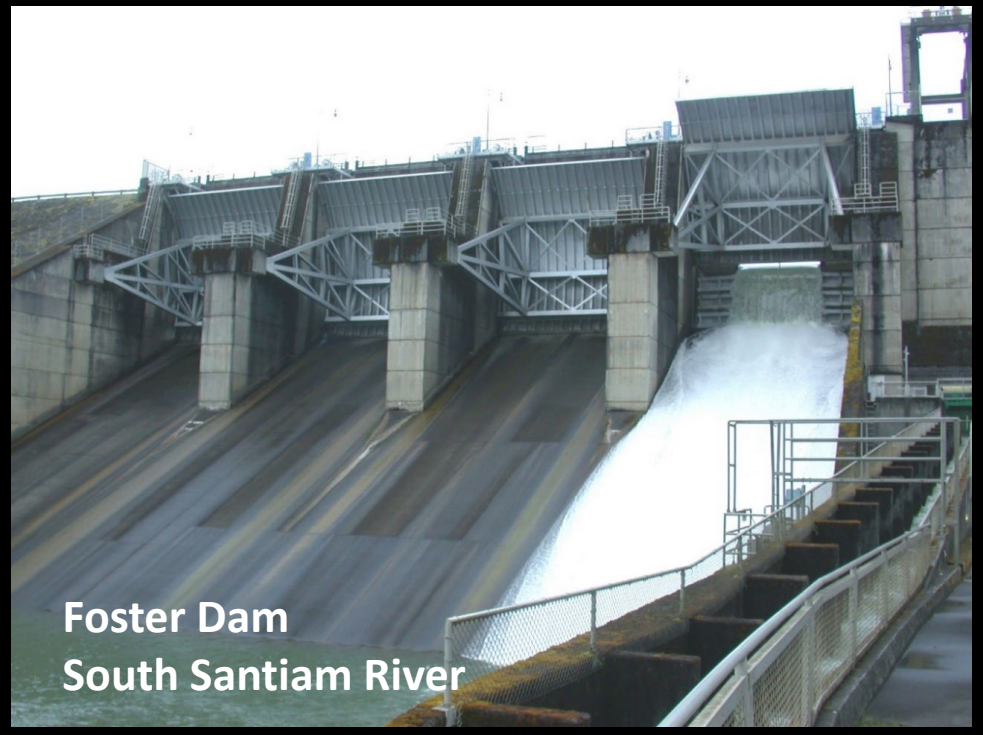
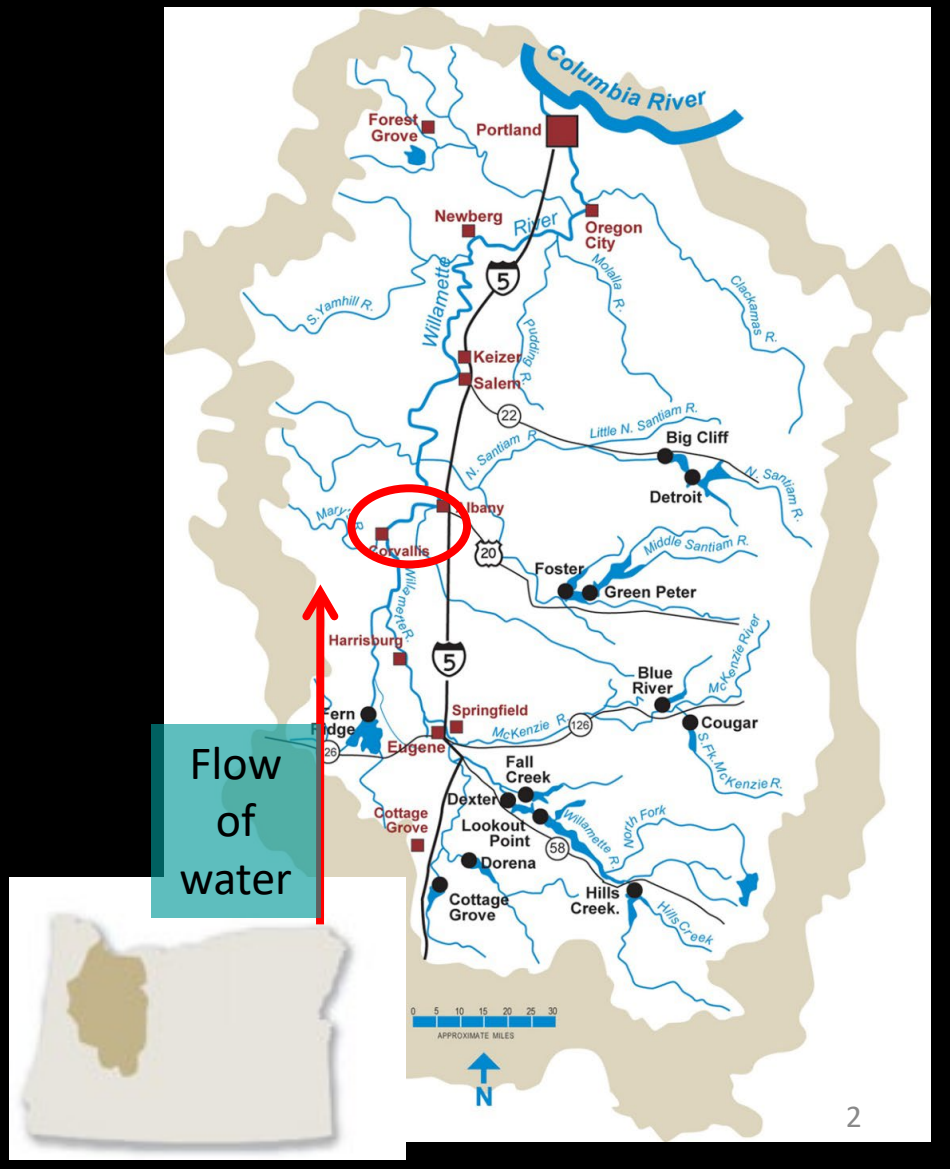
Reviewing the Wild Fishes Surrogate Project's Impact on Juvenile Salmonid Studies in the Willamette River Basin in 2023-2024

Crystal L. Herron, Claire E. Couch, Michelle M. Scanlan, Olivia M. Hakanson, Seth M. White, Ryan B. Couture, Carl B. Schreck, James T. Peterson

Willamette Valley Project Dams (Oregon USA)

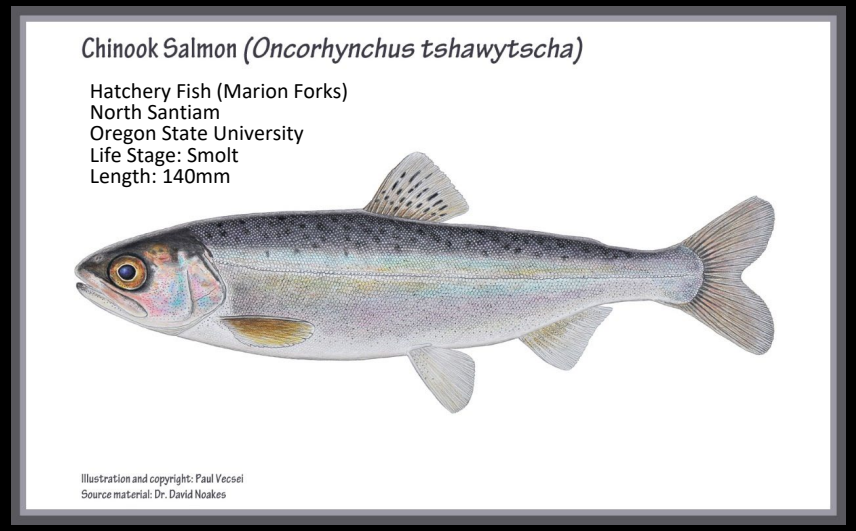
- Halt salmon passage
  - Adults transported upstream
  - Juvenile passage problematic





Investigation Option: Hatchery Reared Fish

Wild Fishes Surrogate Project



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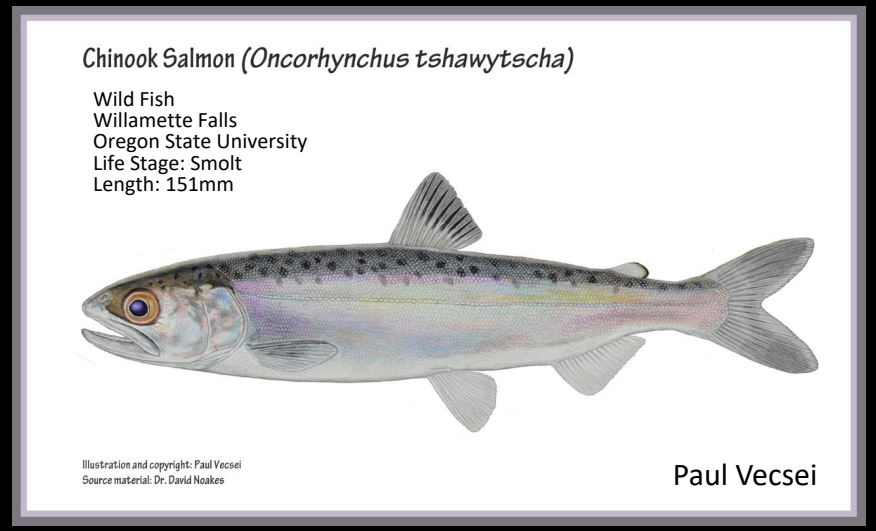
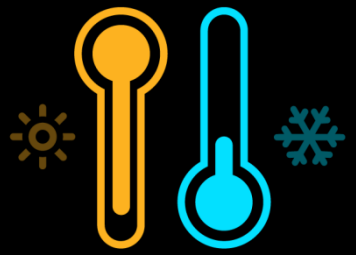
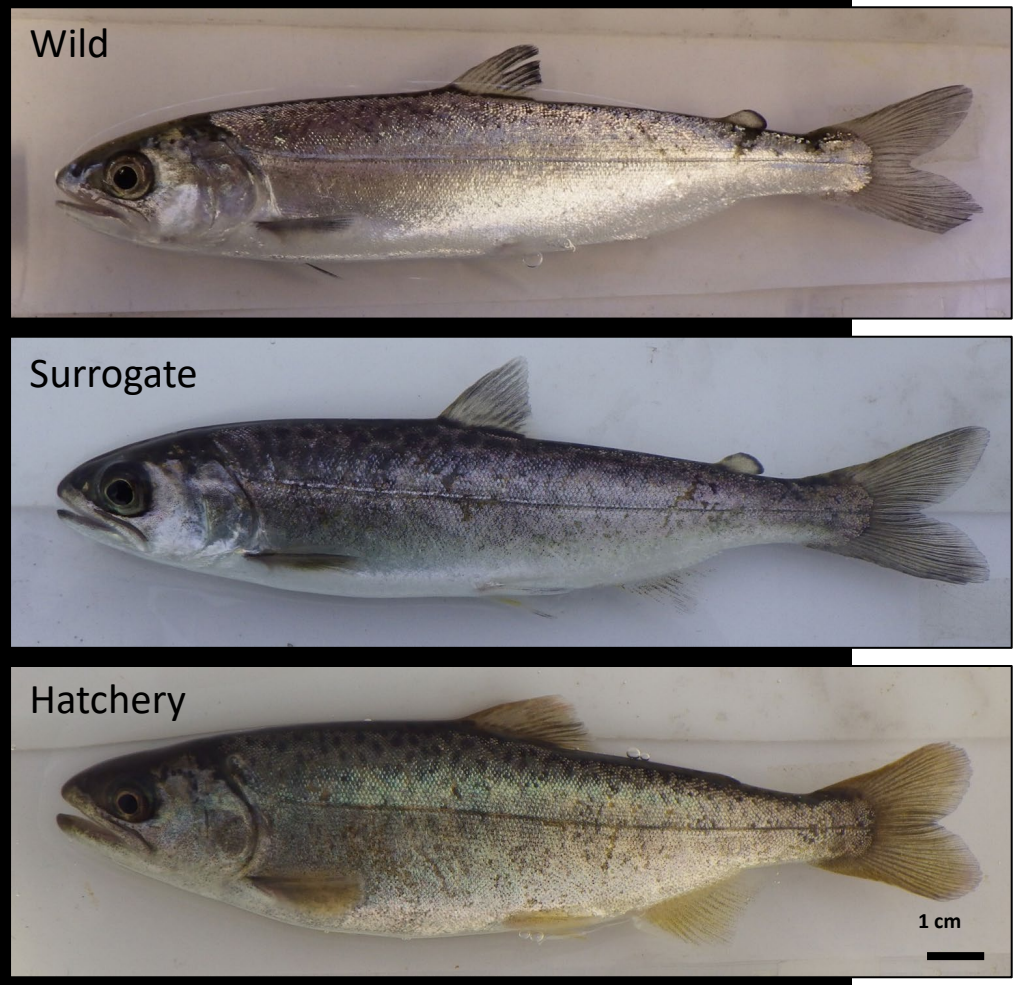
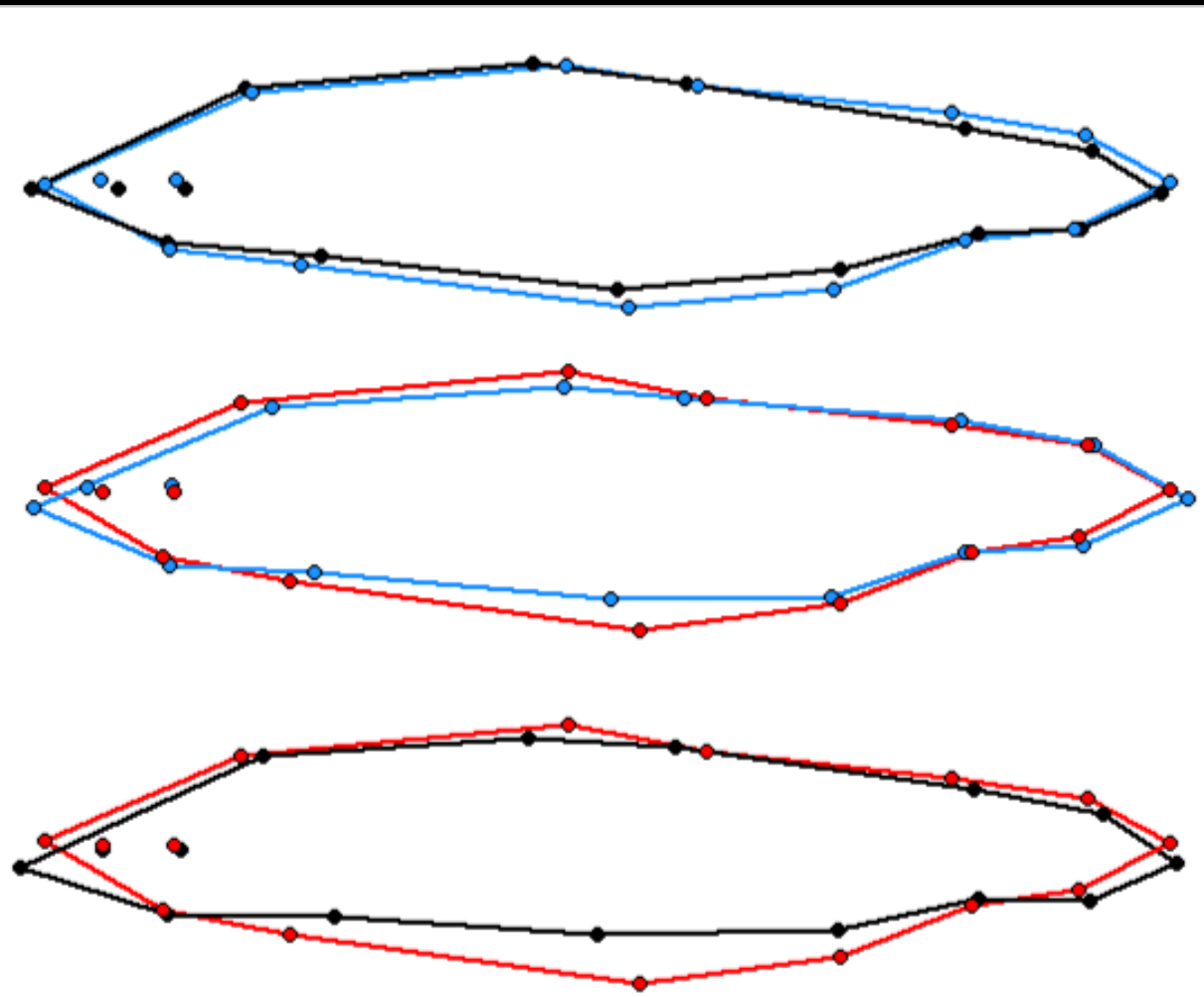


Hatchery origin

Natural origin







Eric Billman

Black = Wild
n = 30
127 ± 10 mm

Blue = Surrogate
n = 49
155 ± 23 mm

Red = Hatchery
n = 47
149 ± 23 mm

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DOI: 10.1111/jfb.14083

REGULAR PAPER

JOURNAL OF FISH BIOLOGY fsbi

Rearing environment affects spatial learning in juvenile Chinook salmon *Oncorhynchus tshawytscha*

Karen M. Cogliati[1] | Julia R. Unrein[1] | Carl B. Schreck[1] | David L. G. Noakes[1,2]

Aquaculture 504 (2019) 96–101

Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture

Reduced stress response in juvenile Chinook Salmon reared with structure

Karen M. Cogliati[a,*], Crystal L. Herron[a], David L.G. Noakes[a,b], Carl B. Schreck[a]

Aquaculture Reports 33 (2023) 101876

Contents lists available at ScienceDirect

Aquaculture Reports

journal homepage: www.elsevier.com/locate/aqrep

Effects of rearing density and in-tank structure on the stress response in juvenile Chinook salmon (*Oncorhynchus tshawytscha*)

Crystal L. Herron[a,*], Karen M. Cogliati[b], Jennifer A. Krajcik[c], David L.G. Noakes[a,c], James L. Peterson[a,d], Carl B. Schreck[a]

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DOI: 10.1111/jfb.13657

JOURNAL OF FISH BIOLOGY fsbi

SPECIAL ISSUE REGULAR PAPER

The effect of rearing structures on behaviour and movement of juvenile steelhead *Oncorhynchus mykiss*

Katharine E. Self[1,2] | Carl B. Schreck[1] | Karen M. Cogliati[1] | Eric J. Billman[1,3] | David L.G. Noakes[1,2]

Articles

Low-Lipid Diets Fed at Reduced Ration: Effects on Growth, Body Composition, and Survival of Juvenile Chinook Salmon

Karen M. Cogliati,* Julia R. Unrein, Wendy M. Sealey, Frederic T. Barrows, Olivia Hakanson, Rob Chitwood, David L.G. Noakes, Carl B. Schreck

Taylor & Francis

Journal of Applied Aquaculture

ISSN: 1045-4438 (Print) 1545-0805 (Online) Journal homepage: http://www.tandfonline.com/loi/wjaa20

Effects of transportation timing on osmoregulation and survival in yearling hatchery Chinook salmon (Oncorhynchus tshawytscha)

Heather A. Stewart, Karen M. Cogliati, Eric J. Billman, Rob Chitwood, Julia R. Unrein, David L. G. Noakes & Carl B. Schreck

Fish and Shellfish Immunology 80 (2018) 655–659

Contents lists available at ScienceDirect

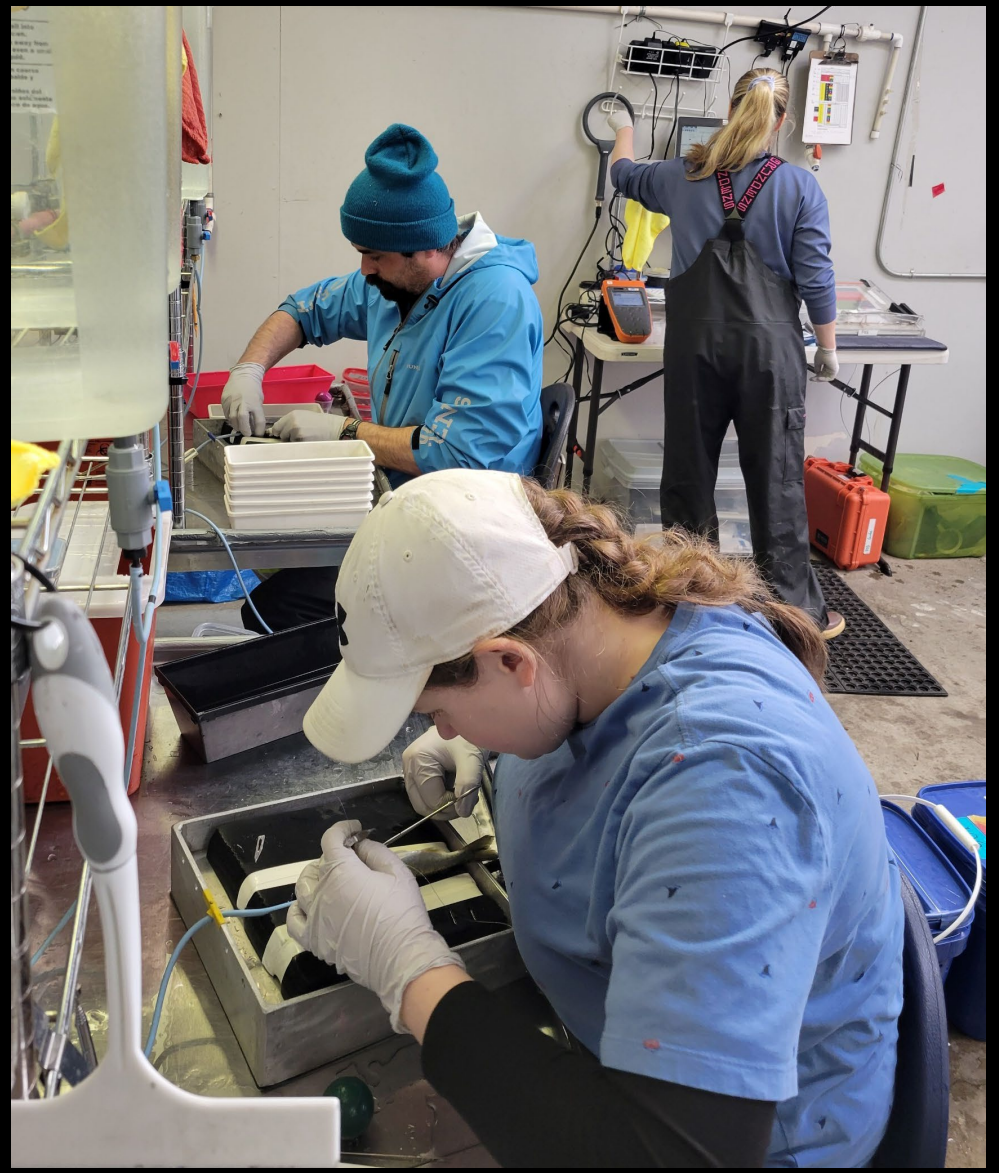
Fish and Shellfish Immunology

journal homepage: www.elsevier.com/locate/fsi

Full length article

Stress up-regulates oxidative burst in juvenile Chinook salmon leukocytes

Crystal L. Herron[a,*], K.M. Cogliati[a], B.P. Dolan[b], A. Munakata[c], C.B. Schreck[a]



2023 Delivered Fish (rolling number)

Chinook

~3,600 PNNL

2,000 USGS

Steelhead

4,000 PNNL

Currently have ~20,000 on site

The Oregon Hatchery Research Center

- Partnership between Oregon Department of Fish & Wildlife and Oregon State University
- Understand differences between hatchery and wild salmon
- Support hatchery management that protects native fish
- Education and outreach to students, managers, and public

Relocated to John L. Fryer Aquatic Animal Health Laboratory (AAHL), Corvallis, Oregon

Rearrange the Furniture

Fish Performance and Genetics Laboratory

Continuing to improve

- Steelhead stress test
- Steelhead fin damage onset

} Density & Structure

- Chinook intermittent fasting
- Chinook surrogate diet gut microbiome

Continuing to improve

- Steelhead stress test
- Steelhead fin damage onset

} Density & Structure

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https://c1.staticflickr.com/7/6028/5924573884_3bd22ca8cd_b.jpg

Schreck

http://image.oregonlive.com/home/olive-media/width620/img/environment_impact/photo/15134829-mmmain.jpg

Can Chinook salmon be prepared for this period of not eating?

Rearing

Satiation before

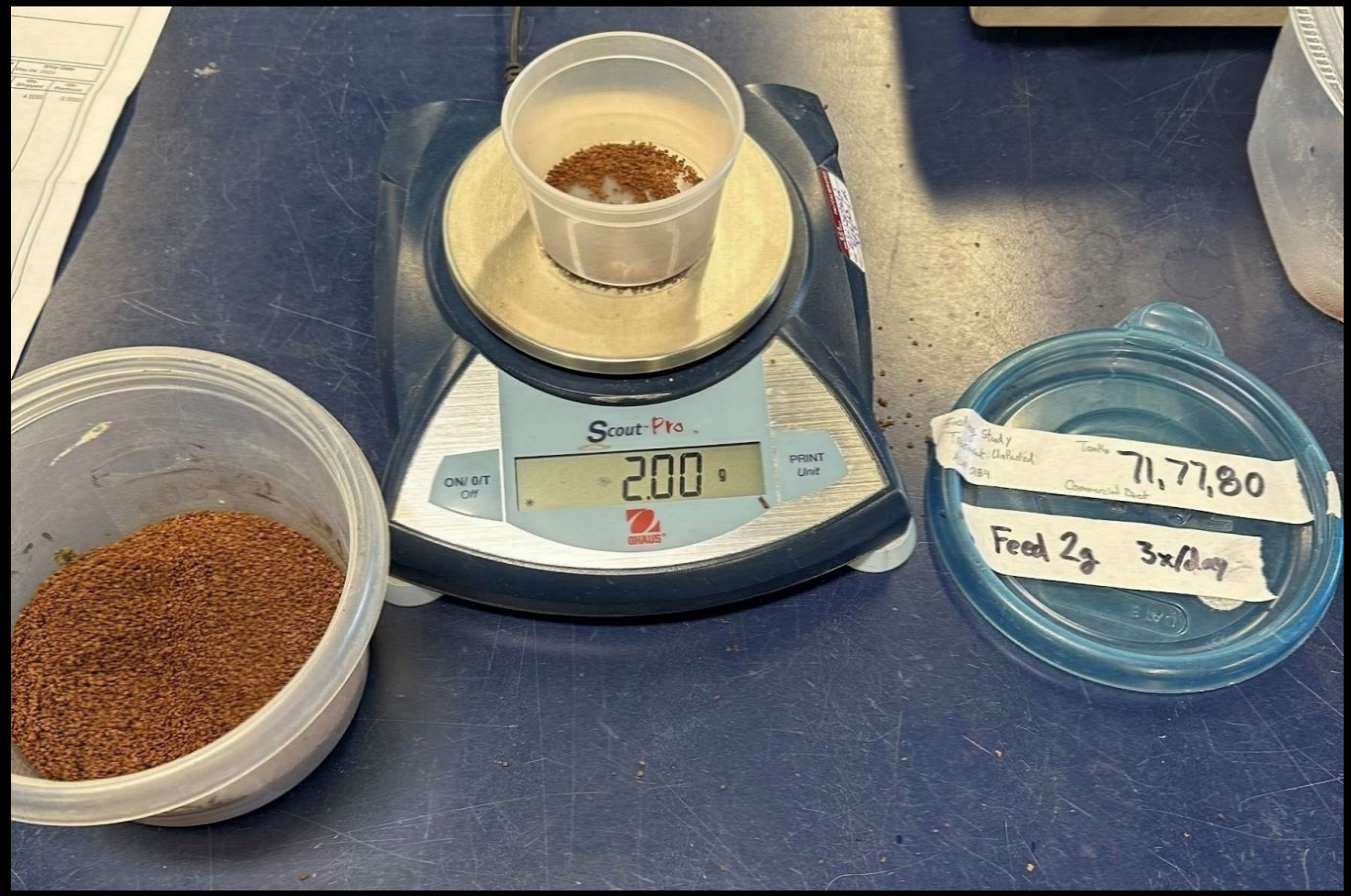
Oregon BioVita

1.2% BW

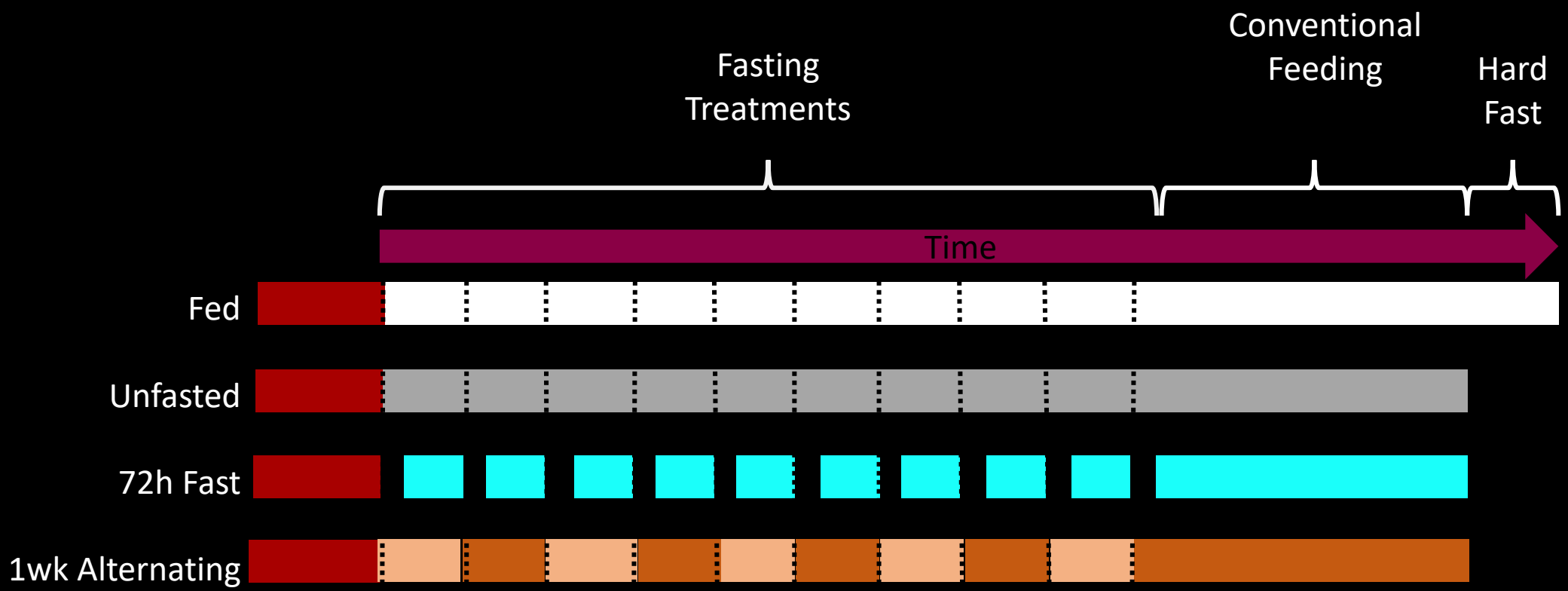
3x daily (weekends 2x)

12 °C

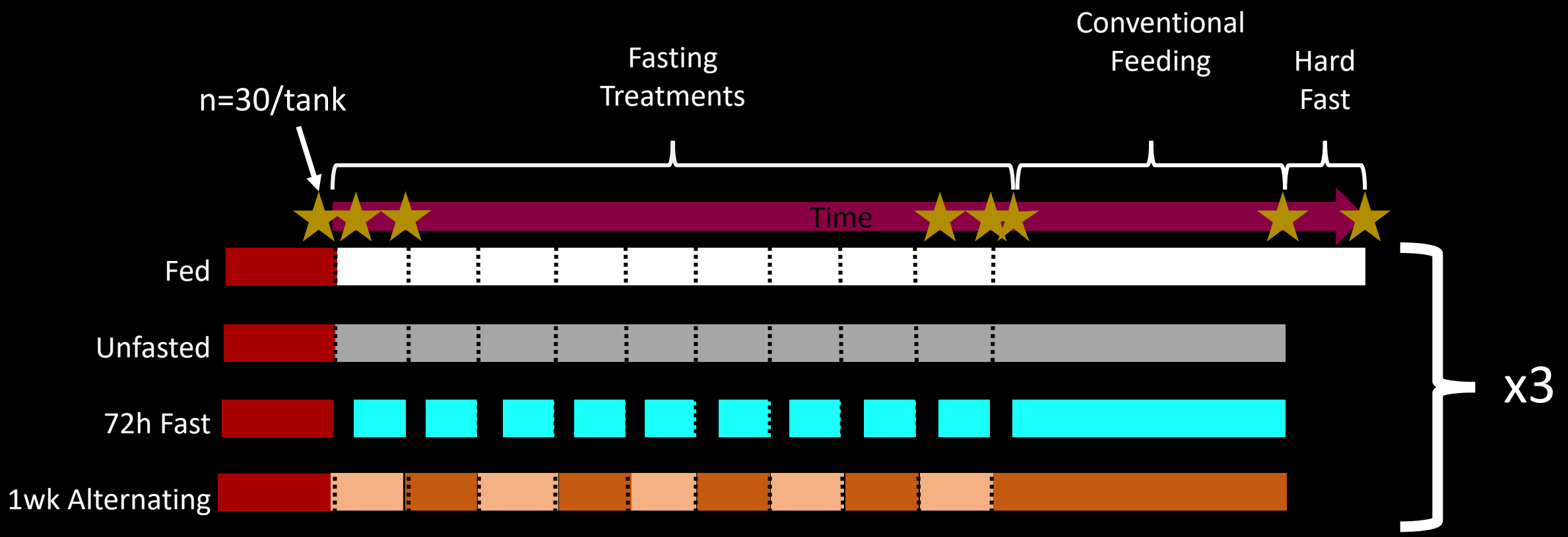
3’ tanks indoors



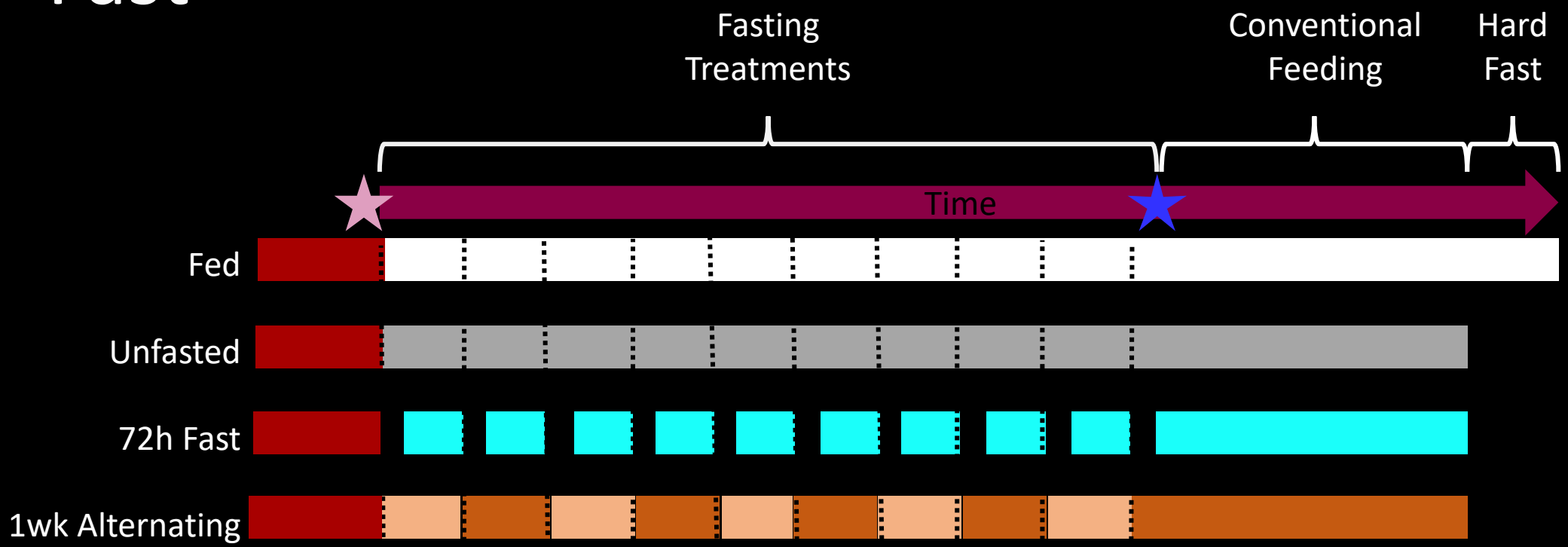
Experiment Design



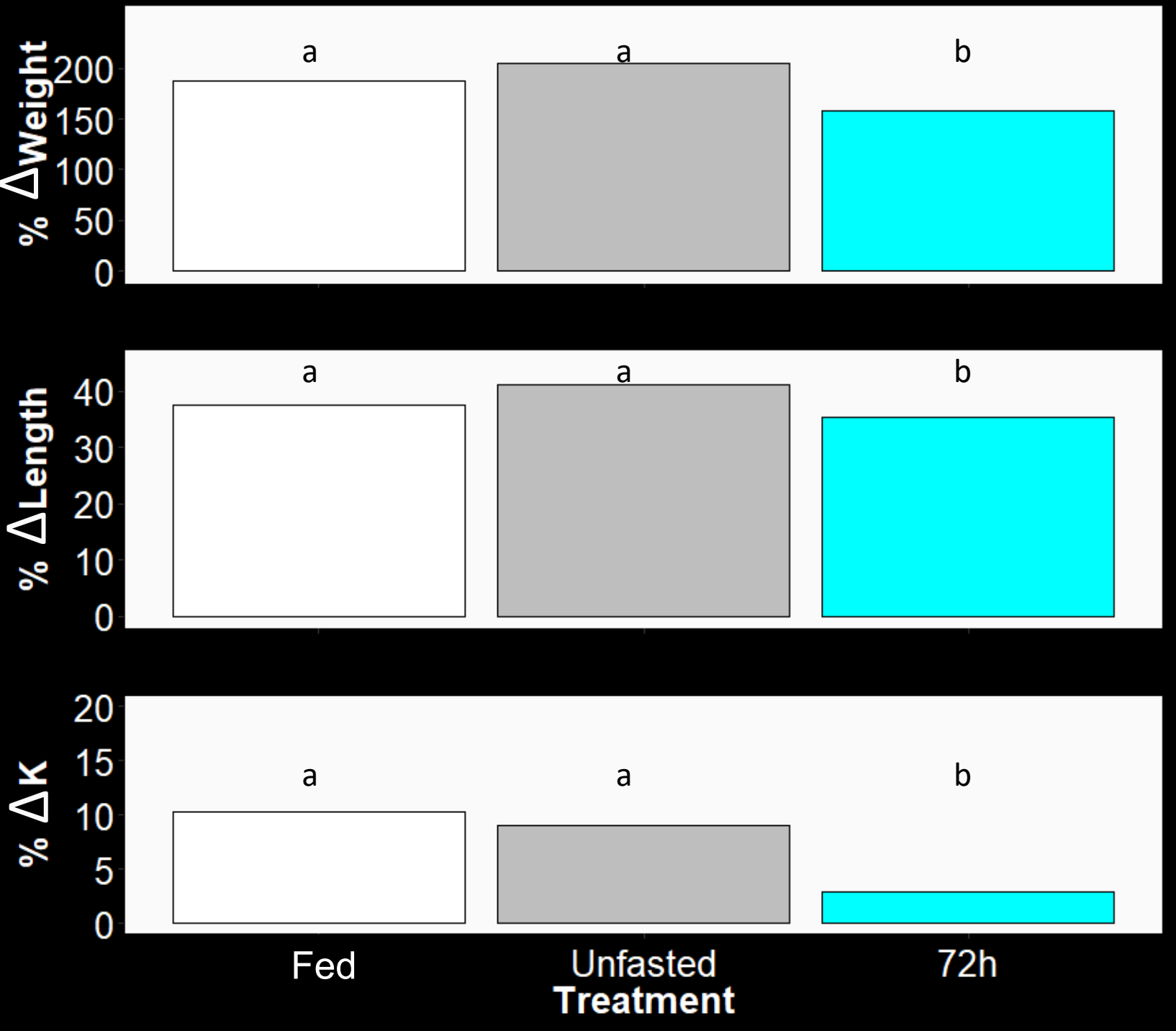
Experiment Design



Last 72h Fast

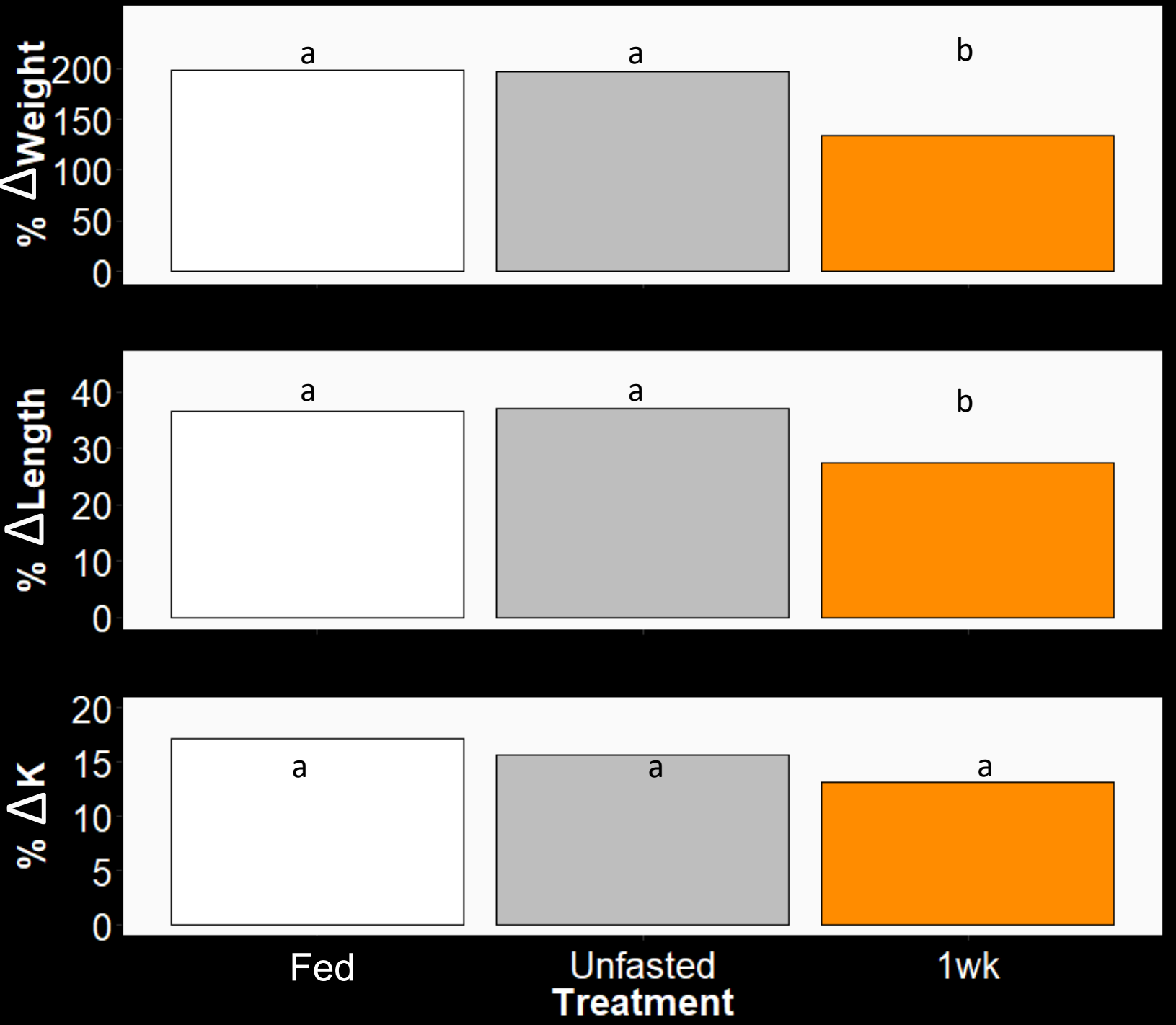


Last 72h Fast



Preliminary data

Last Half Ration



Preliminary data

Proximate Analysis

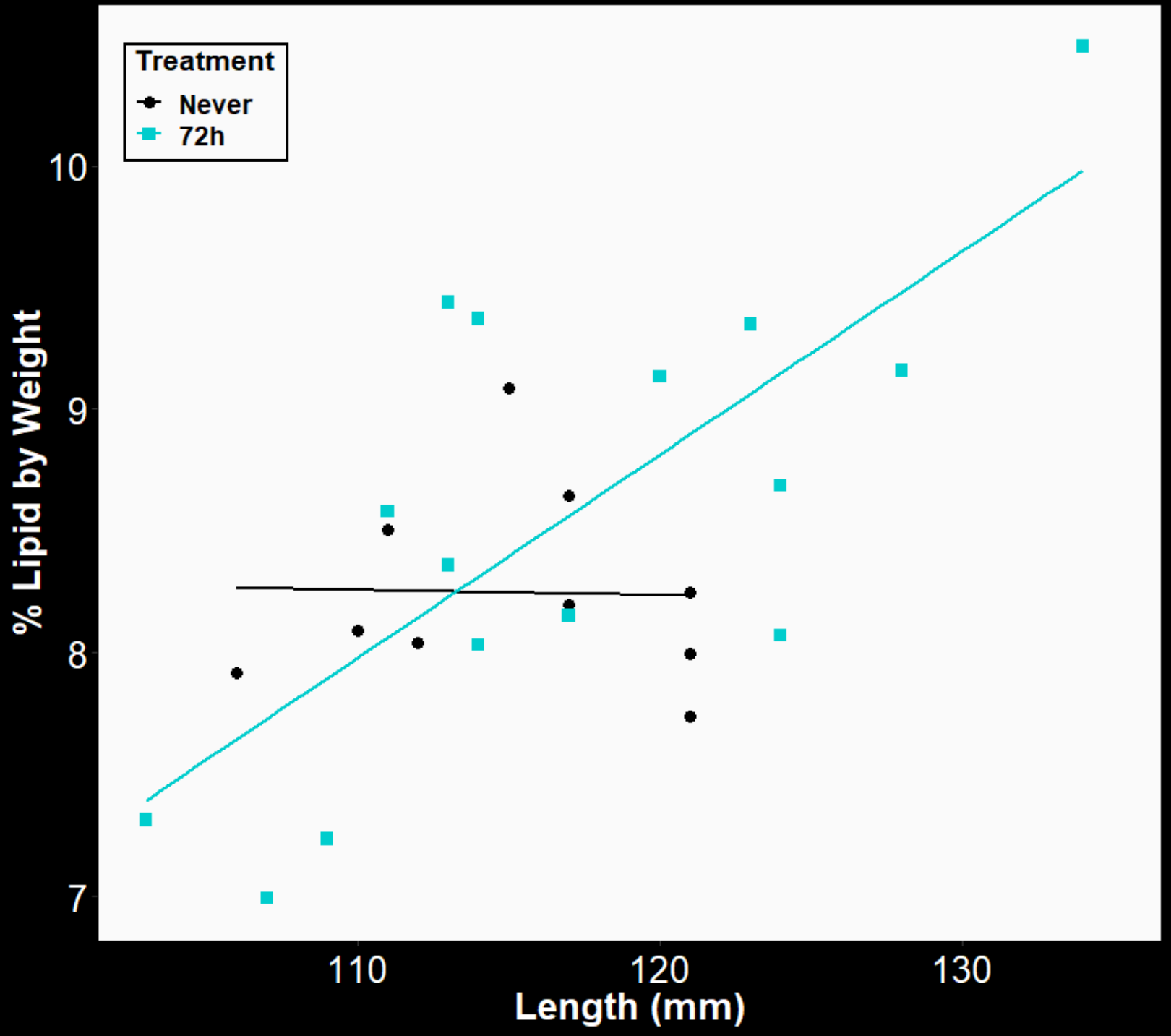
Dry content

Lipid content

Ash content

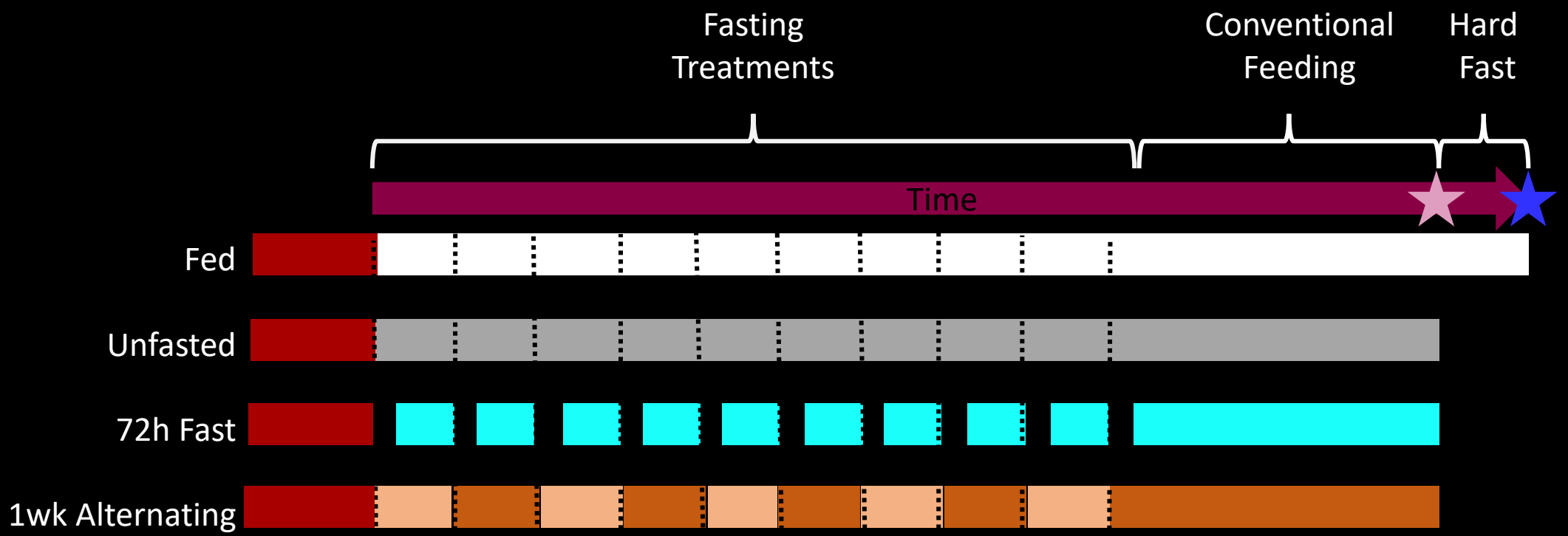
Protein content estimate

Last 72h Fast

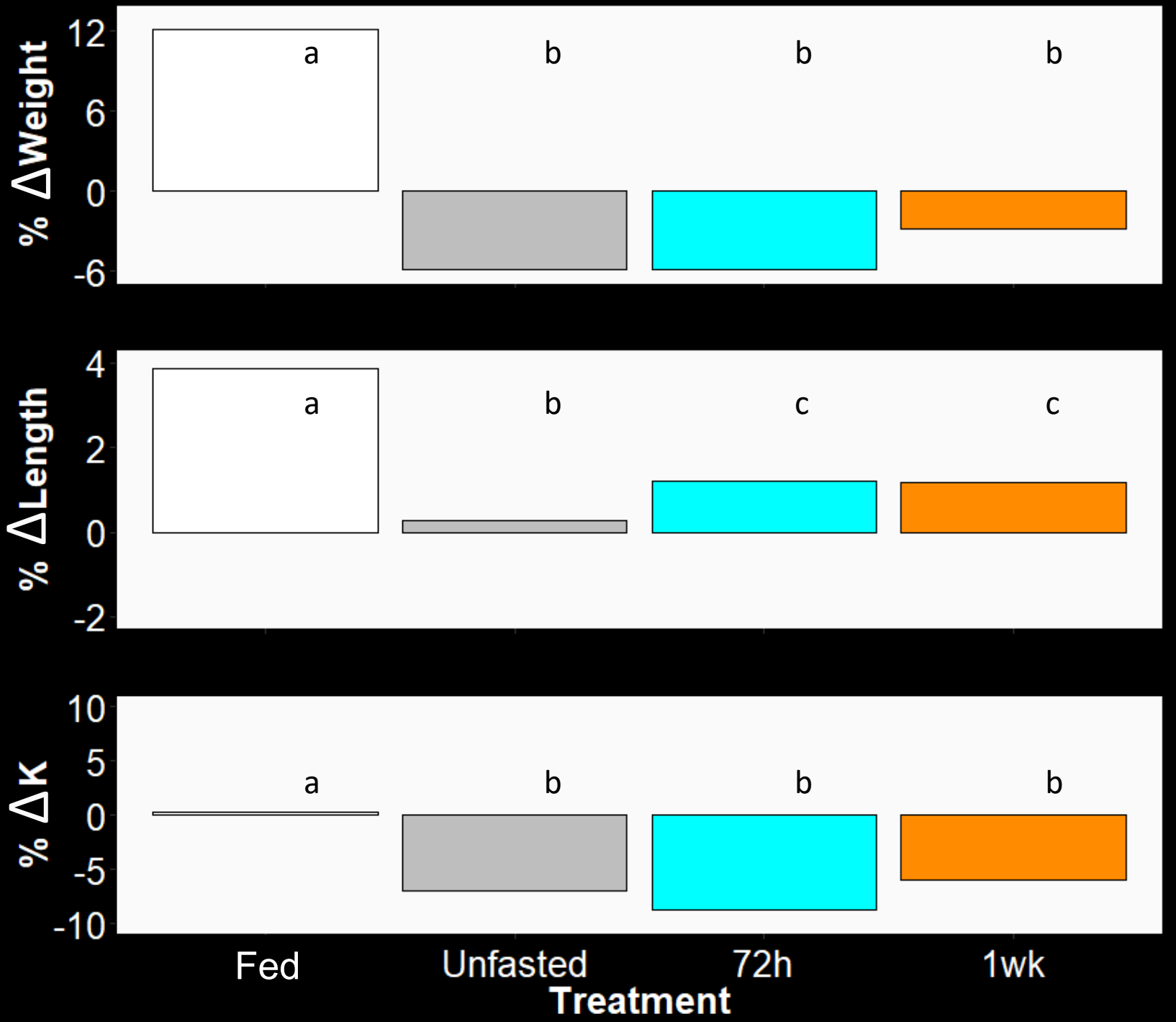


Preliminary data

Hard Fast

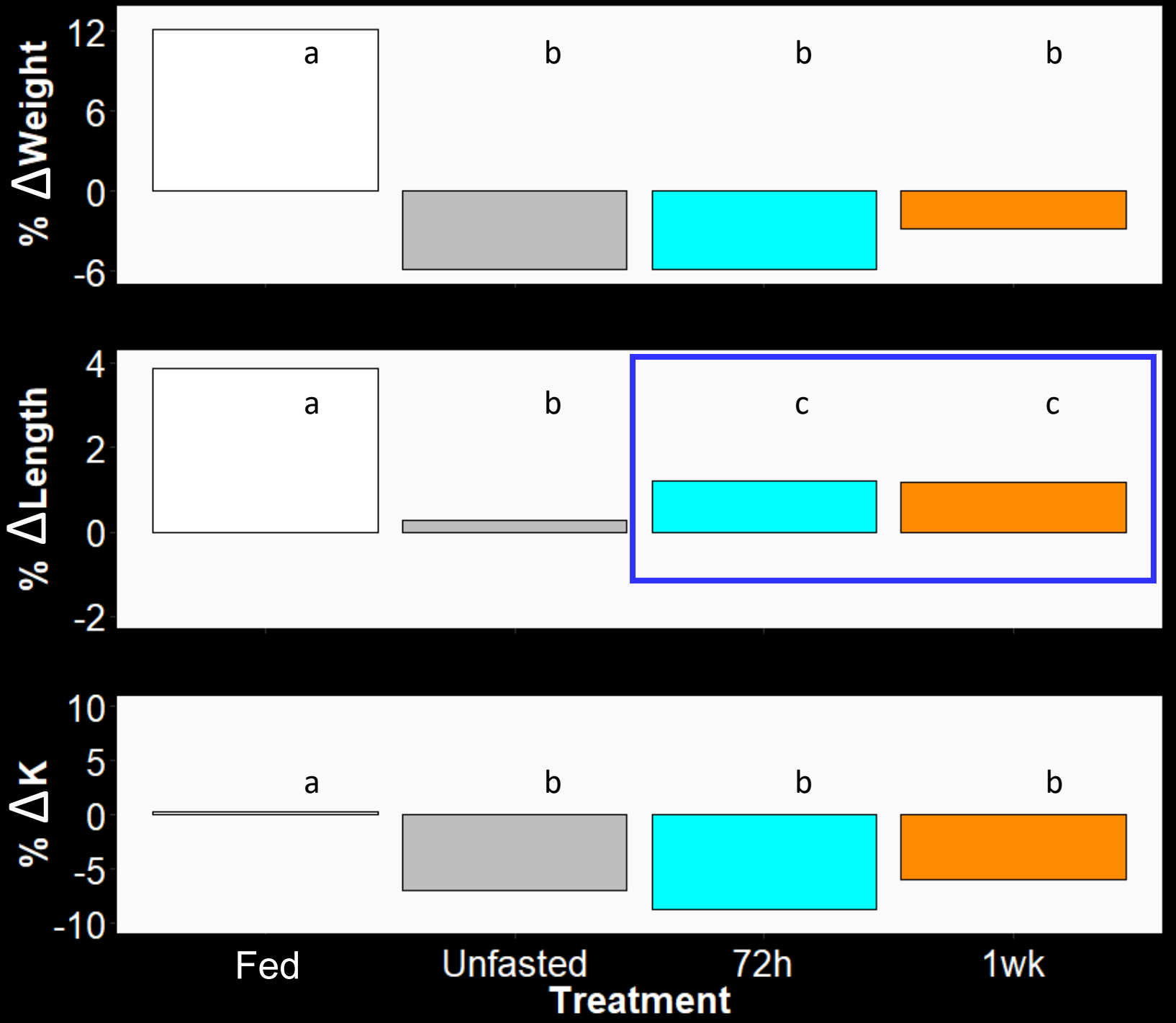

Fasting Treatments
Conventional Feeding
Hard Fast
Time
Fed
Unfasted
72h Fast
1wk Alternating

Hard Fast



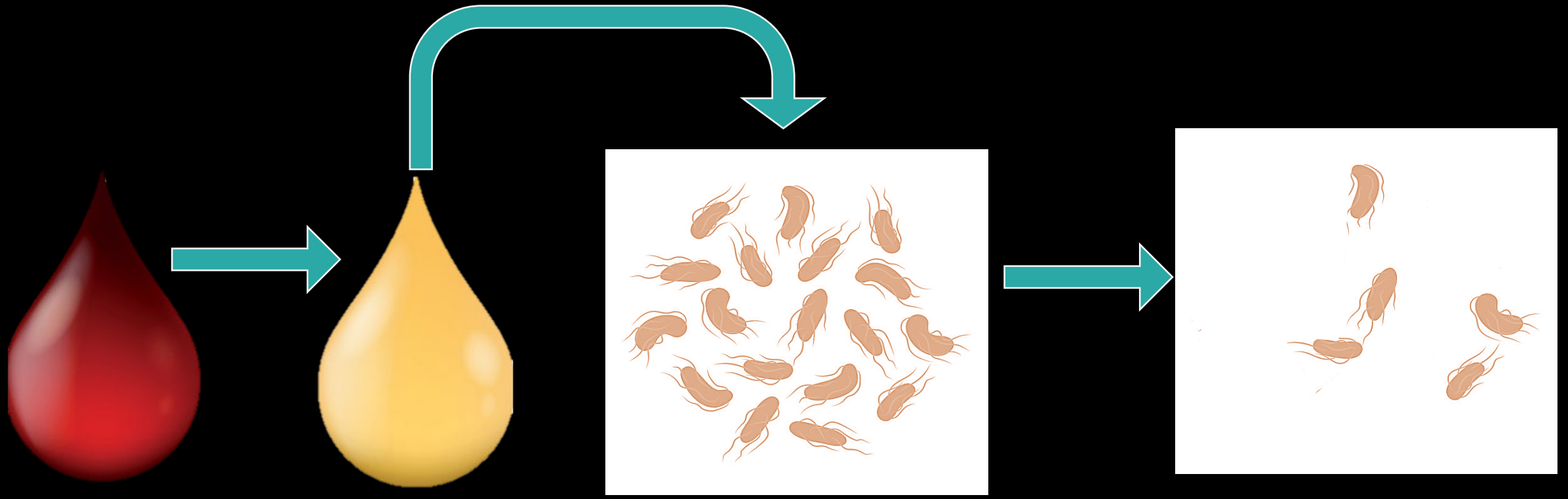
Preliminary data

Hard Fast



Preliminary data

Innate Immunity- Bacterial Killing Assay



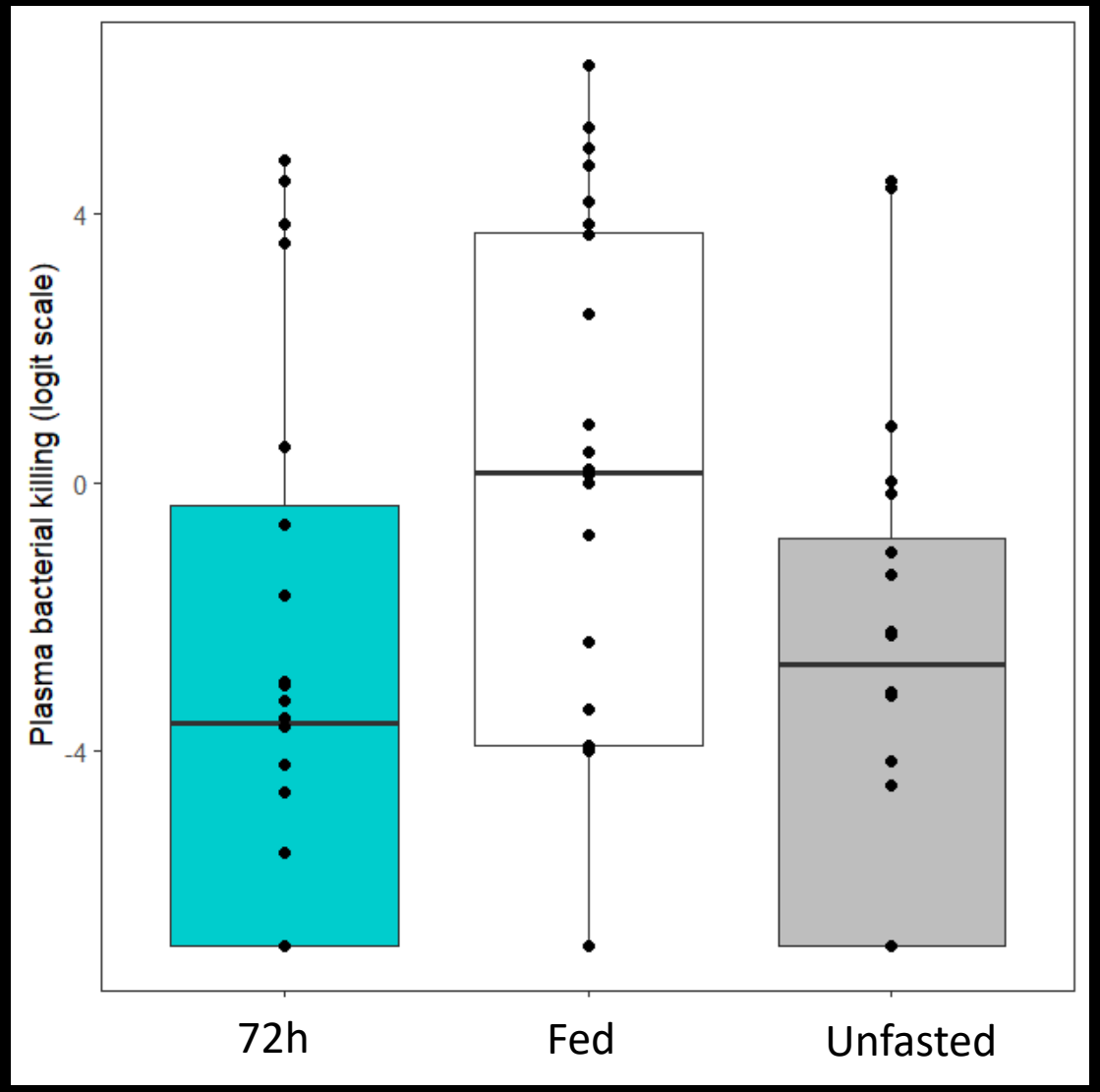
Blood

Plasma

Escherichia coli
10^5/mL

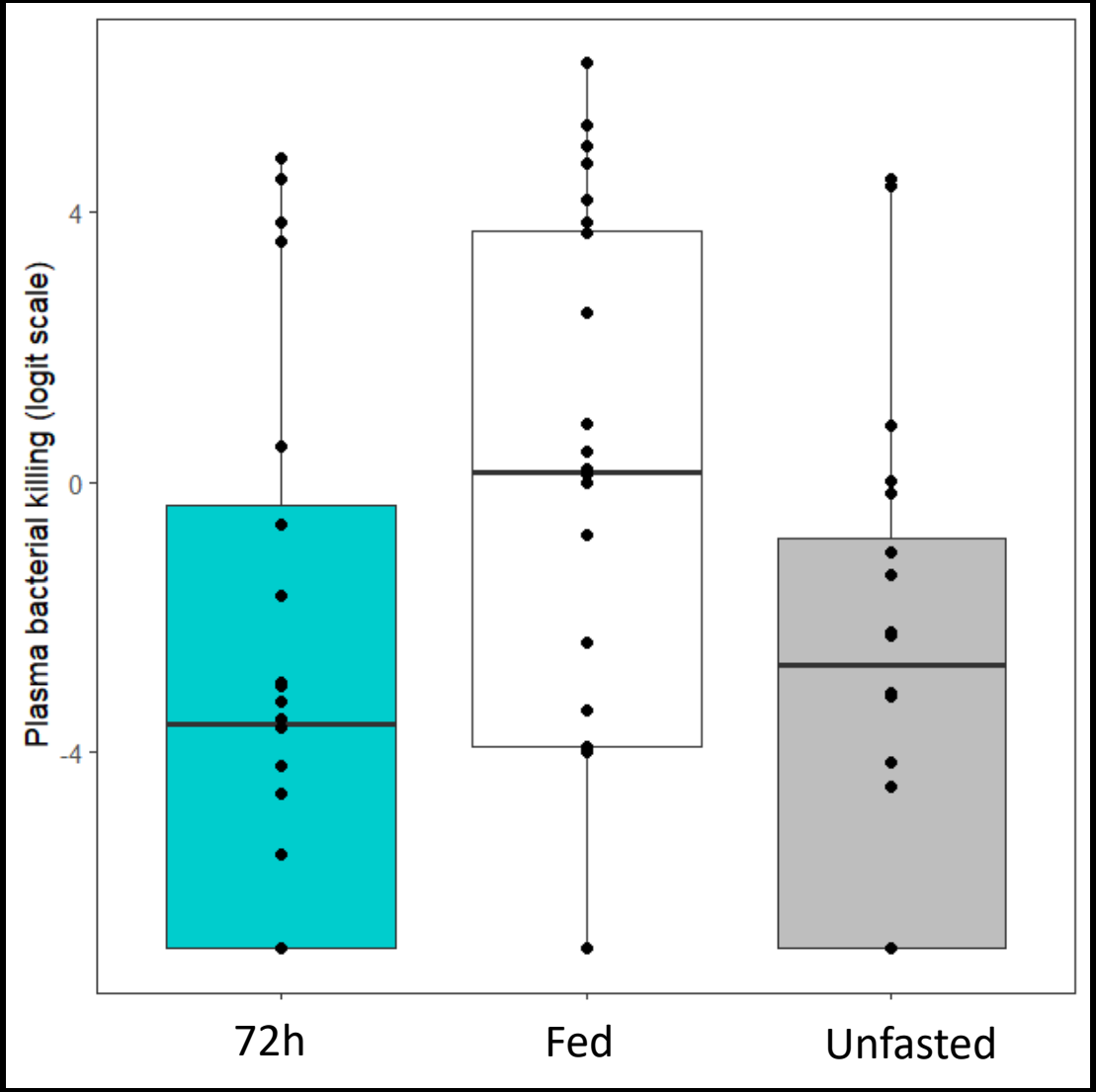
Escherichia coli
measure abundance

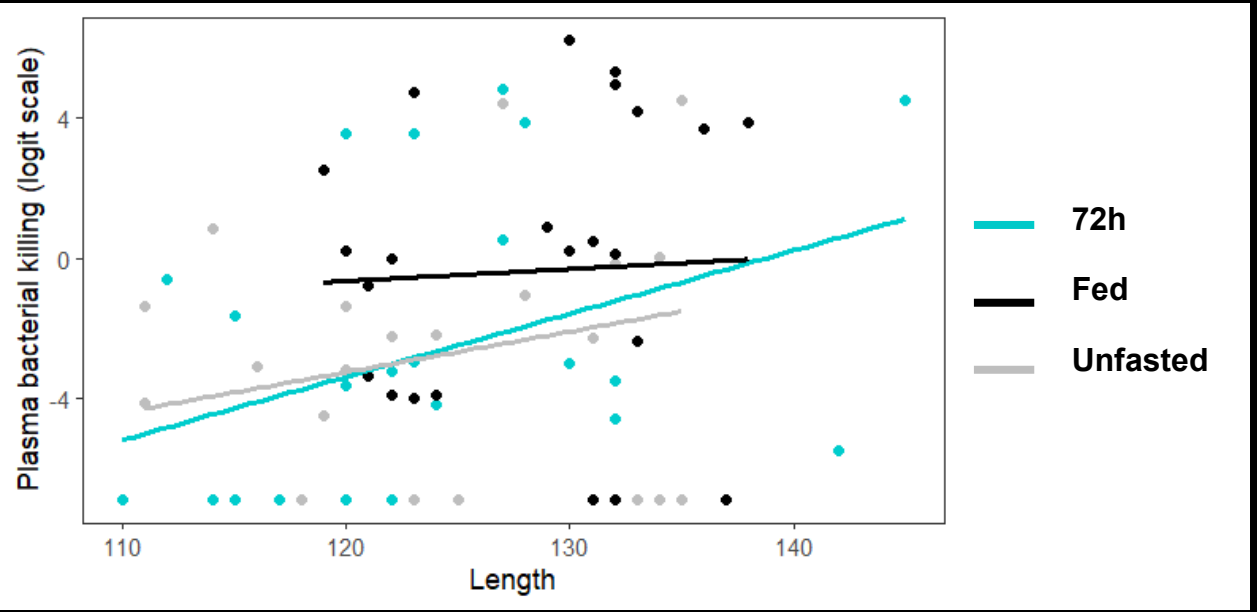
Innate Immunity – After Hard Fast



Preliminary data

Innate Immunity – After Hard Fast



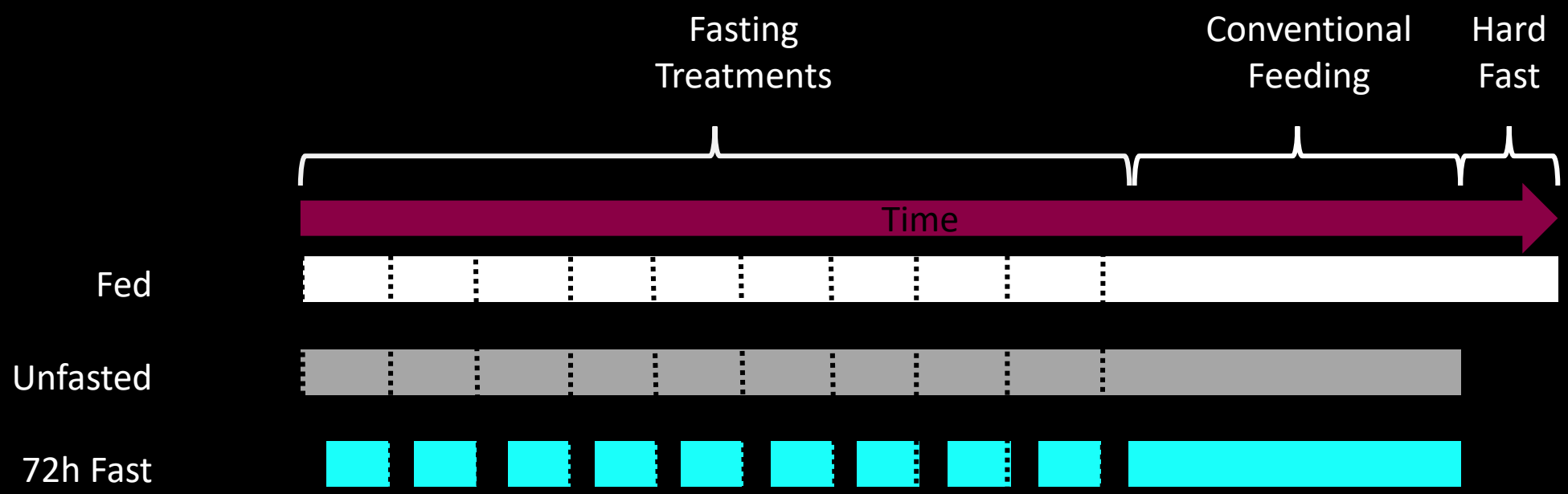


Length correlation

Follow-up with a more sensitive test

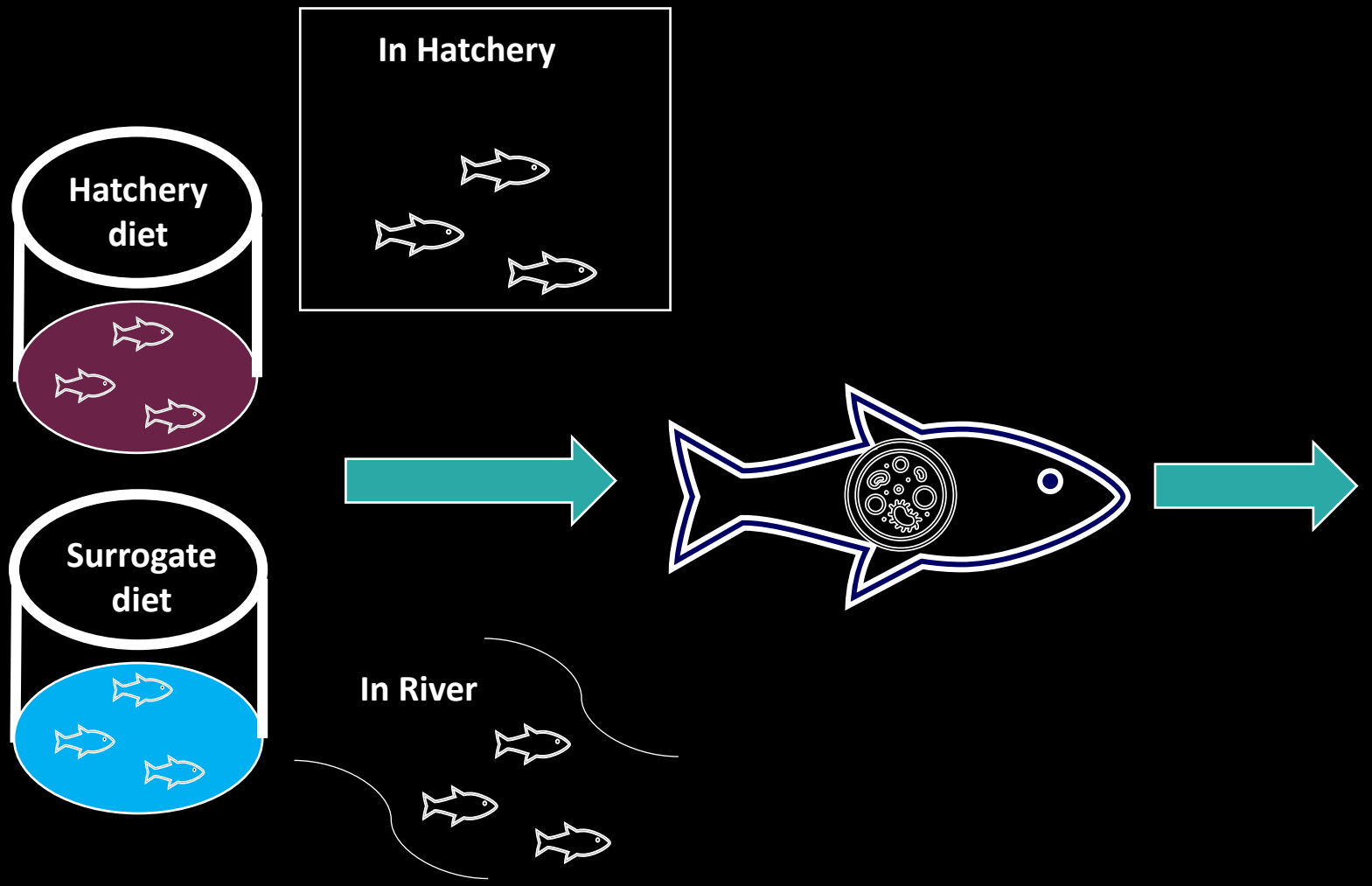
Preliminary data

Follow-up: Surrogate Diet



Can Chinook salmon be prepared for a wild-like diet?

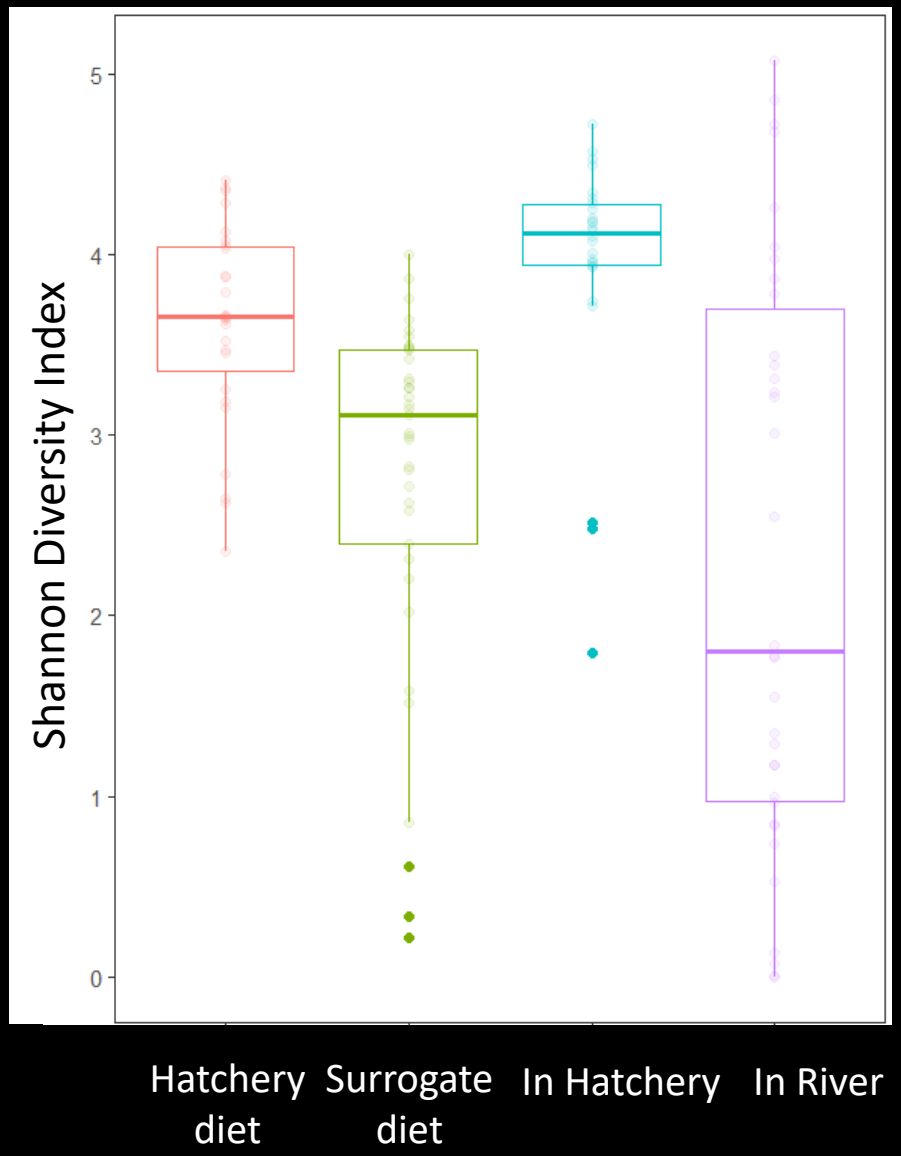
Gut Microbiome – a tool for adapting?



Differences between lab, hatchery, & wild microbiomes

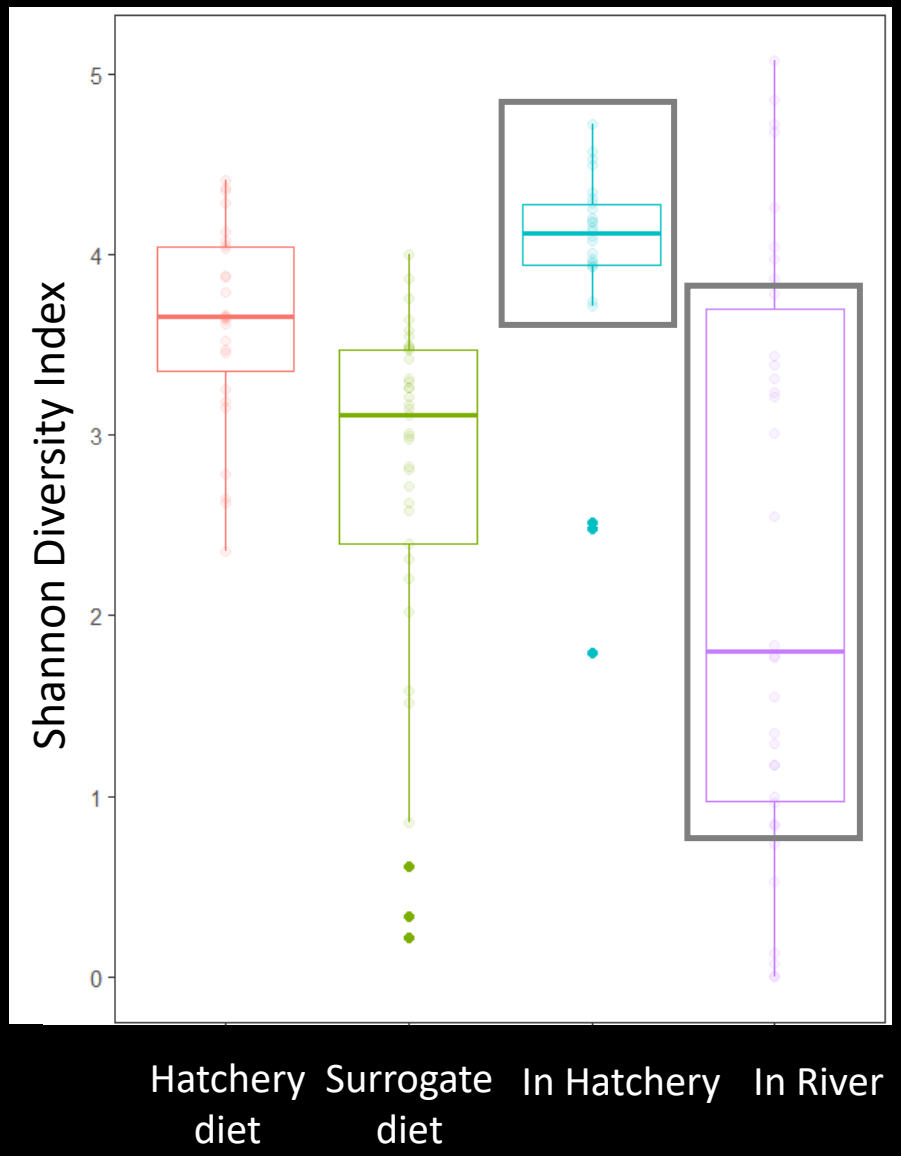
Claire Couch

Microbiome Diversity



Couch et al.
In preparation

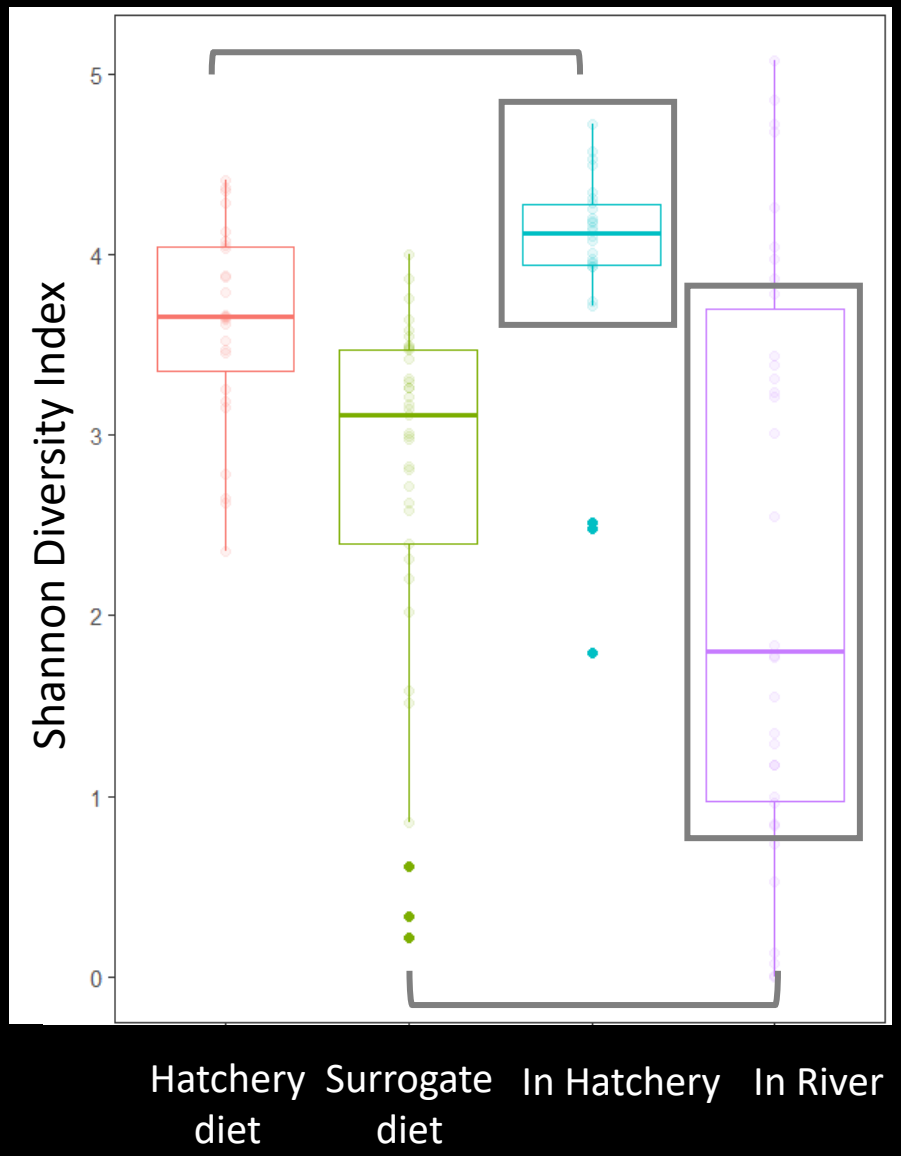
Microbiome Diversity



- Diversity highest in hatchery (Marion Forks)
- Lowest in river (Stayton screw trap)

Couch et al.
In preparation

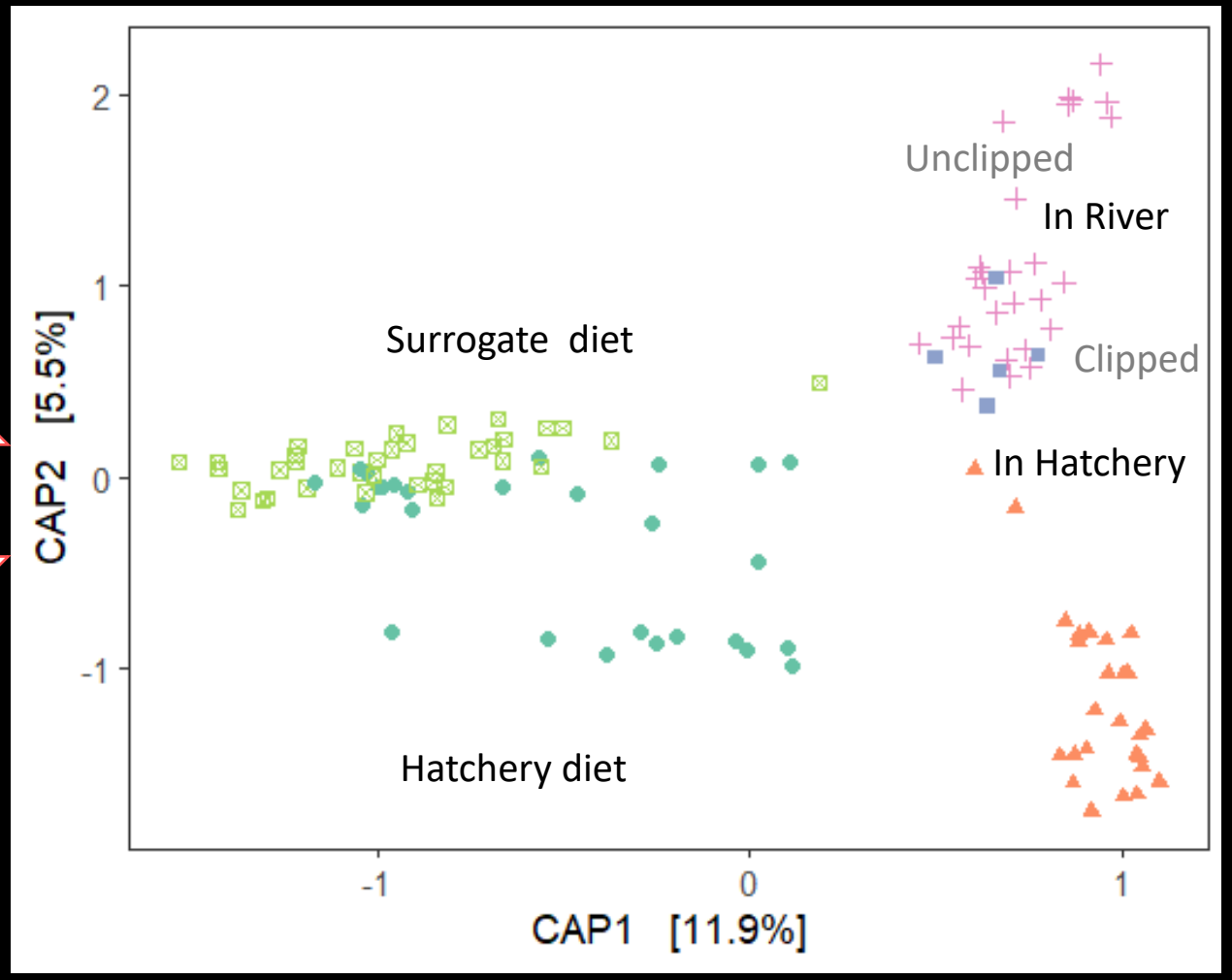
Microbiome Diversity



- Diversity highest in hatchery (Marion Forks)
- Lowest in river (Stayton screw trap)
- Hatchery diet ≈ hatchery fish
- Surrogate diet ≈ wild fish

Couch et al.
In preparation

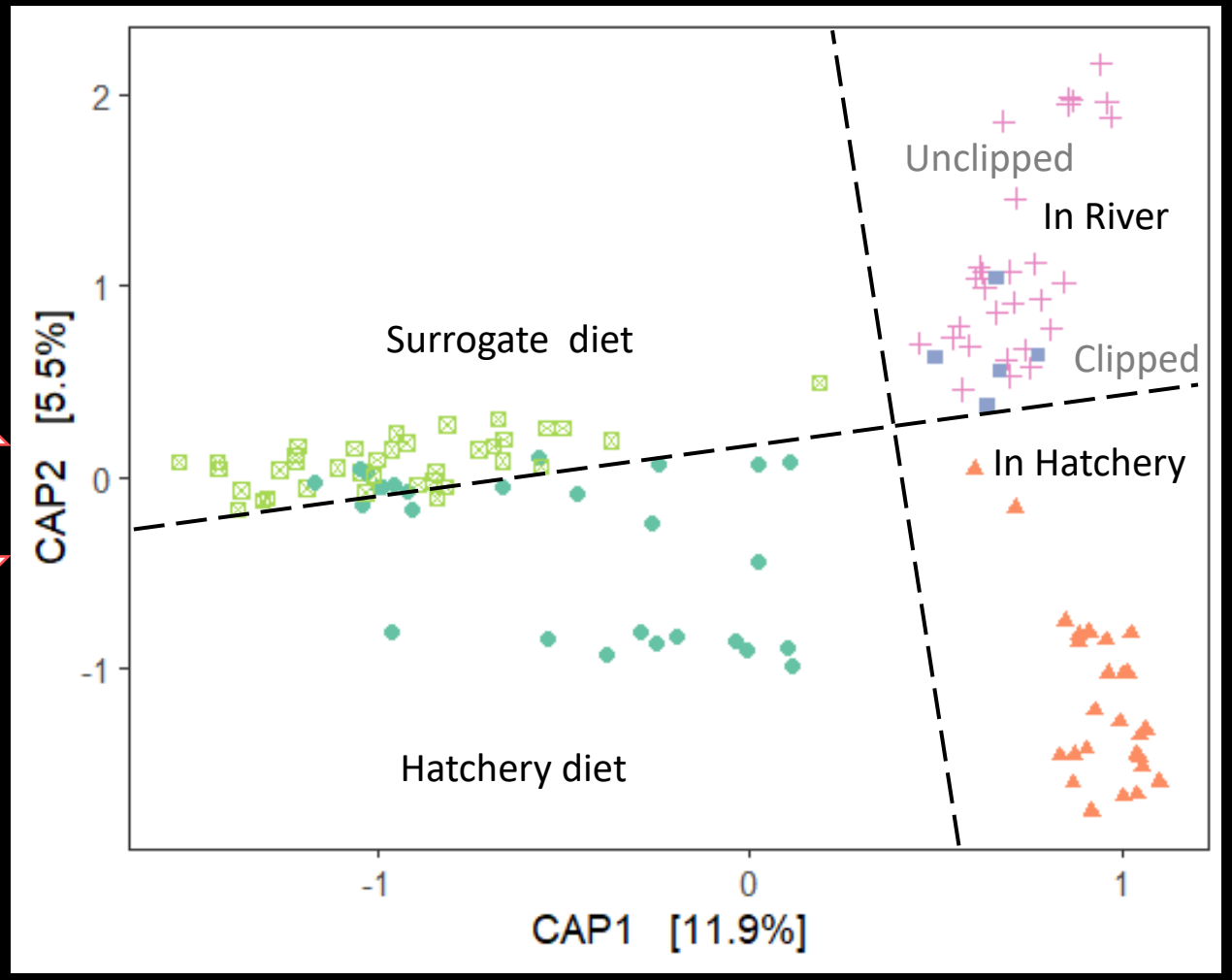
Microbiome Composition



Lab ⟷ Field

Couch et al.
In preparation

Microbiome Composition

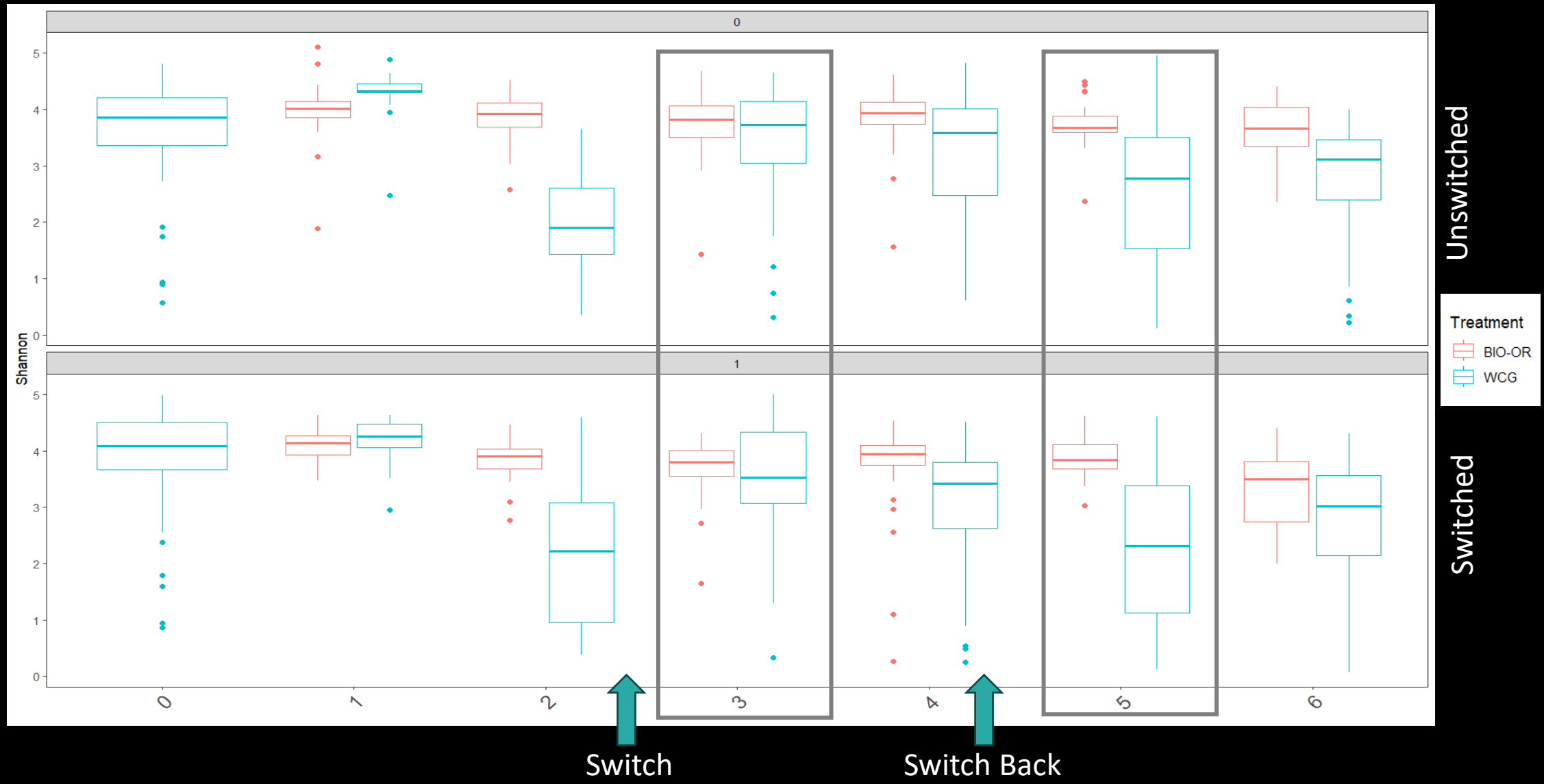


Lab ⟷ Field

- Hatchery diet ≈ hatchery fish
- Surrogate diet ≈ fish in river

- How long does the microbiome change take?

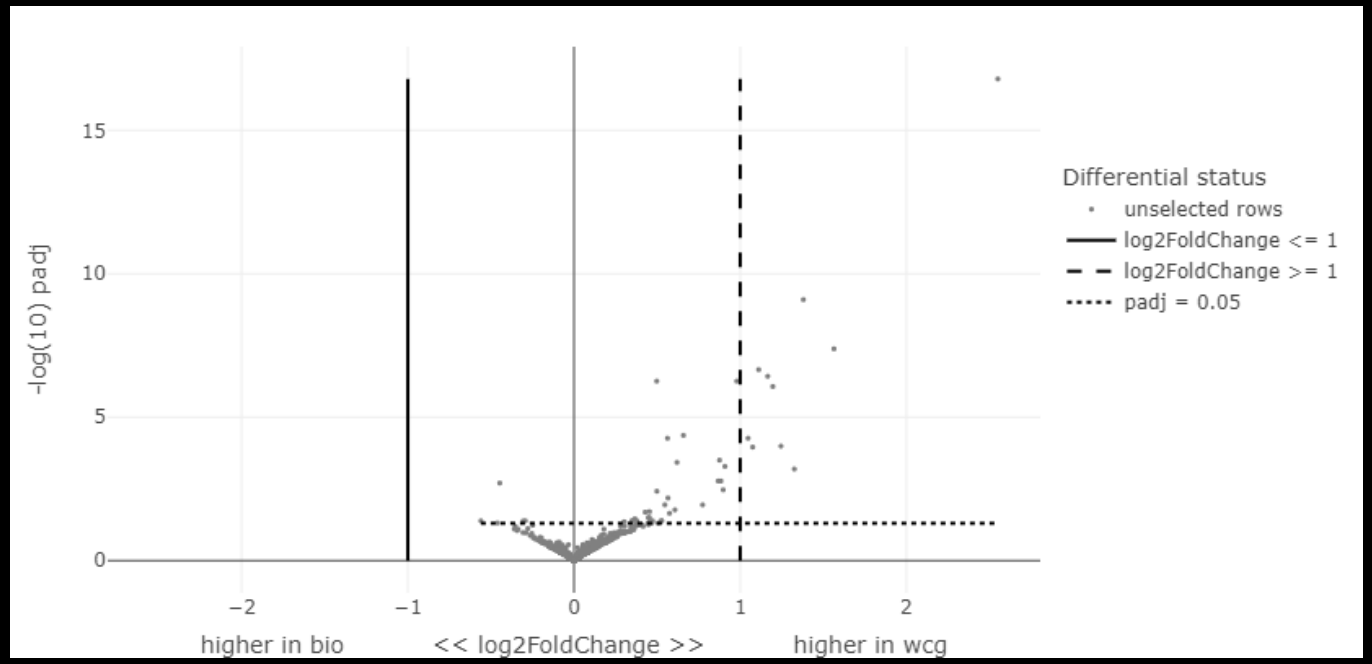
Couch et al.
In preparation



Gut microbiome diversity changes quickly (<2 weeks) after diet change (similar results for composition)

Couch et al.
In preparation

Upregulated Host Gene Expression



Lit search of salmonid gene expression

- -Smolting
- -Stress/+control over stress
- +Immune function
- -Inflammation

Largest differences in a set of 10 genes expressed ~2X higher on surrogate diet.

Couch et al.
In preparation

Take Aways

- Surrogate Project provides wild-like phenotypic fish for scientific investigations.
- Intermittent cyclic fasting may be preparatory step prior to release.
- Surrogate diet fed gut microbiome ≈ wild fed gut microbiome.

Questions?