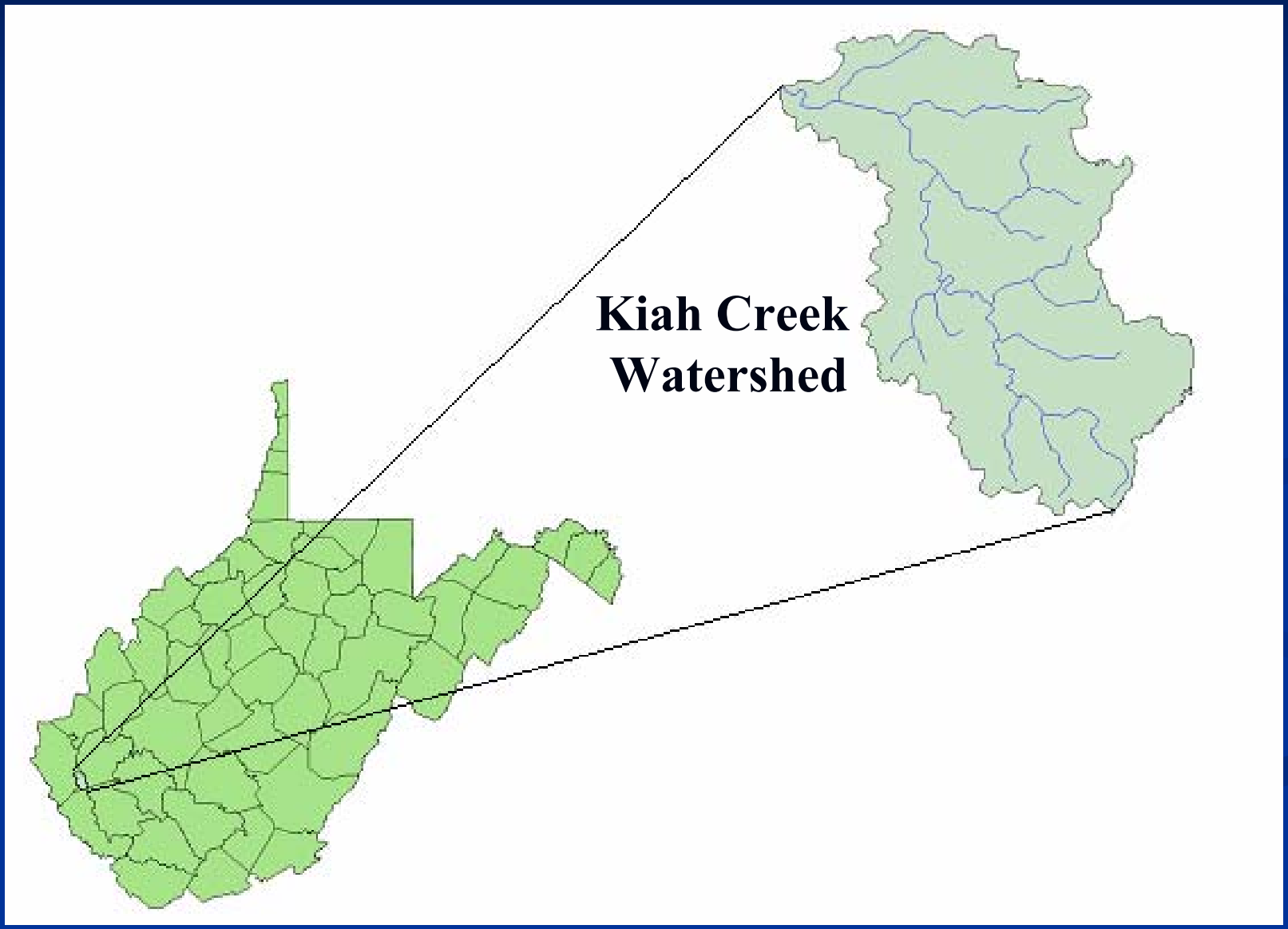
A Preliminary Study of the Selenium Levels Found in Fishes Collected Downstream from Active Coal Mining & Valley Fill Operations

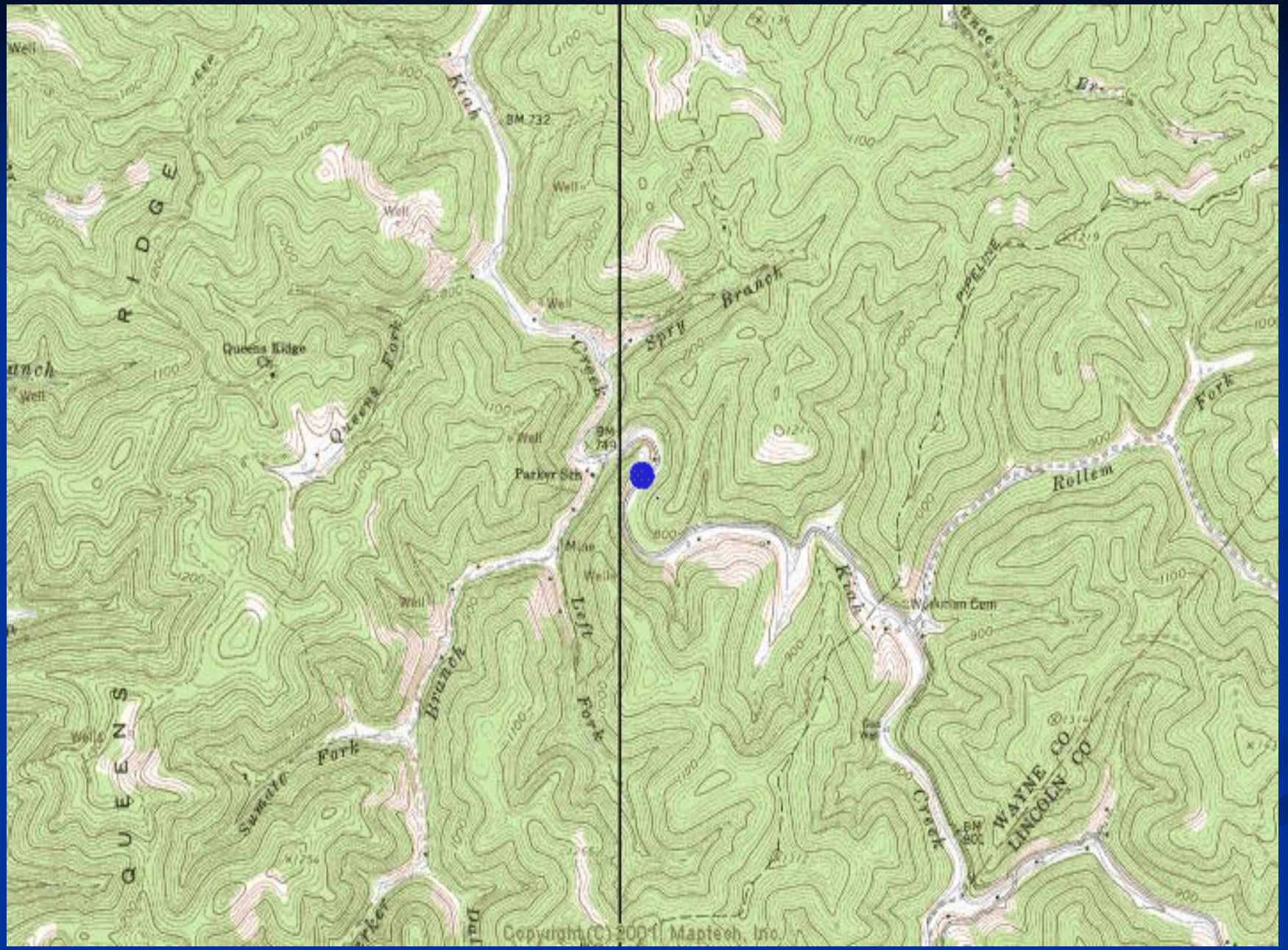
Objectives:

To study levels of Se in fishes downstream of coal mining operations:

- Examine Se levels among different fish species.
- Examine Se levels between organs.
- Compare Se level variances between different methodologies of measuring Se.

Kiah Creek, West Virginia




Kiah
BM 732
Well
RIDGE
Queens Ridge
Queens Fork
Creek
Spry Branch
Pipeline
Fork
Rollem
BM 749
Parker Sch
Left Fork
Branch
Kiah
Cemetery
Creek
QUEENS
Sawdie Fork
WAYNE CO.
LINCOLN CO.
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Kiah Creek Water

- Total Se <0.0010 mg/l (MDL) for this study.
  Spring 2003: Total Se = 0.0020 mg/l
  Fall 2003: Total Se = 0.0046 mg/l.

- Fecal coliform = 2,000 cfu/100ml

- Alk. = 22.4 mg/l. Hardness = 148 mg/l
  Cond. = 366 µs. Diss. Al = 0.066 mg/l
  Sulfate = 133 mg/l. Total Fe = 0.273 mg/l

Kiah Creek Habitat

- Scored 138 out of 200
- Limited by “embeddedness”, “frequency of riffles”, “velocity depth combinations”.
- Habitat is considerably more limiting than water quality.

Kiah Benthic Community

- Marginal to poor
- 291 individuals & 8 taxa from Spring 2004
- 95% Tolerant
- Average WV-SCI score = 52.1 since Spring 1995.
- Very low #'s from EPT groups (≈ 85-90% Chiro)

Kiah Creek Fisheries

- Fairly healthy
- 680 fishes from 21 taxa in Spring 2001
- 70% Intermediate tolerant
- Shiners, minnows, darters, chubs, stonerollers, suckers

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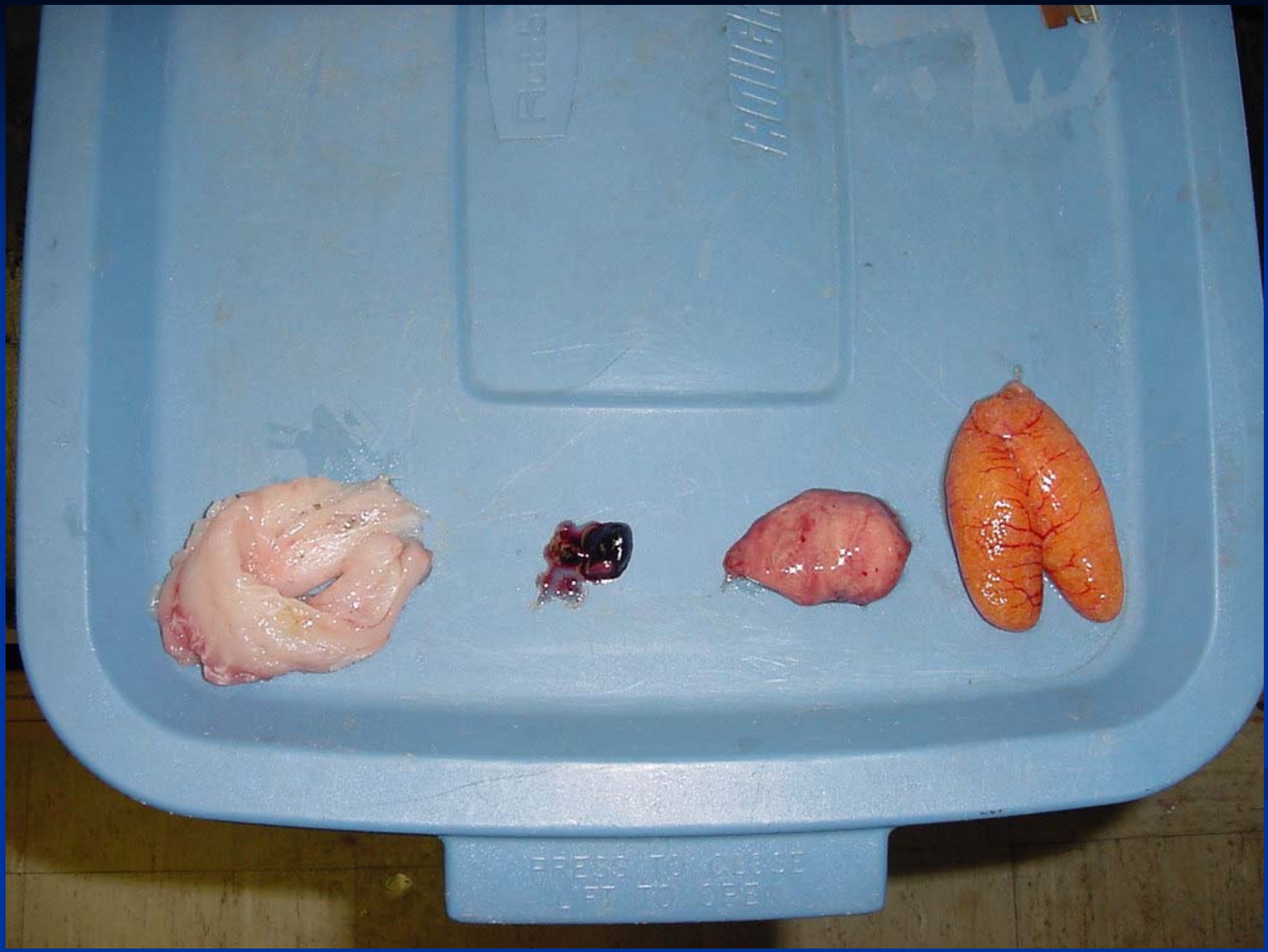
EXIT

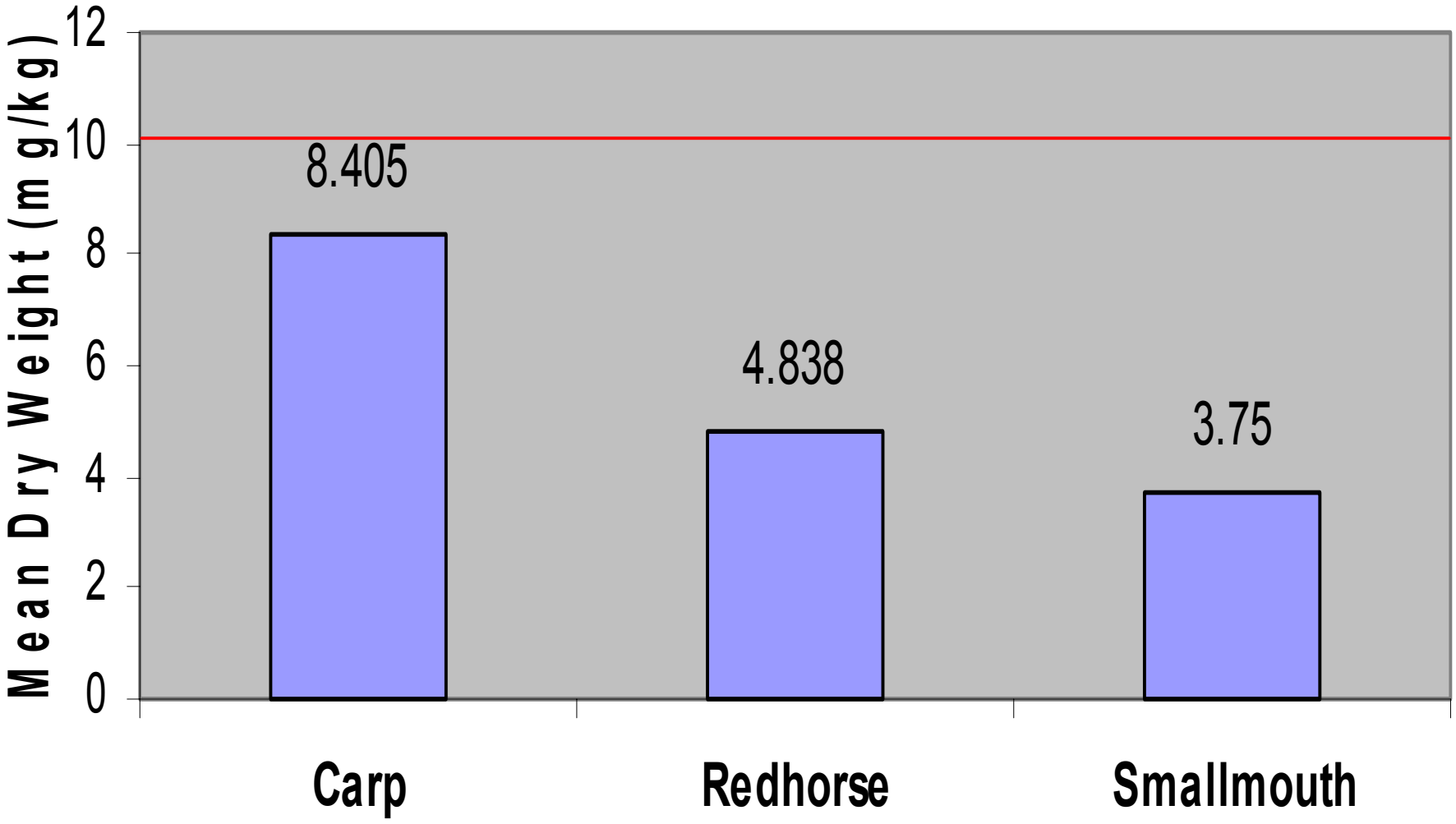

FIVE
Gloves
Powder-Free
Textured

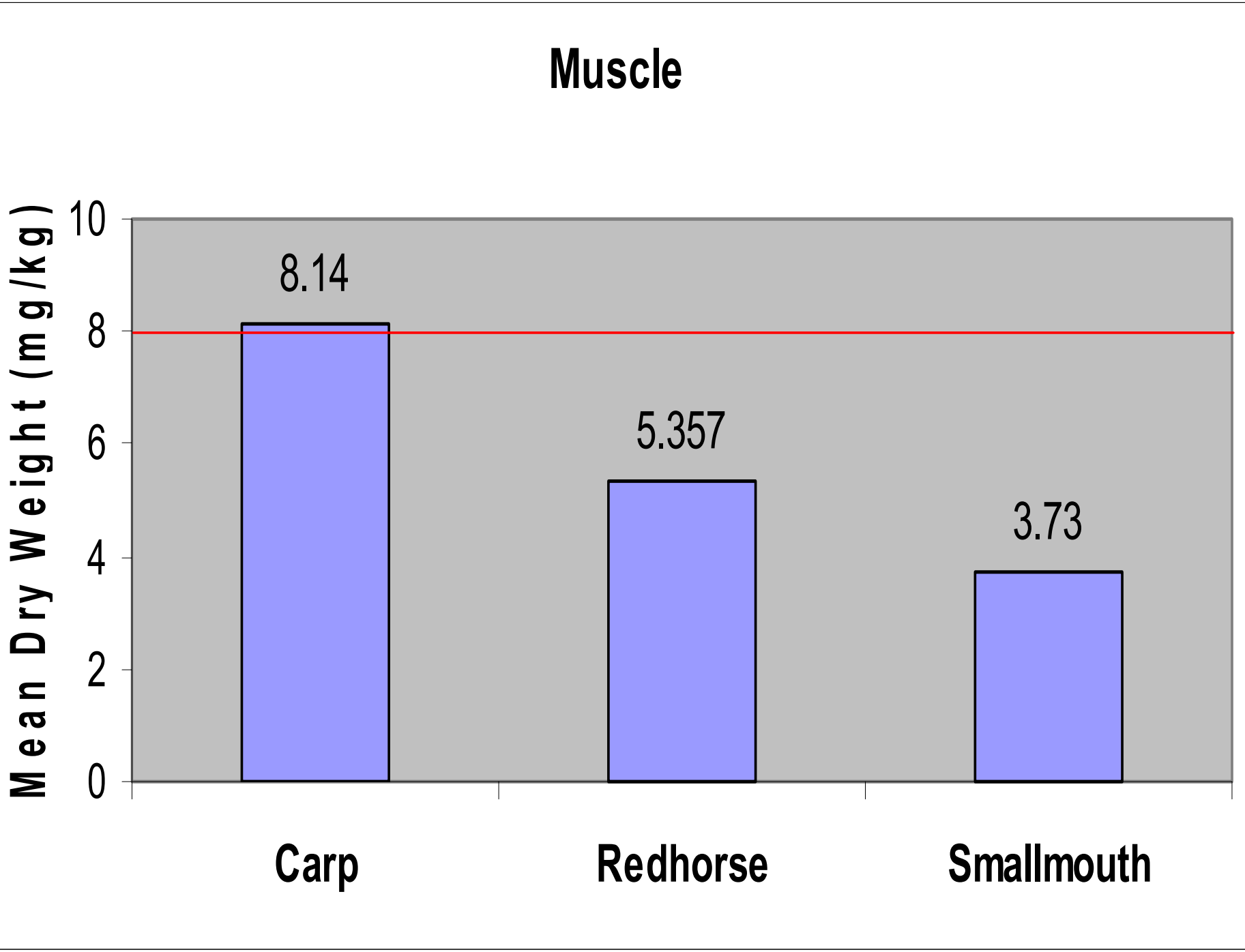


Limiting Factor

$$$

Eggs


Mean Dry Weight (mg/kg)
12
10
8
6
4
2
0
8.405
4.838
3.75
Carp
Redhorse
Smallmouth


Muscle
Mean Dry Weight (mg/kg)
10
8
6
4
2
0
8.14
5.357
3.73
Carp
Redhorse
Smallmouth

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- Examine Se levels between organs within species.
- Compare variances between different methodologies of measuring Se.

Heart Tissue
(Dry Wt; mg/kg)

Smallmouth Bass #1	5.55
Smallmouth Bass #2	6.13
Golden Redhorse #1	4.74
Golden Redhorse #2	4.70
Bluegill #1	5.67

Liver Tissue
(Dry Wt; mg/kg)

Smallmouth Bass #1	7.15
Smallmouth Bass #2	10.38
Bluegill #1	17.84*

* small mass; caution

Eggs/Gonads
(Dry Wt; mg/kg)

Smallmouth Bass #1	4.79
Smallmouth Bass #2 male	6.18
Golden Redhorse #1	8.13
Golden Redhorse #2	4.90

Muscle Tissue
(Dry Wt; mg/kg)

Smallmouth Bass #1	4.58
Smallmouth Bass #2	5.29
Golden Redhorse #1	5.70
Golden Redhorse #2	4.39
Bluegill #1	5.67

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REI Consultants, Inc.

- Tissue Prep. SW-846 EPA Method 3050B (acid digest using nitric acid, hydrogen peroxide, & heat). Oven-dried 100° C to constant weight.

- Se Tissue Analysis SW 7740 (Graphite Furnace-Atomic Absorption Spectroscopy) MDL = 0.5 mg/kg

Univ. Missouri- Columbia Research Reactor (MURR)

- Tissue samples freeze dried (-50°C).

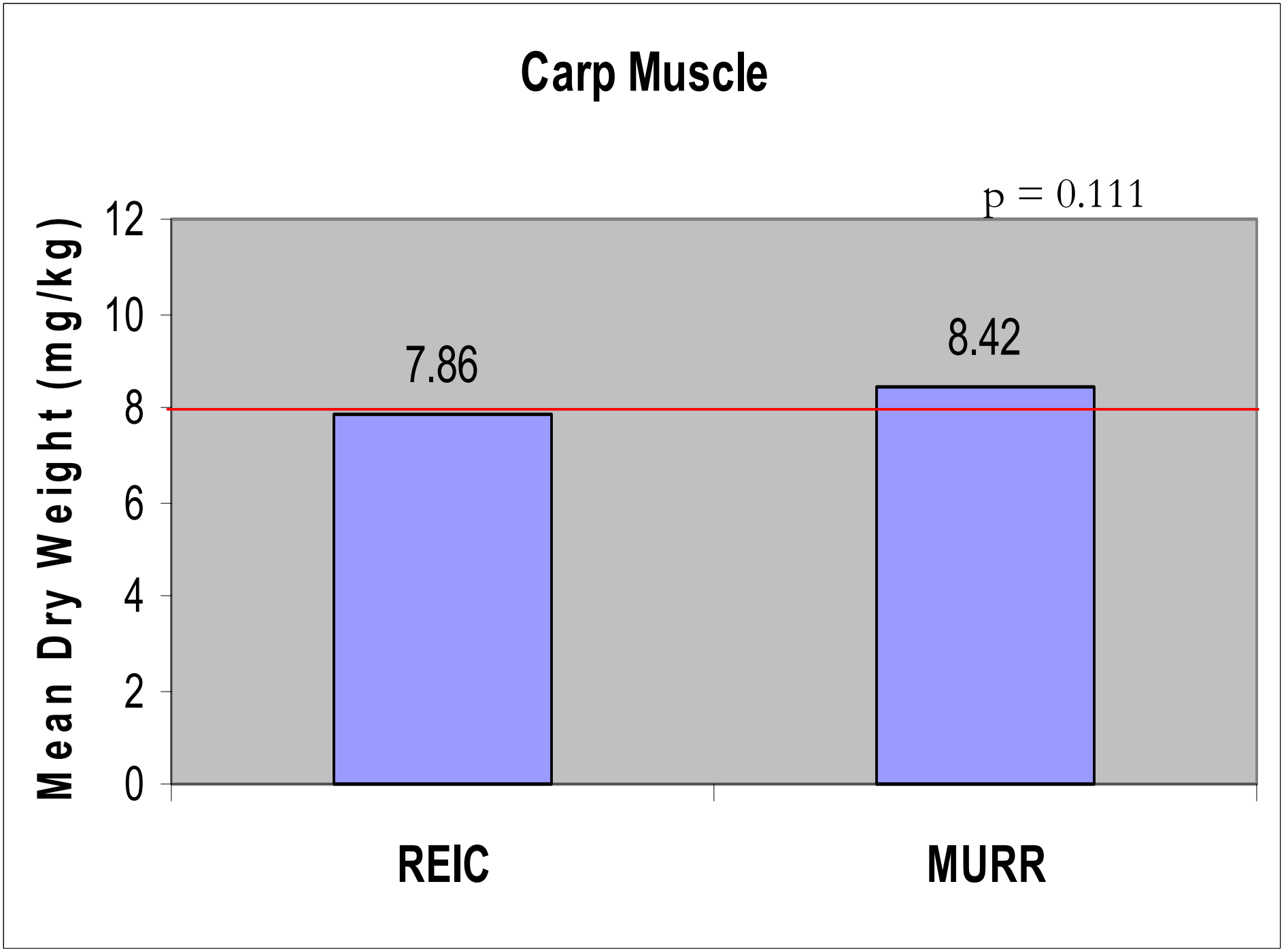
- NAA (Neutron Activation Analysis). Nuclear technique where radionuclides specific to element of interest (Se) are induced by exposure to neutrons at a research reactor. The induced activity for Se is measured by high-resolution gamma ray spectroscopy.

Carp Muscle

(Dry Wt; mg/kg)

REIC	MURR
8.05	7.91
7.82	8.69
7.71	8.66

P-value = 0.111


Carp Muscle
p = 0.111
Mean Dry Weight (mg/kg)
12
10
8
6
4
2
0
7.86
8.42
REIC
MURR

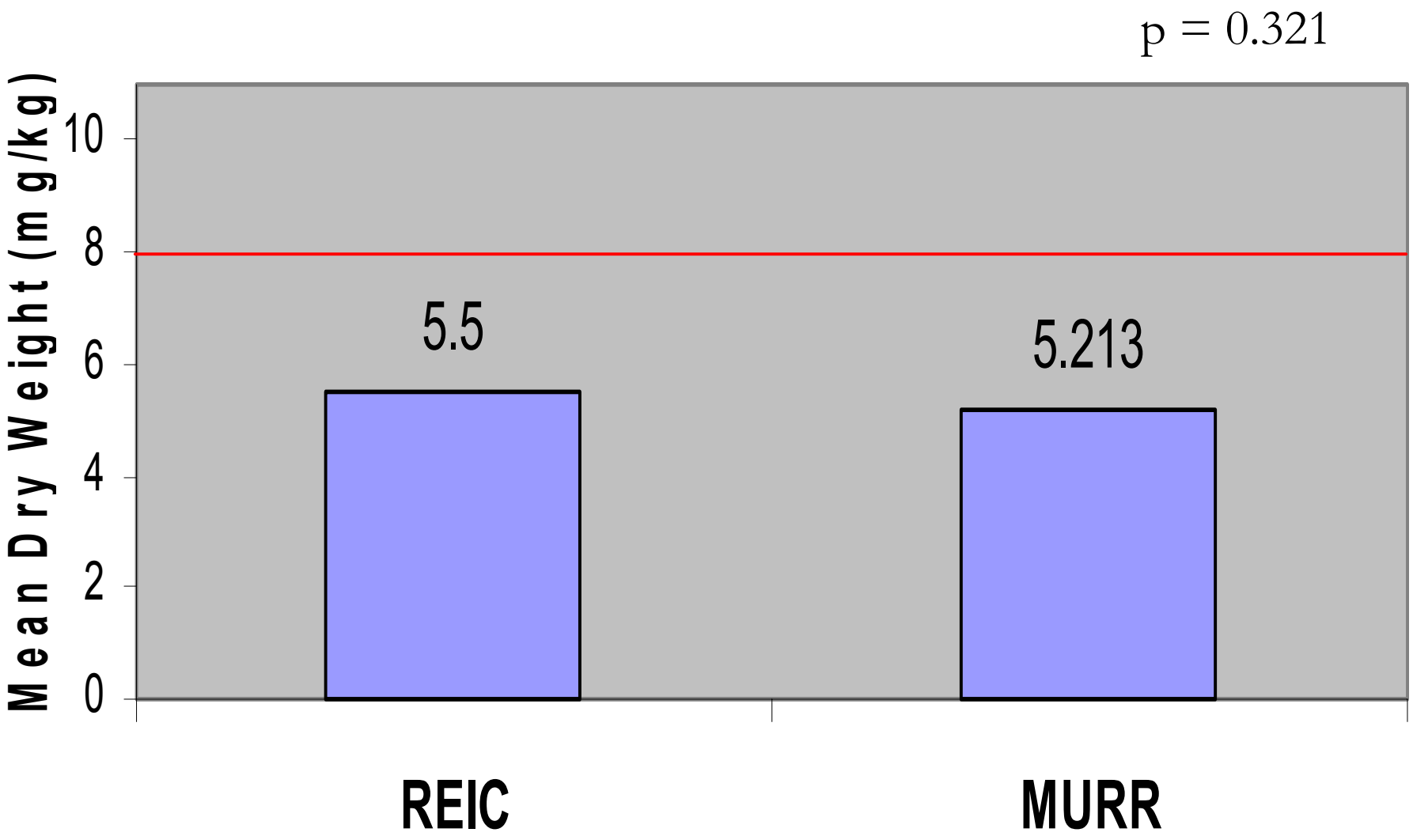
Golden Redhorse Muscle

(Dry Wt; mg/kg)

REIC	MURR
5.91	5.29
5.54	5.22
5.05	5.13

P-value = 0.321

Redhorse Muscle



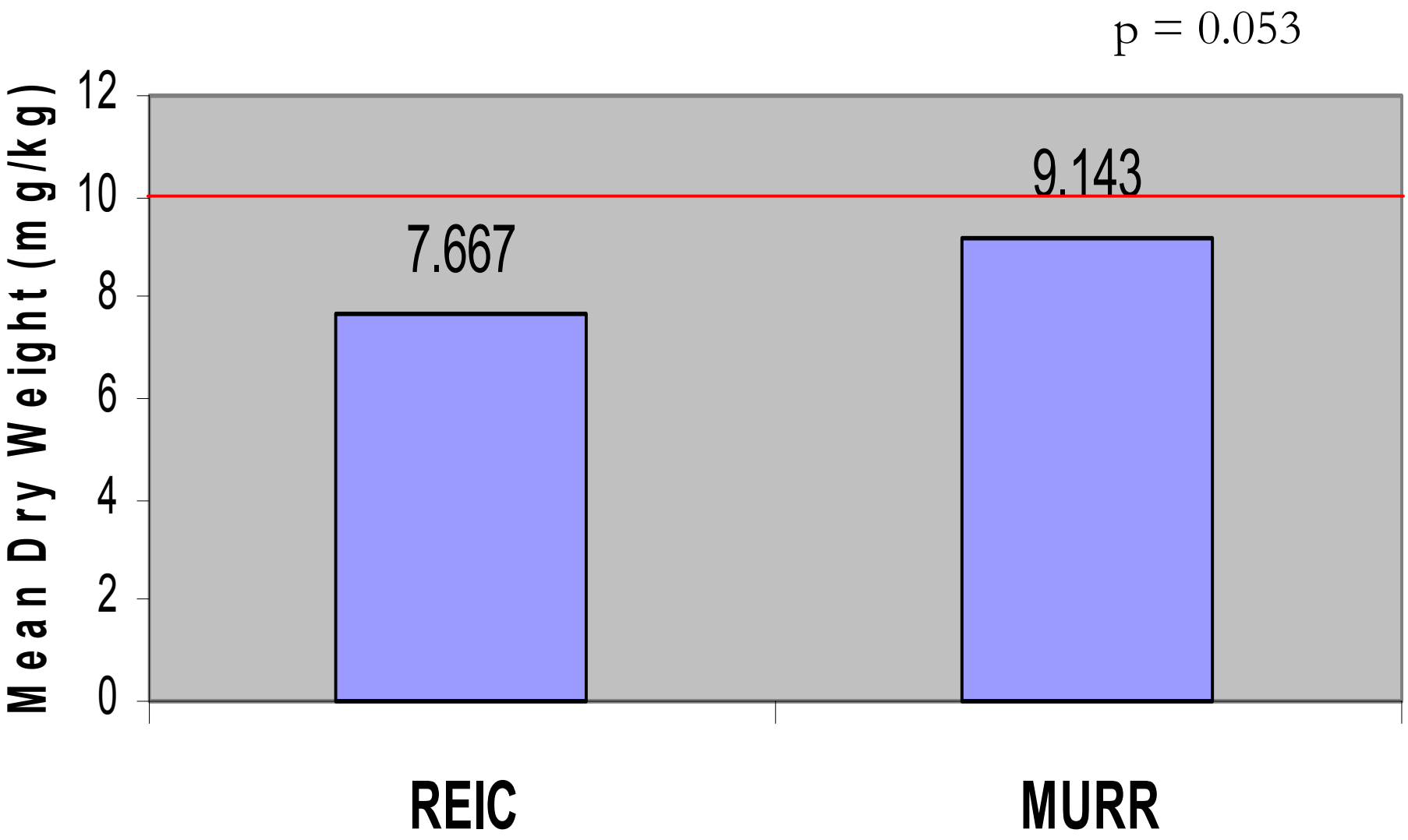
Carp Eggs

(Dry Wt; mg/kg)

REIC	MURR
6.65	9.45
8.00	8.91
8.35	9.07

P-value = 0.053

Carp Eggs



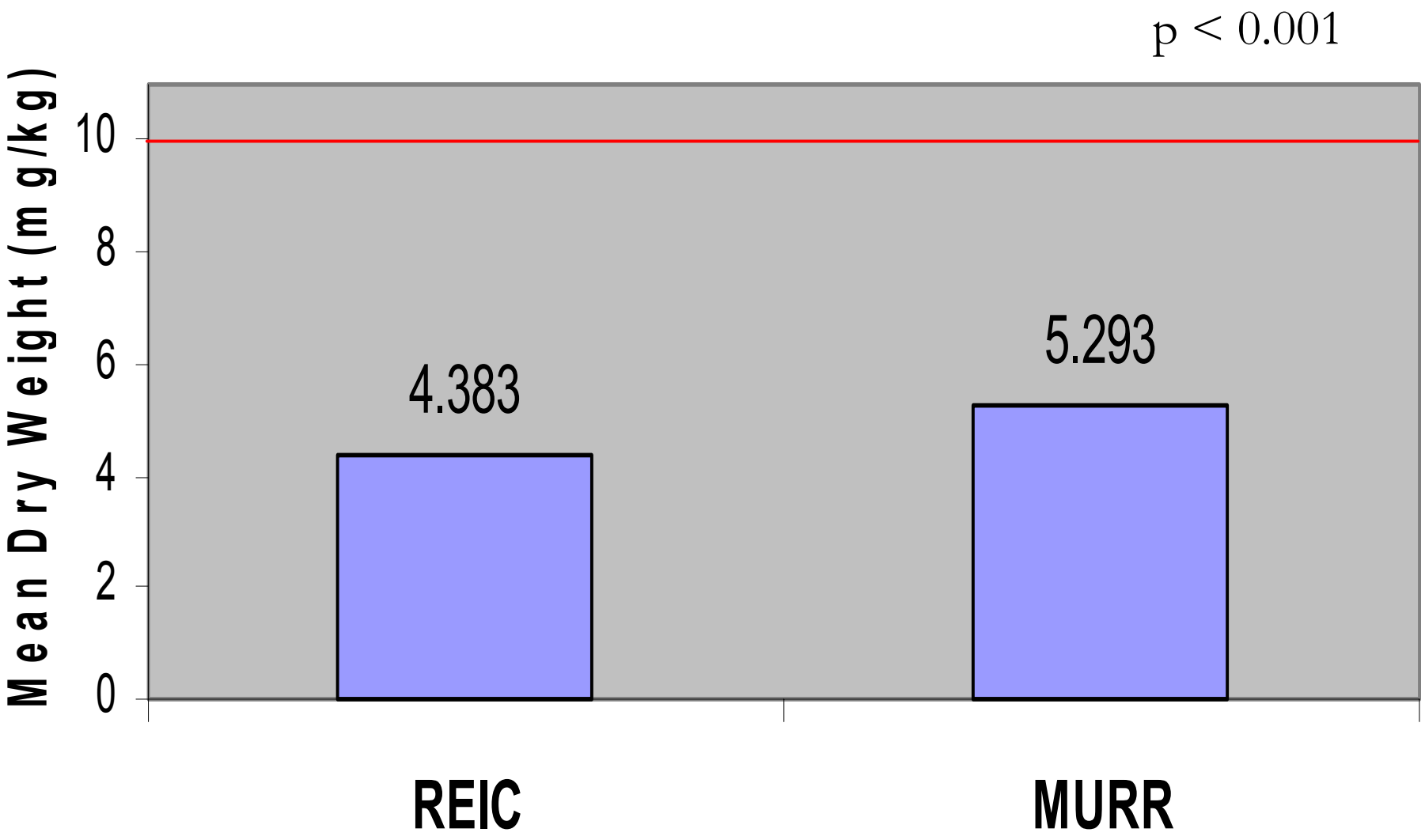
Golden Redhorse Eggs

(Dry Wt; mg/kg)

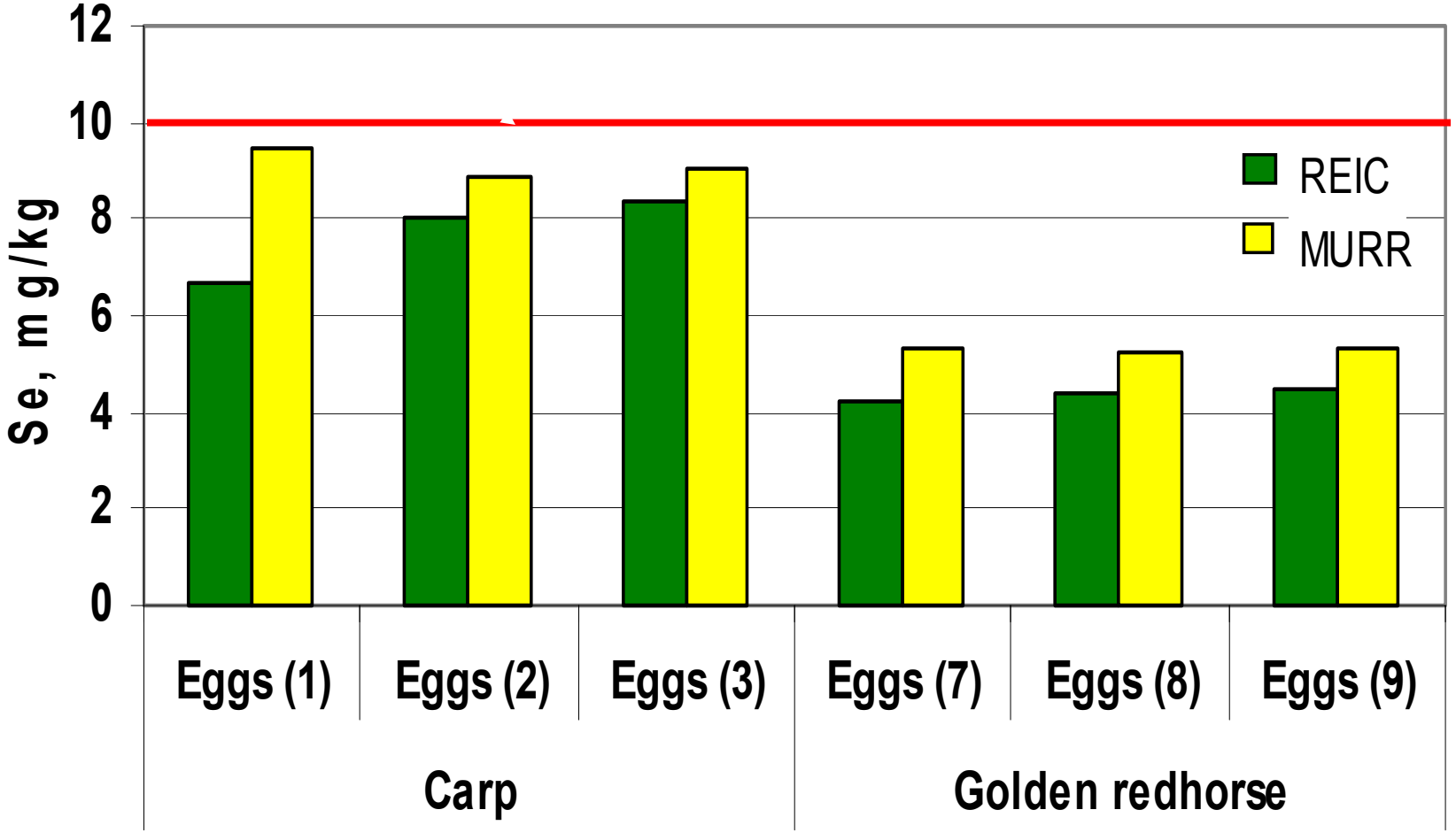
REIC	MURR
4.25	5.34
4.40	5.20
4.50	5.34

P-value = < 0.001*

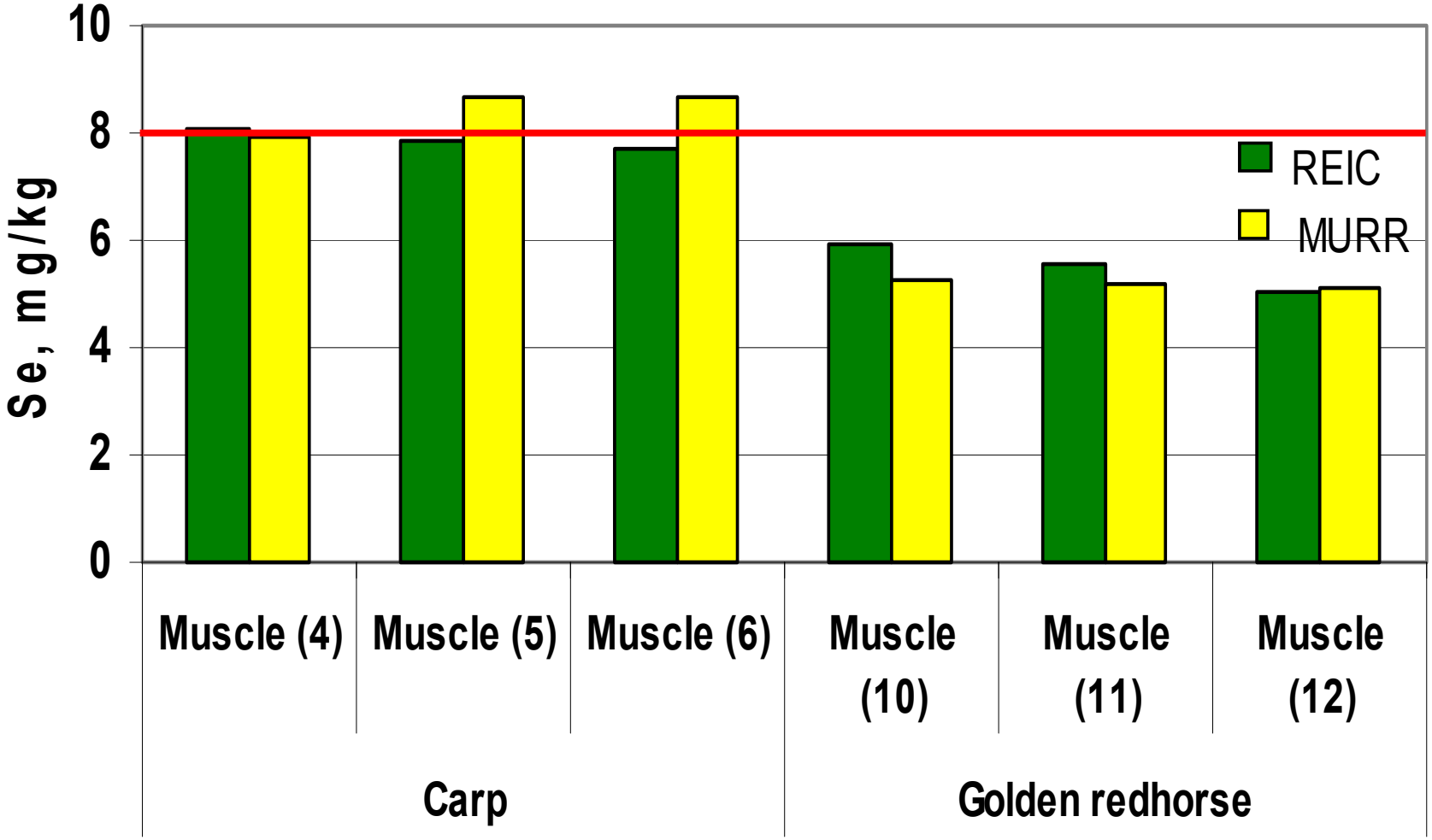
Redhorse Eggs



Selenium Concentration (dry weight) in Eggs of Selected Fish Species in Kiah Creek - July 2004



Selenium Concentrations (dry weight) in Muscle Tissue of Selected Fish Species from Kiah Creek - July 2004



Conclusions

- Appear to be large (even significant) differences in Se levels between fish species.
- Obviously large differences in Se levels of different organs/tissues.
- Somewhat inconclusive on oven drying & Graphite Furnace AA vs freeze drying & NAA.

What's Next?

- Need more data!!! More Se analysis by species, by tissue, and from different sources (streams).

- Consideration of a tissue-based Se criteria make me nervous due to wide variations seen in this study between both species and tissue type.

Acknowledgements

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- Christy Mower, Claude Scott, & Ivan Leef (REI Consultants, Inc.)
- Dr. Steven Morris (MURR)