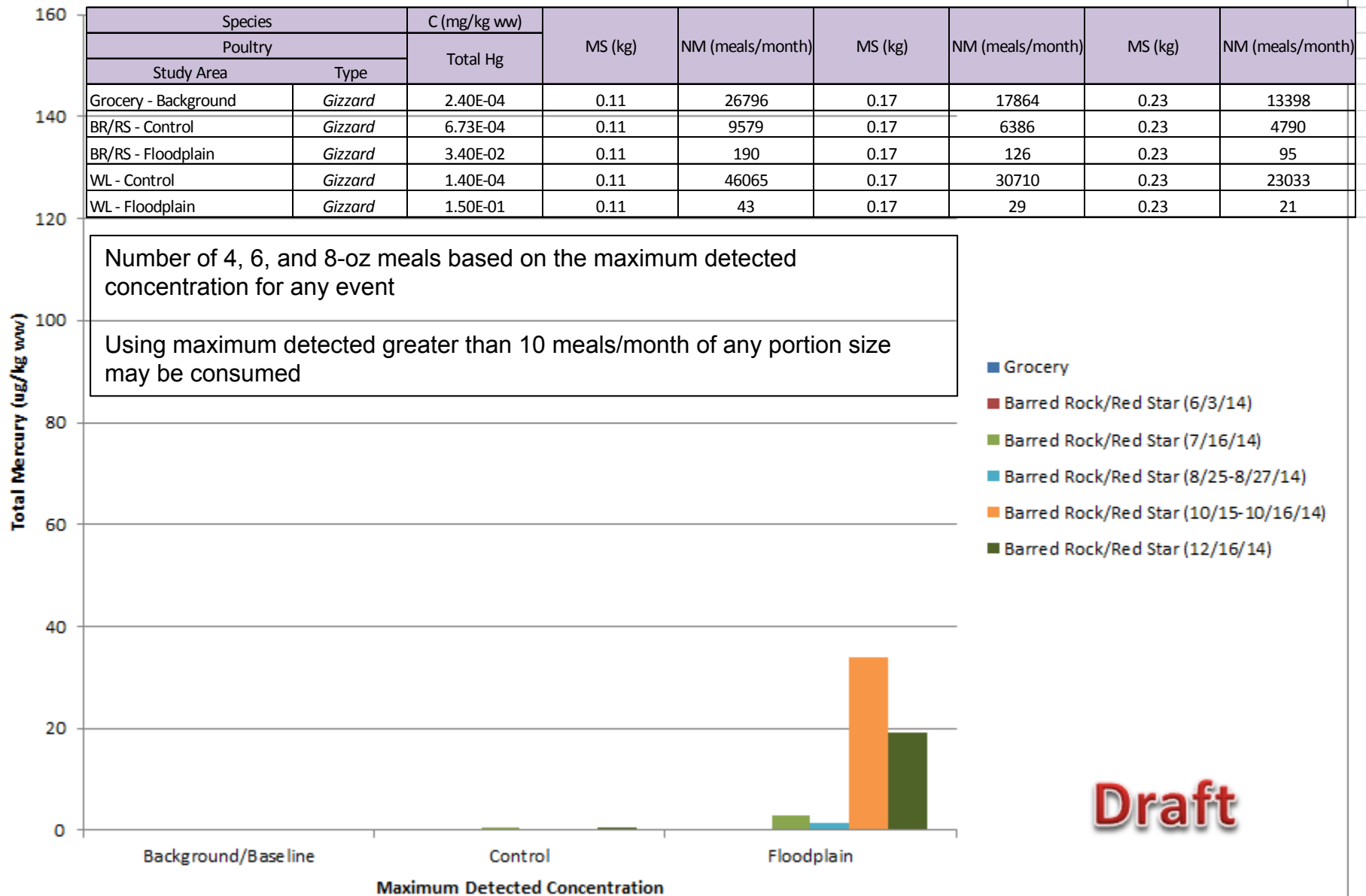
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Hg in Gizzard Tissue - Barred Rock/Red Star

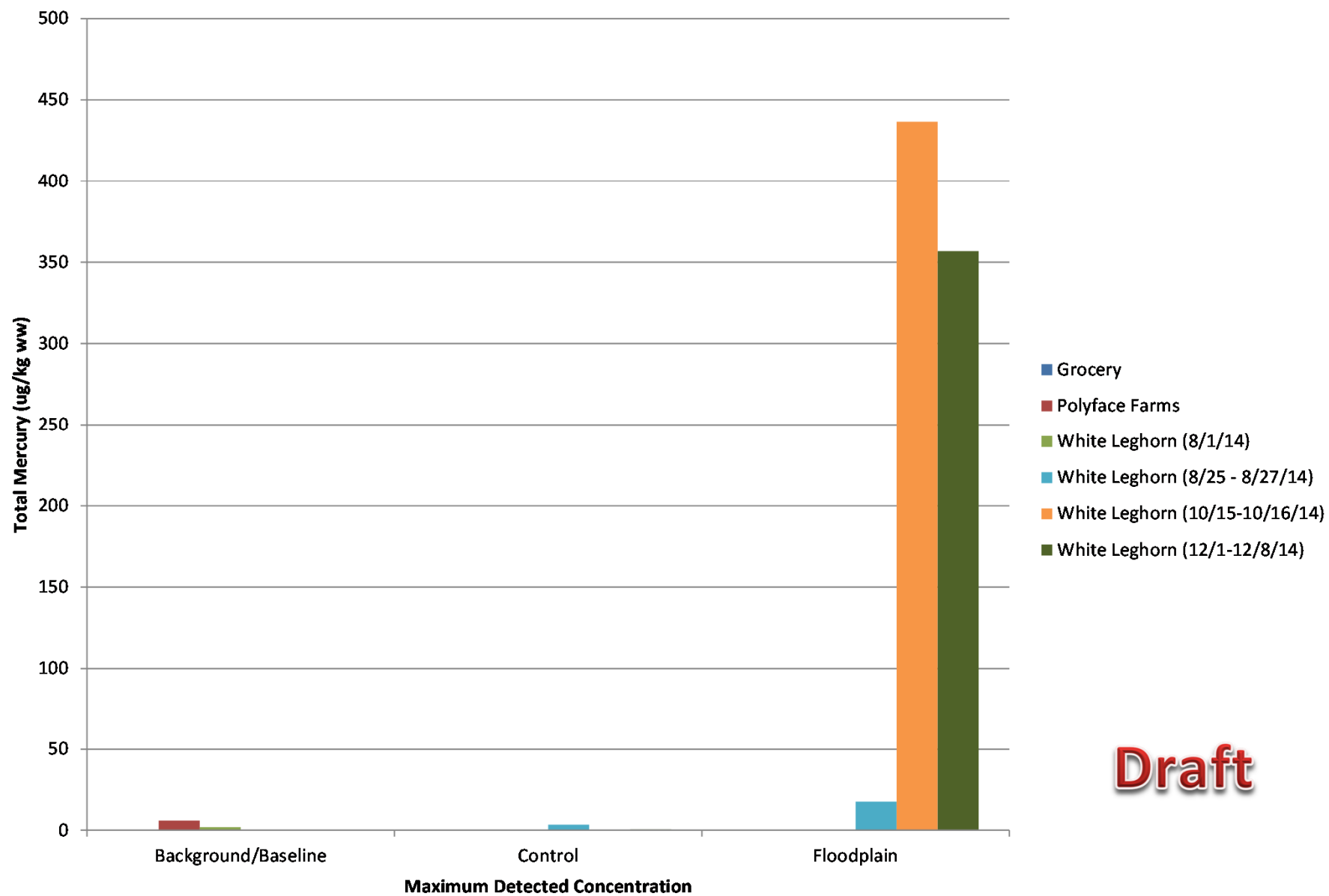


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Hg in Gizzard Tissue - Barred Rock/Red Star

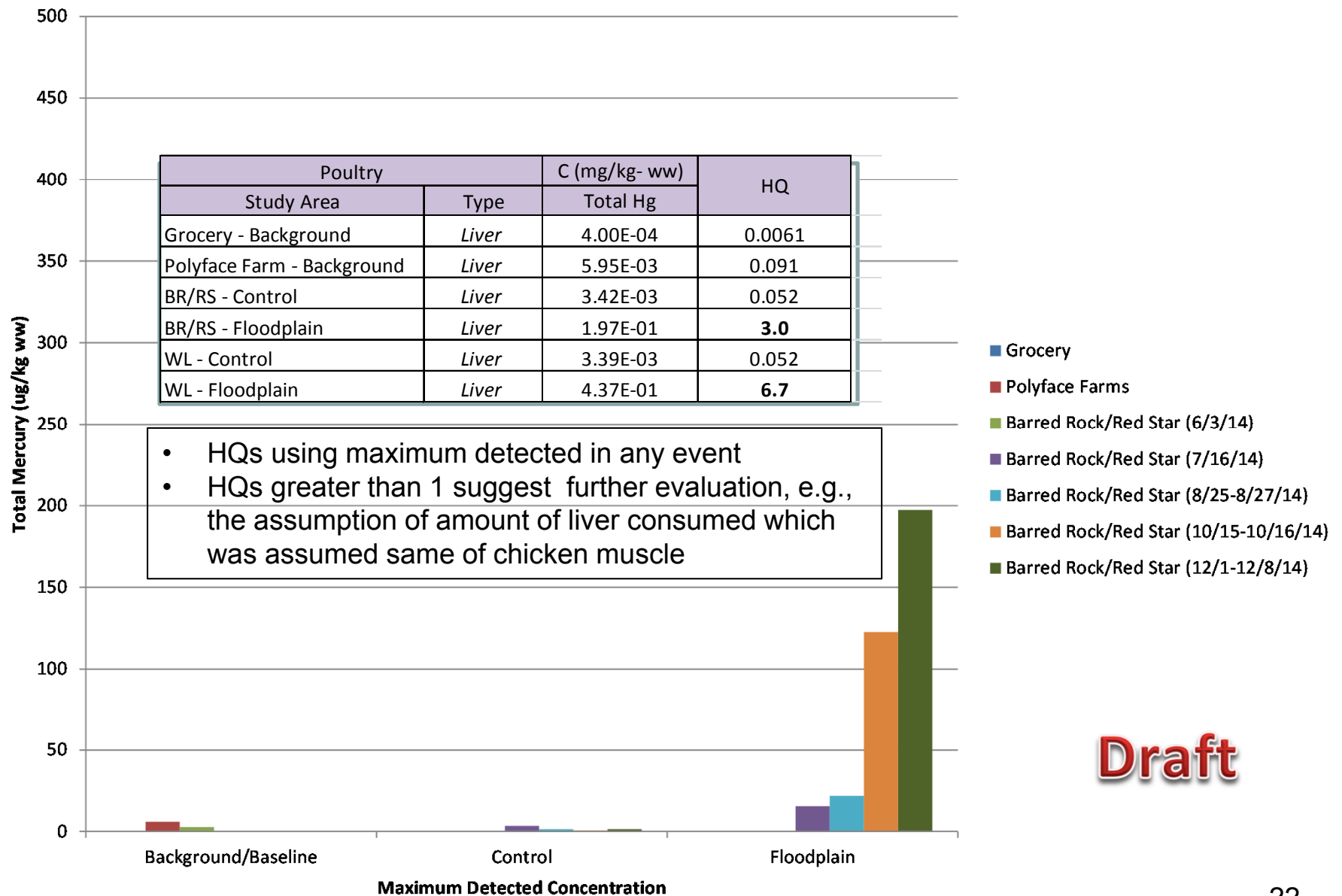


Hg in Liver Tissue - White Leghorn



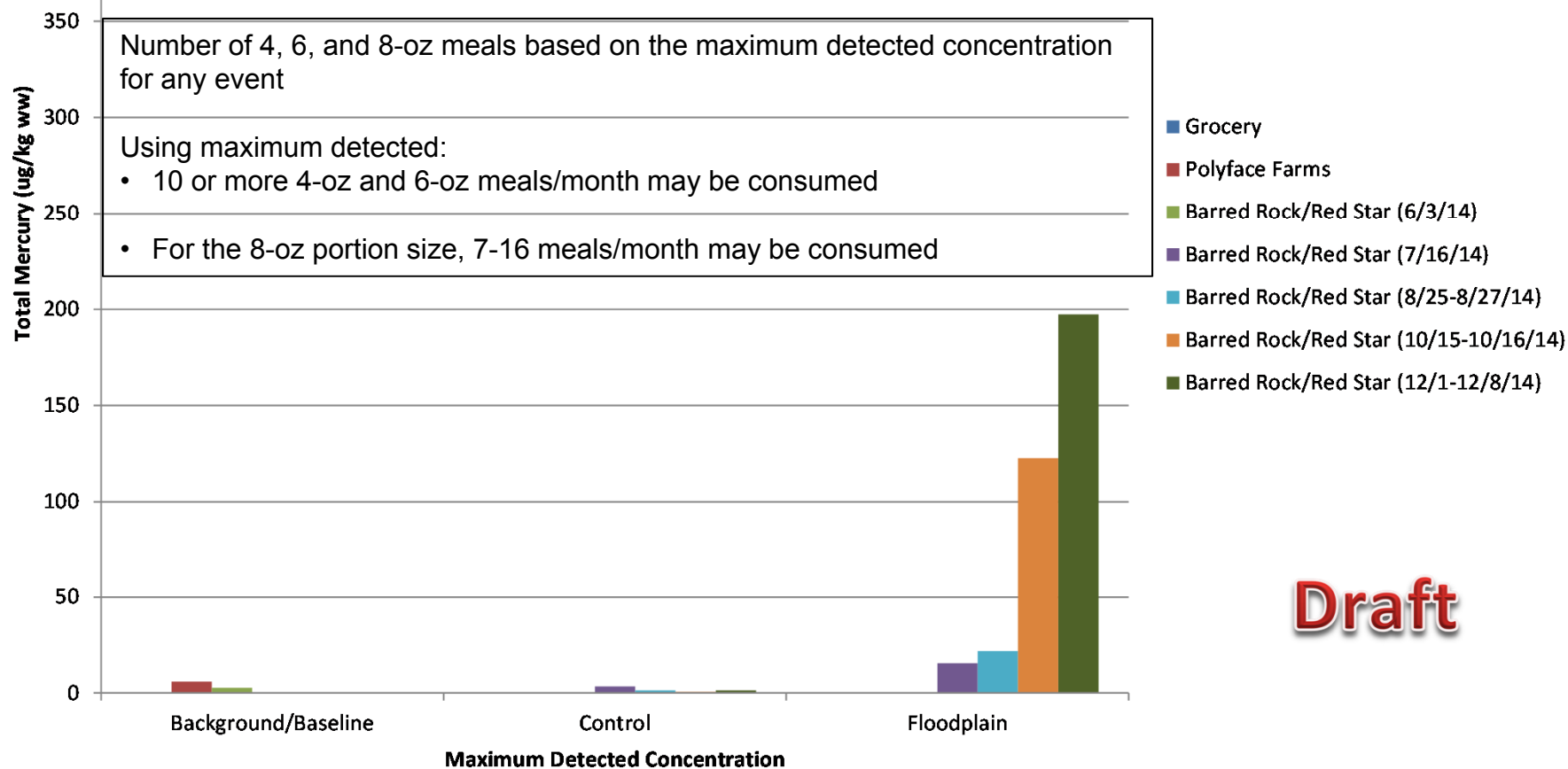
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Hg in Liver Tissue - Barred Rock/Red Star



Hg in Liver Tissue - Barred Rock/Red Star

Species		C (mg/kg ww)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)	MS (kg)	NM (meals/month)
Poultry		Total Hg						
Study Area	Type							
Grocery - Background	Liver	4.00E-04	0.11	16106	0.17	10737	0.23	8053
Polyface Farm - Background	Liver	5.95E-03	0.11	1083	0.17	722	0.23	541
BR/RS - Control	Liver	3.42E-03	0.11	1884	0.17	1256	0.23	942
BR/RS - Floodplain	Liver	1.97E-01	0.11	33	0.17	22	0.23	16
WL - Control	Liver	3.39E-03	0.11	1900	0.17	1267	0.23	950
WL - Floodplain	Liver	4.37E-01	0.11	15	0.17	10	0.23	7

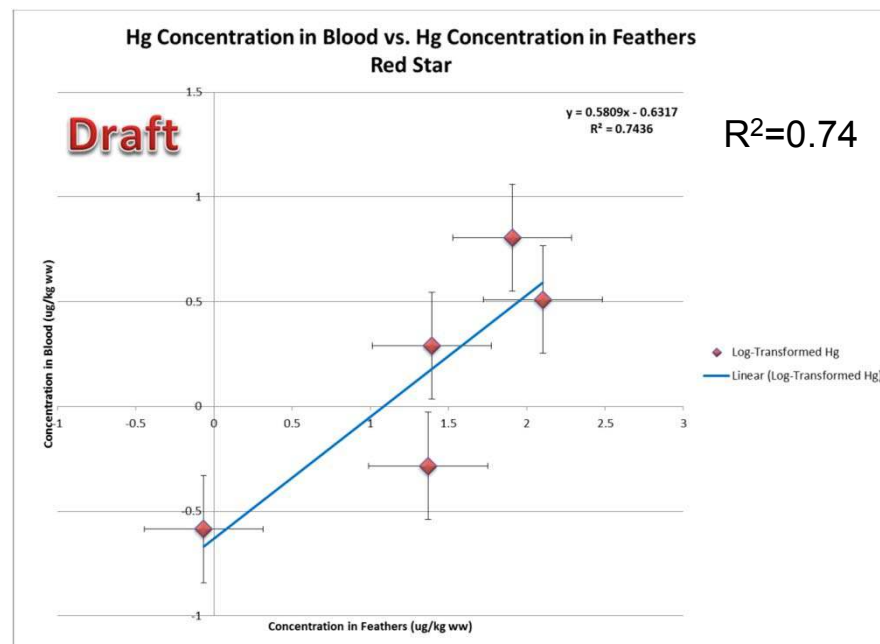
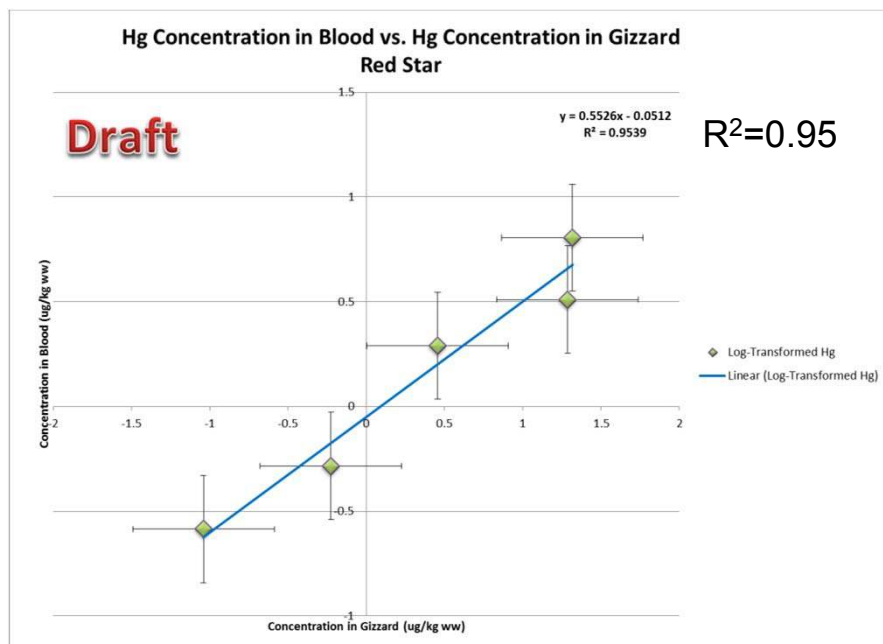
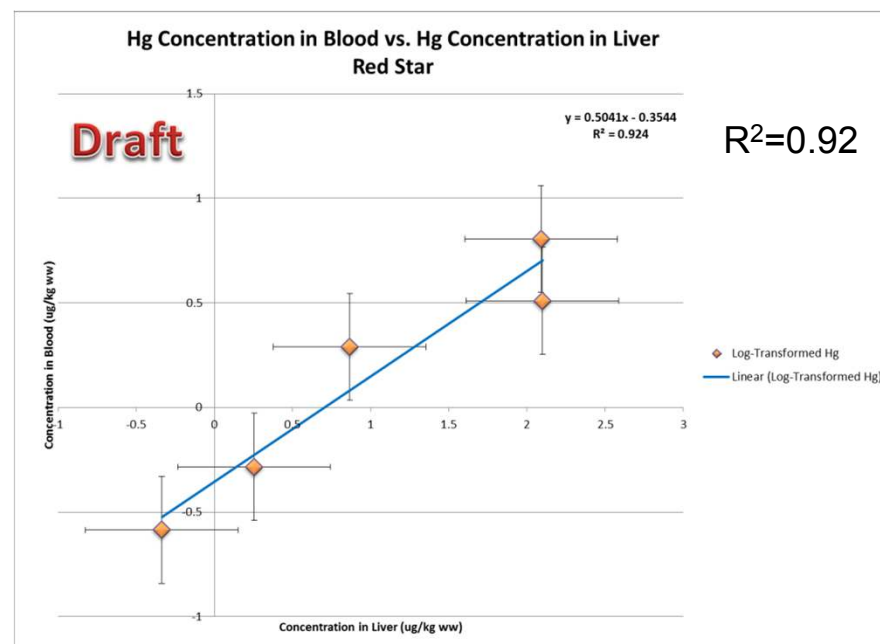
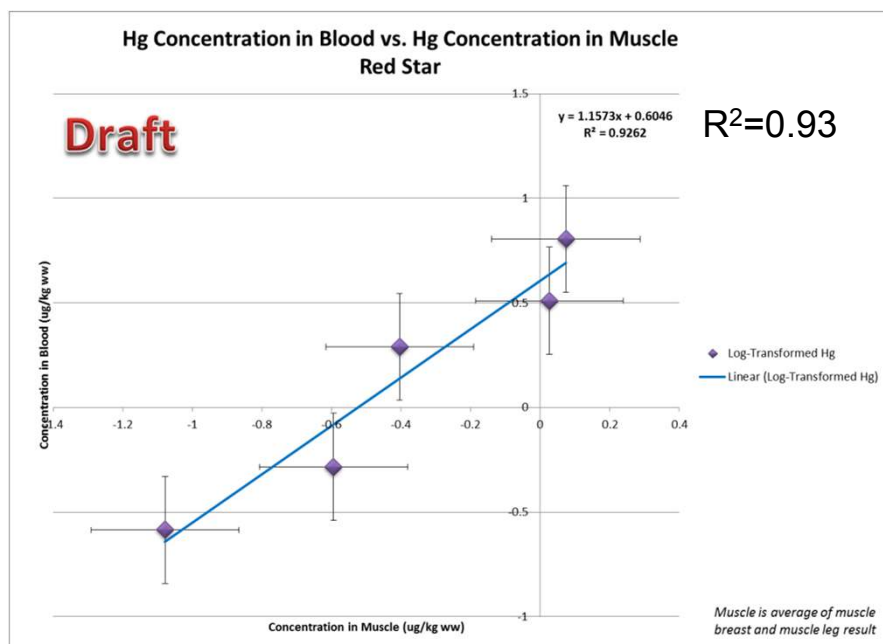


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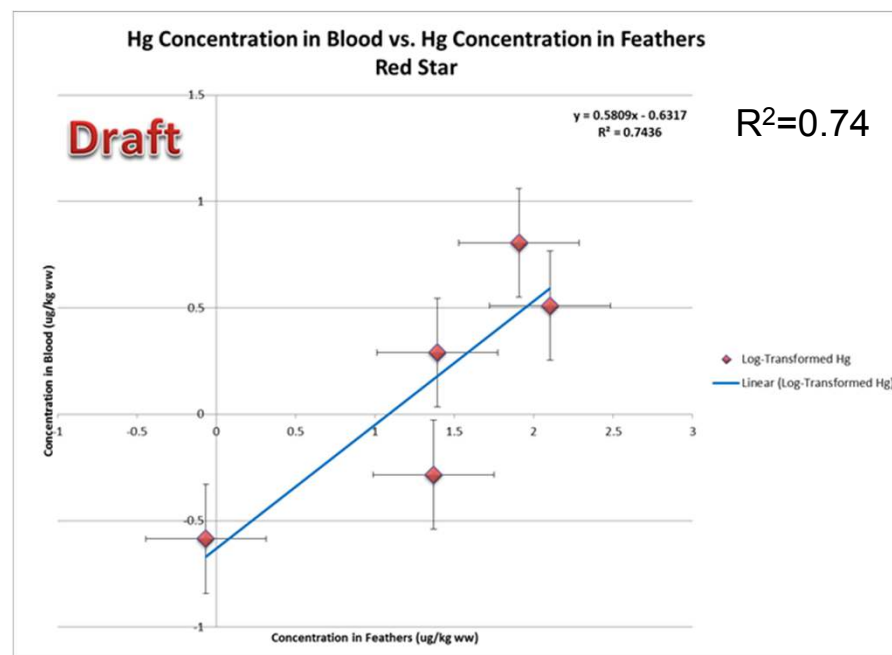
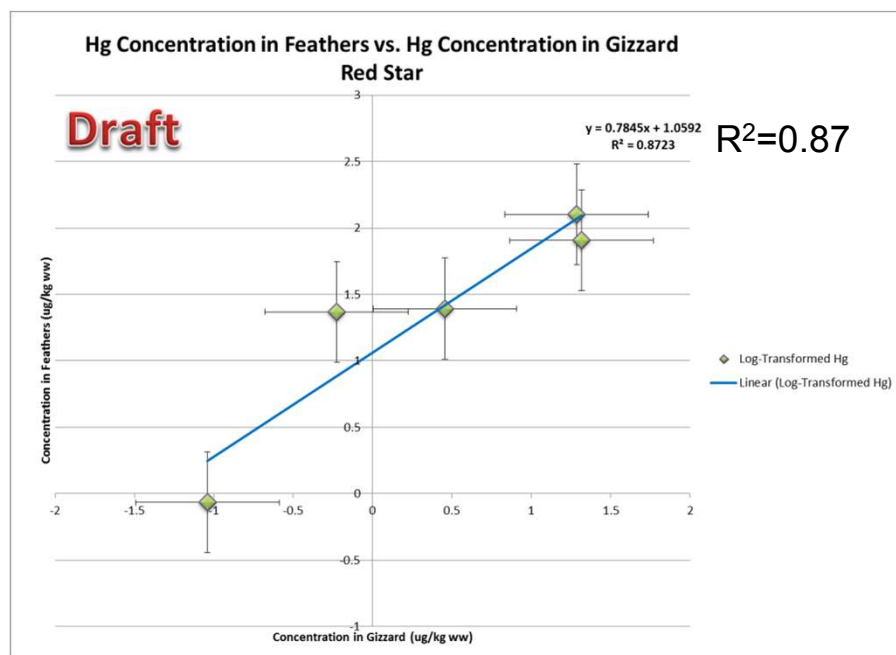
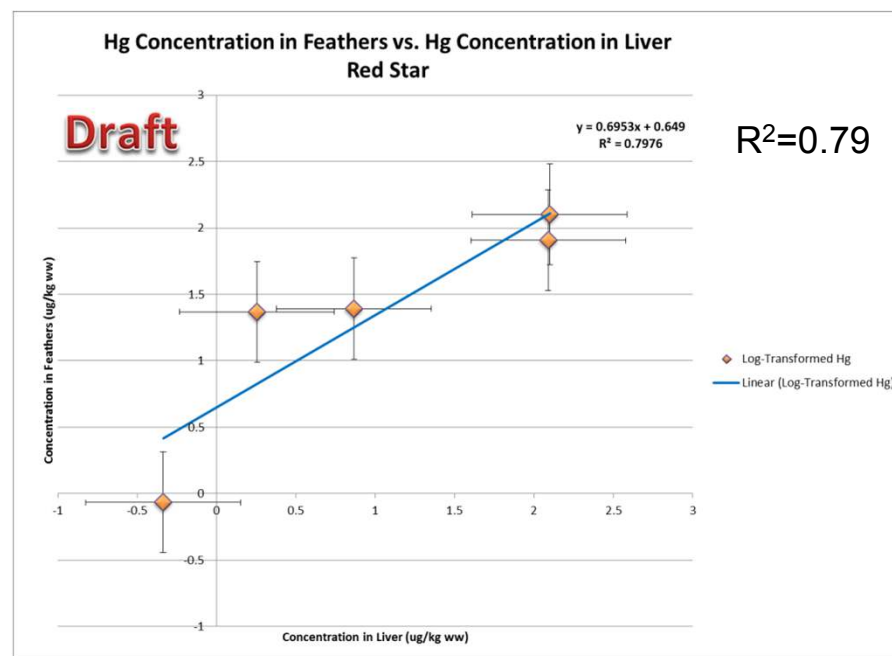
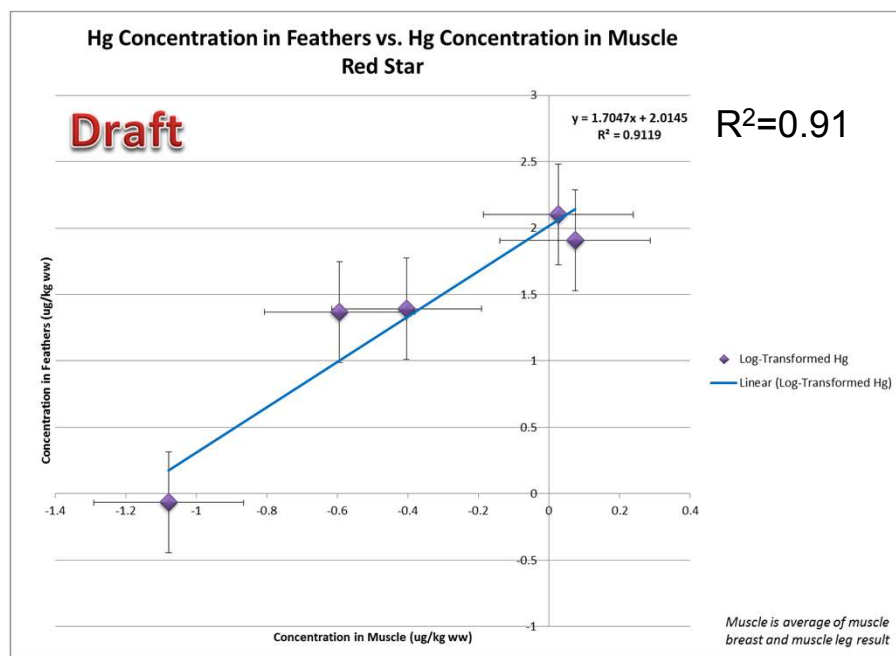
Blood and Feather Data

- Regression analyses were conducted to assess the relationship between Hg levels in blood / feathers and other tissue types.
- Objective was to determine whether:
 - Blood sampling could serve as a non-invasive biomarker for exposure from other tissues
 - Feather data could be instructive in assessing Hg elimination

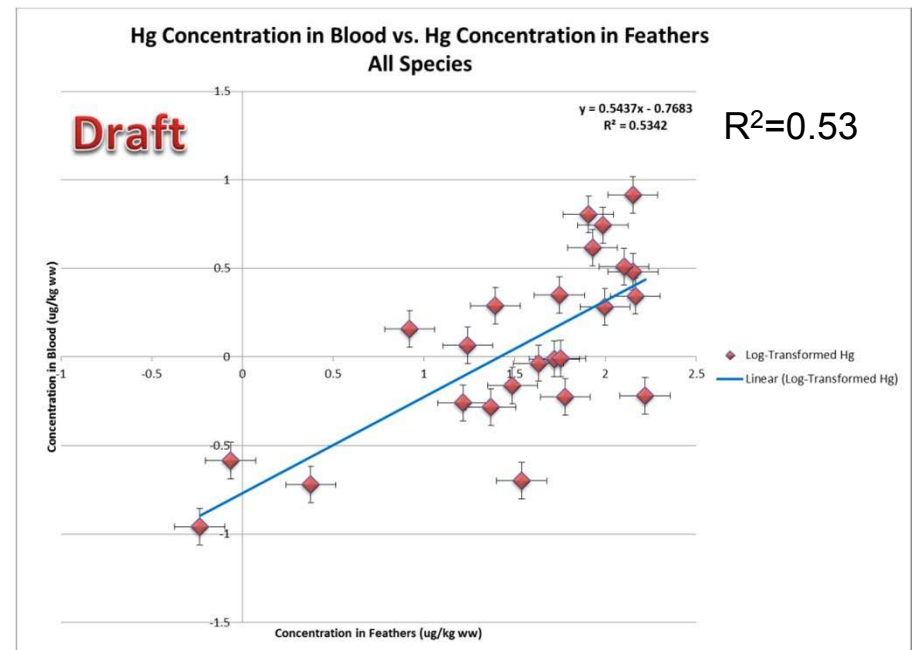
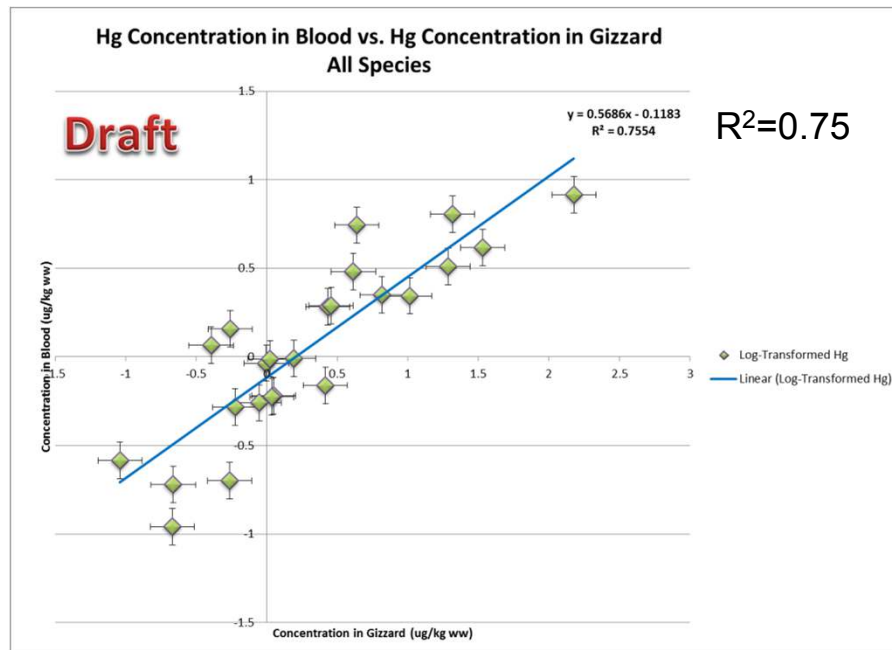
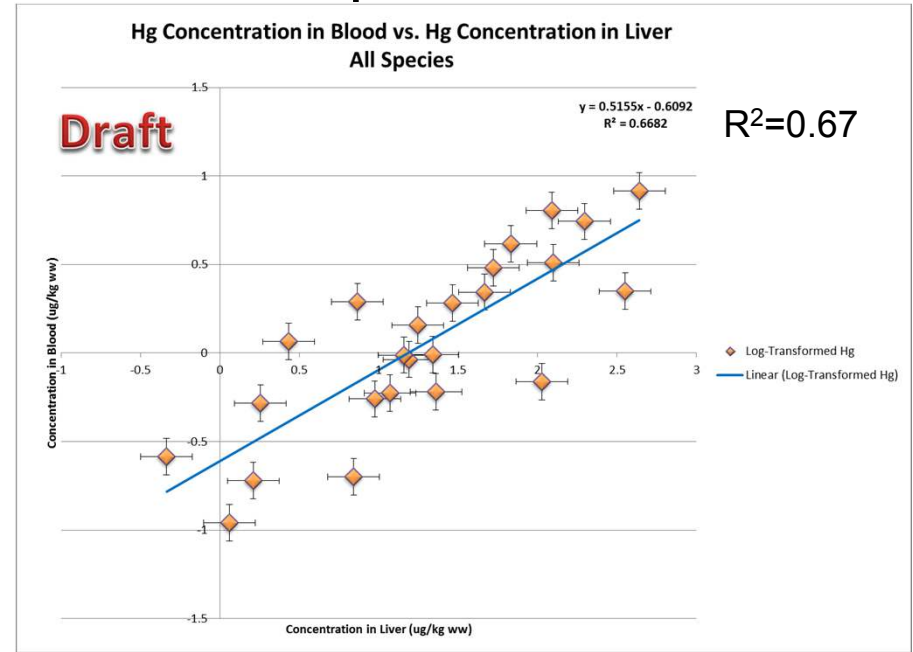
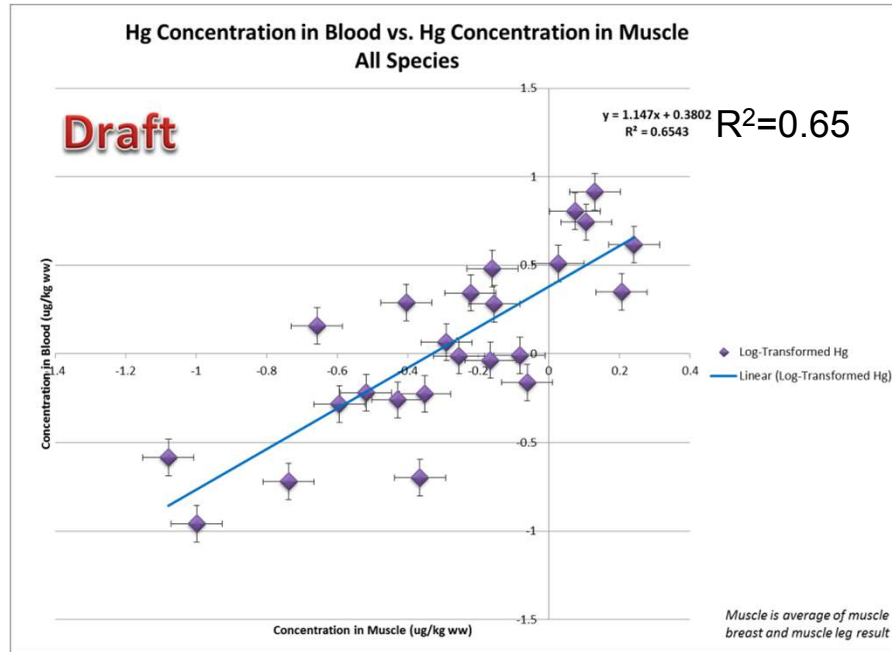
Blood vs. Other Tissues – Red Star



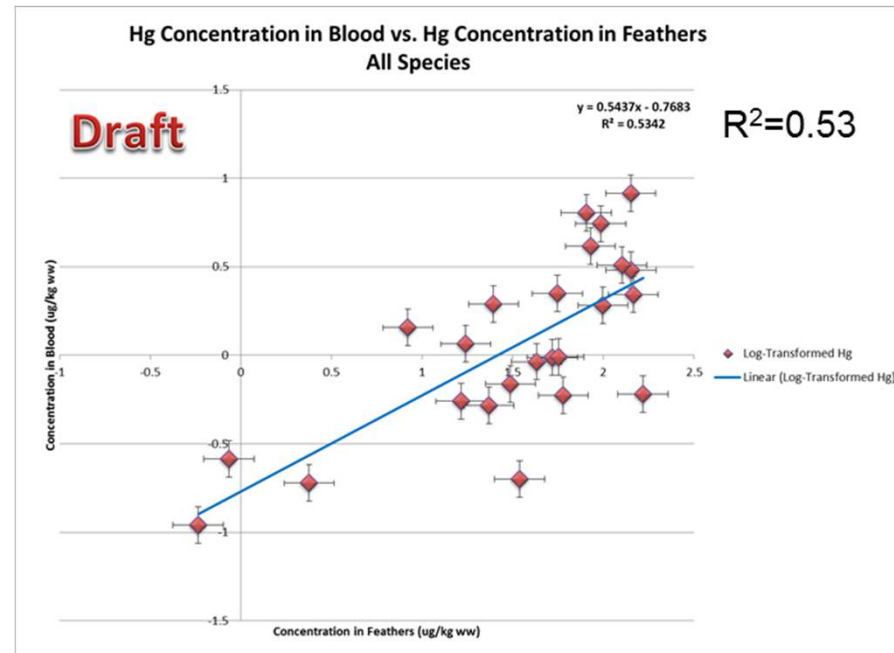
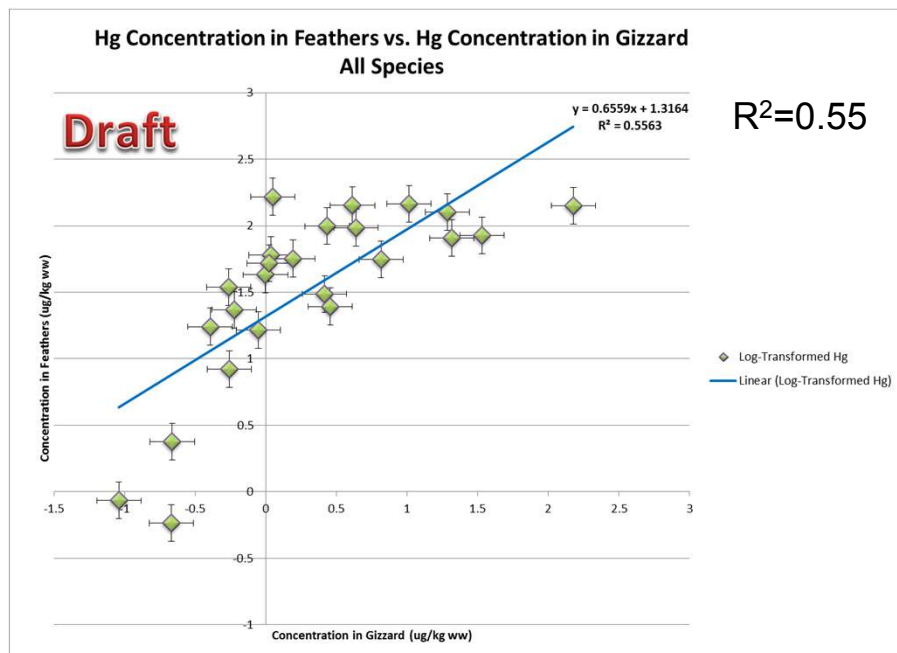
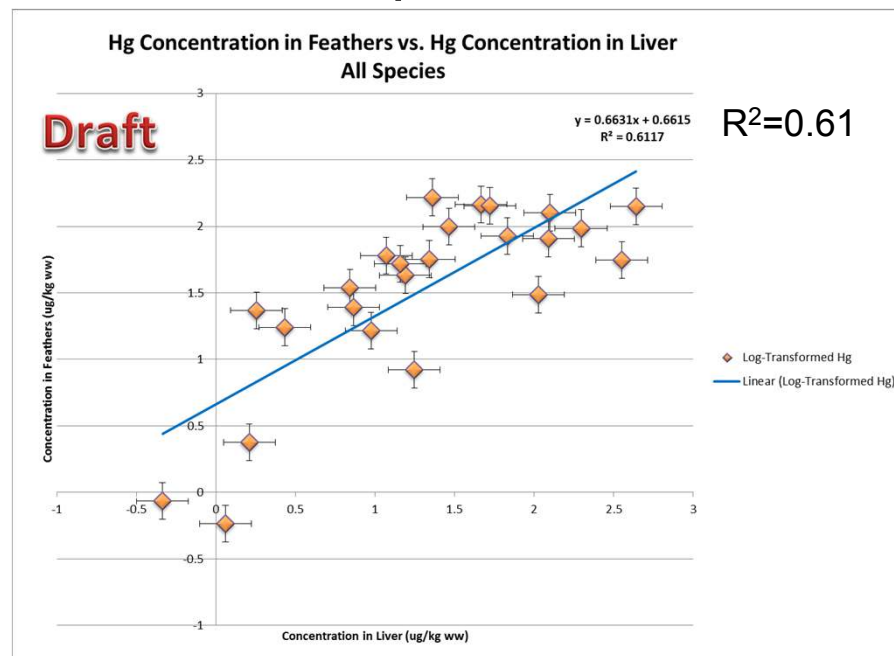
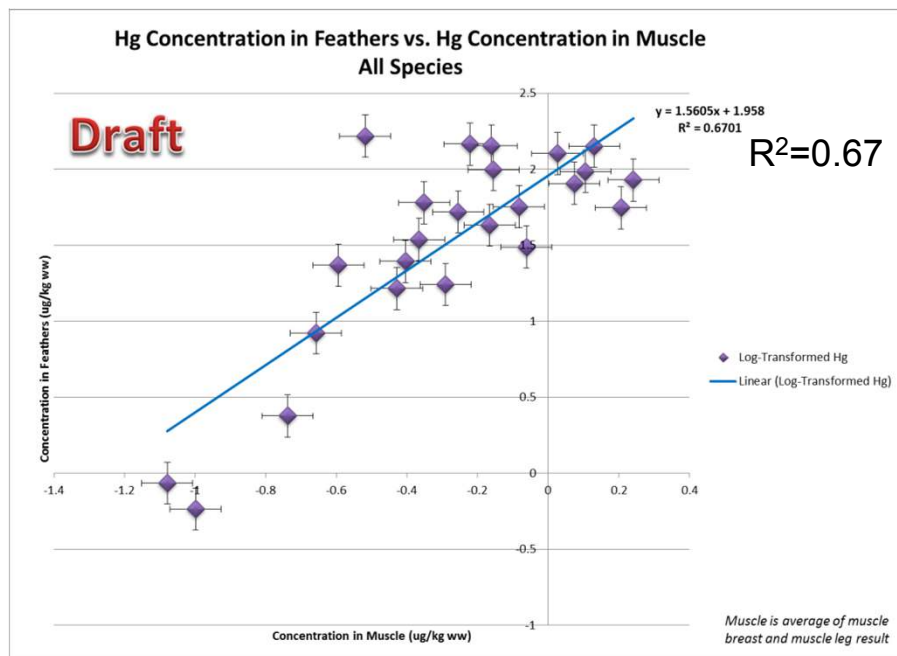
Feathers vs. Other Tissues – Red Star



Blood vs. Other Tissues – All Species



Feathers vs. Other Tissues – All Species



Summary of Regression Analyses

	Total Hg Concentration Compared to Tissue Type (ug/kg ww)							
	Blood THg (r^2)				Feathers THg (r^2)			
	All Species	White Leghorn	Barred Rock	Red Star	All Species	White Leghorn	Barred Rock	Red Star
<i>Blood</i>	-	-	-	-	0.5342	0.5064	0.3516	0.7436
<i>Muscle</i>	0.6543	0.5832	0.6571	0.9262	0.6701	0.5823	0.2092	0.9119
<i>Liver</i>	0.6682	0.7933	0.6542	0.924	0.6117	0.604	0.7173	0.7976
<i>Gizzard</i>	0.7554	0.8174	0.599	0.9539	0.5563	0.5444	0.4968	0.8723
<i>Feathers</i>	0.5342	0.5064	0.3516	0.7436	-	-	-	-

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Summary

- Sampled eggs and poultry (specifically chicken) muscle to determine the potential for chickens reared on the South River floodplain to accumulate mercury.
- The information will be used to inform decisions about exposure through potential food consumption of eggs and chickens reared on the floodplain.
- Observations from the evaluation of results:
 - Poultry samples from mercury impacted floodplain show higher mercury levels than background locations and control areas
 - Risk calculations indicate that egg and muscle consumption are acceptable
 - Concentrations in eggs and muscle do not indicate a need to restrict consumption
 - Risk calculations for gizzard and liver suggest the need for additional context (e.g., consumption rates set equivalent to chicken muscle)
 - Consumption of gizzard and liver acceptable to some degree
- Blood Hg data correlations with Hg data in edible tissues:
 - Strong correlations in Red Star ($R^2=0.92-0.95$)
 - Correlation less robust when considering all species collectively ($R^2=0.65-0.75$)
- Feather Hg data correlations with Hg data in other tissues:
 - Reasonably good correlations in Red Star ($R^2=0.74-0.91$)
 - Correlations less robust in other species / tissue combinations

Human Exposure Evaluation

Fact Sheets

- √ Fact sheets completed
 - √ Fact Sheet 1: General Introduction
 - *About the South River Science Team*
 - √ Fact Sheet 2: Exposure Summary
 - *People, Mercury, and the River*
 - √ Fact Sheet 3: Soil Sampling Results
 - *Summary of South River Floodplain Soil Survey*
 - √ Fact Sheet 5: Garden Study
 - *Eating Vegetables Grown on the South River Floodplain*
 - √ Fact Sheet 6: Wildlife Consumption
 - *Eating Waterfowl, Game, and Other Animals from the South River Watershed*
- Other Fact Sheets, as warranted
 - Livestock/Poultry

Backup Information



Microsoft Excel
Worksheet