Dynamic Energy Budget for modeling 'imprinting': insights from rainbow trout

B. Sadoul*, S. Augustine*, M. M. Vijayan
* equally contributed

DEB 2017

DEB symposium, 31st May 2017

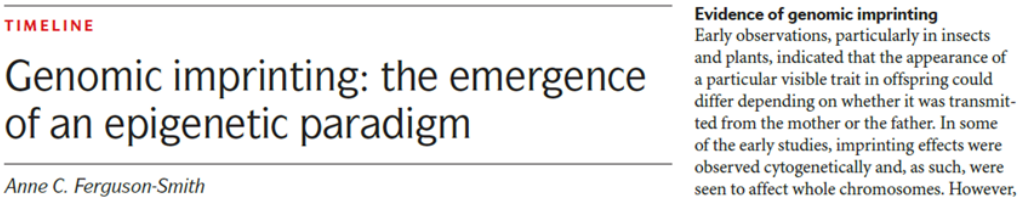
UNIVERSITY OF CALGARY

IMPRINTING

PERSPECTIVES

- **Genomic**

An epigenetic mechanism for accomplishing persistent change in gene expression.



TIMELINE

Genomic imprinting: the emergence of an epigenetic paradigm

Anne C. Ferguson-Smith

Evidence of genomic imprinting
Early observations, particularly in insects and plants, indicated that the appearance of a particular visible trait in offspring could differ depending on whether it was transmitted from the mother or the father. In some of the early studies, imprinting effects were observed cytogenetically and, as such, were seen to affect whole chromosomes. However,

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- **Ecologic**

Current Biology

Cell PRESS

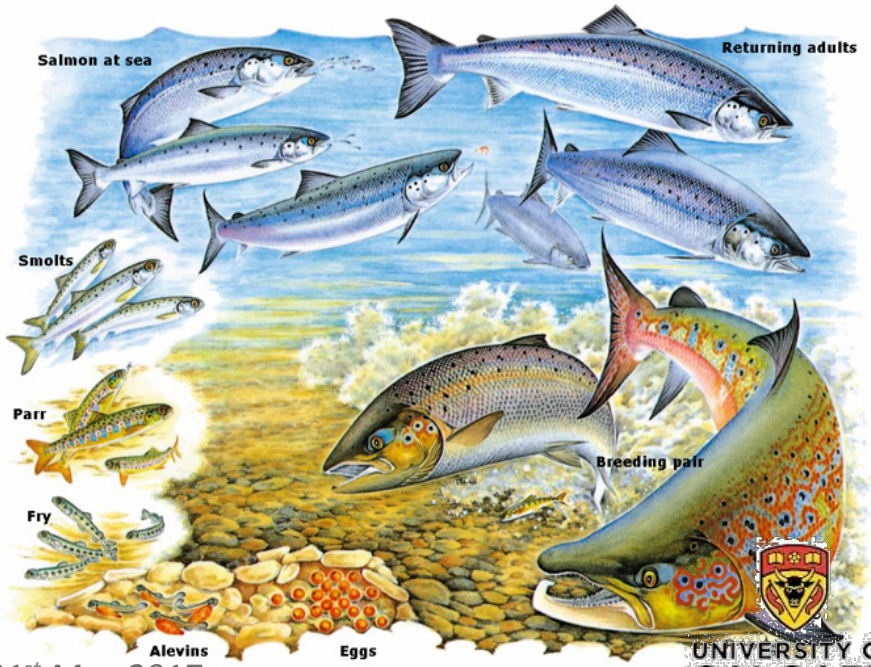
Volume 23, Issue 4, 18 February 2013, Pages 312–316

Report

Evidence for Geomagnetic Imprinting as a Homing Mechanism in Pacific Salmon

Nathan F. Putman[1], Kenneth J. Lohmann[2], Emily M. Putman[3], Thomas P. Quinn[4], A. Peter Klimley[5], David L.G. Noakes[1,6]

Show more



IMPRINTING

= a persistent change of phenotype due to a

ponctual or ancestral environmental change

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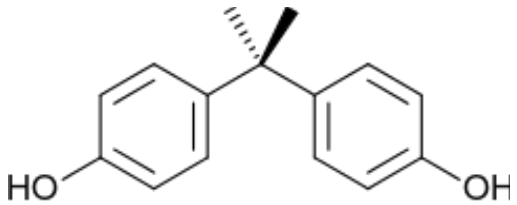
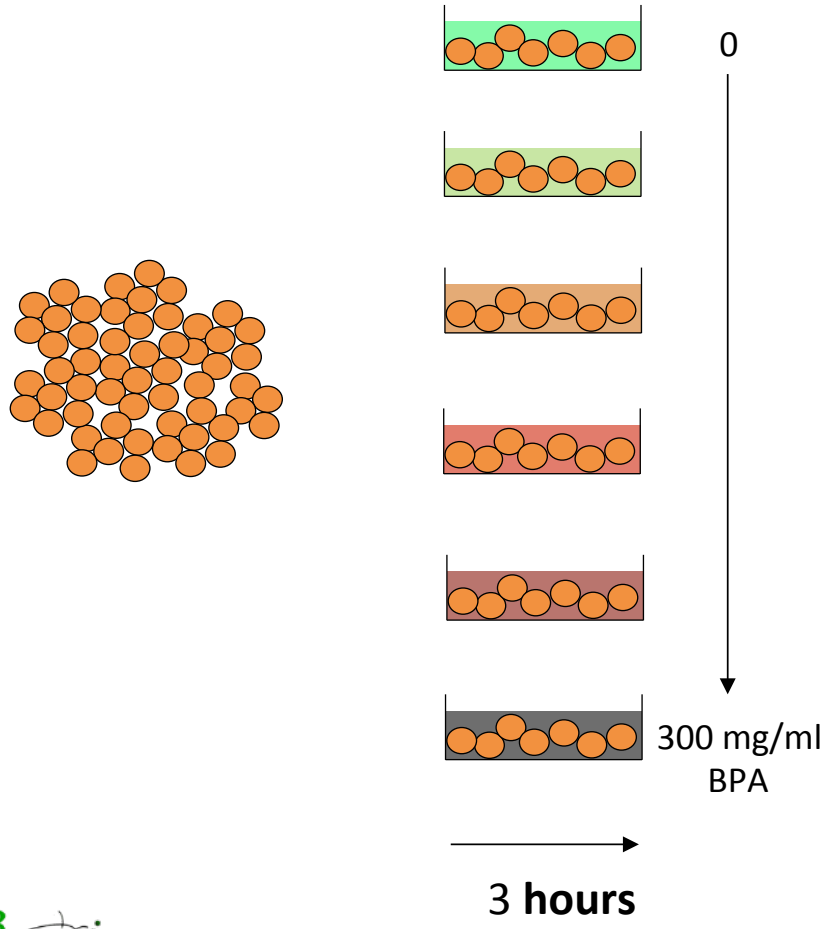
ponctual or ancestral environmental change

→ e.g. BPA exposure



IMPRINTING BY BPA IN TROUT



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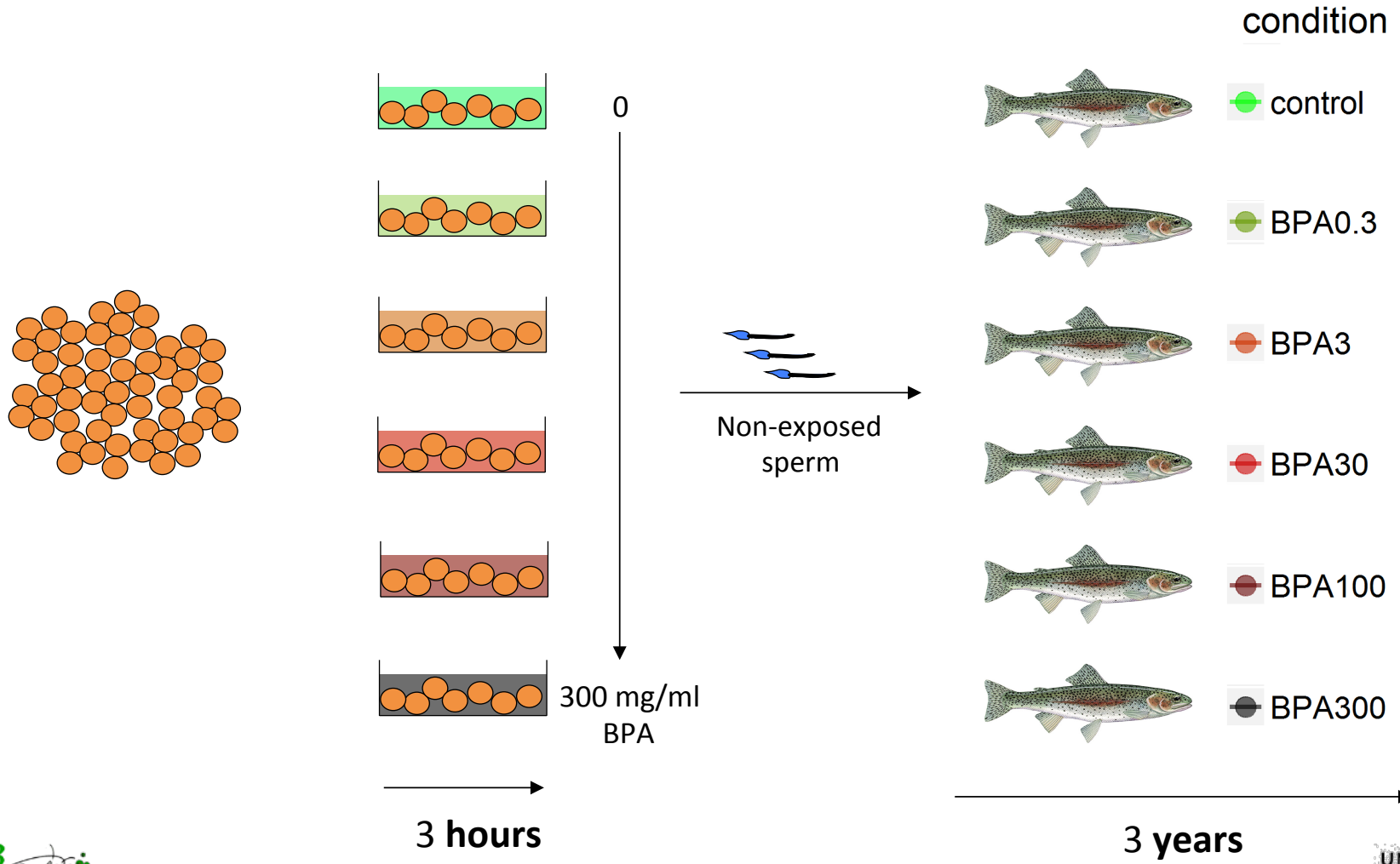

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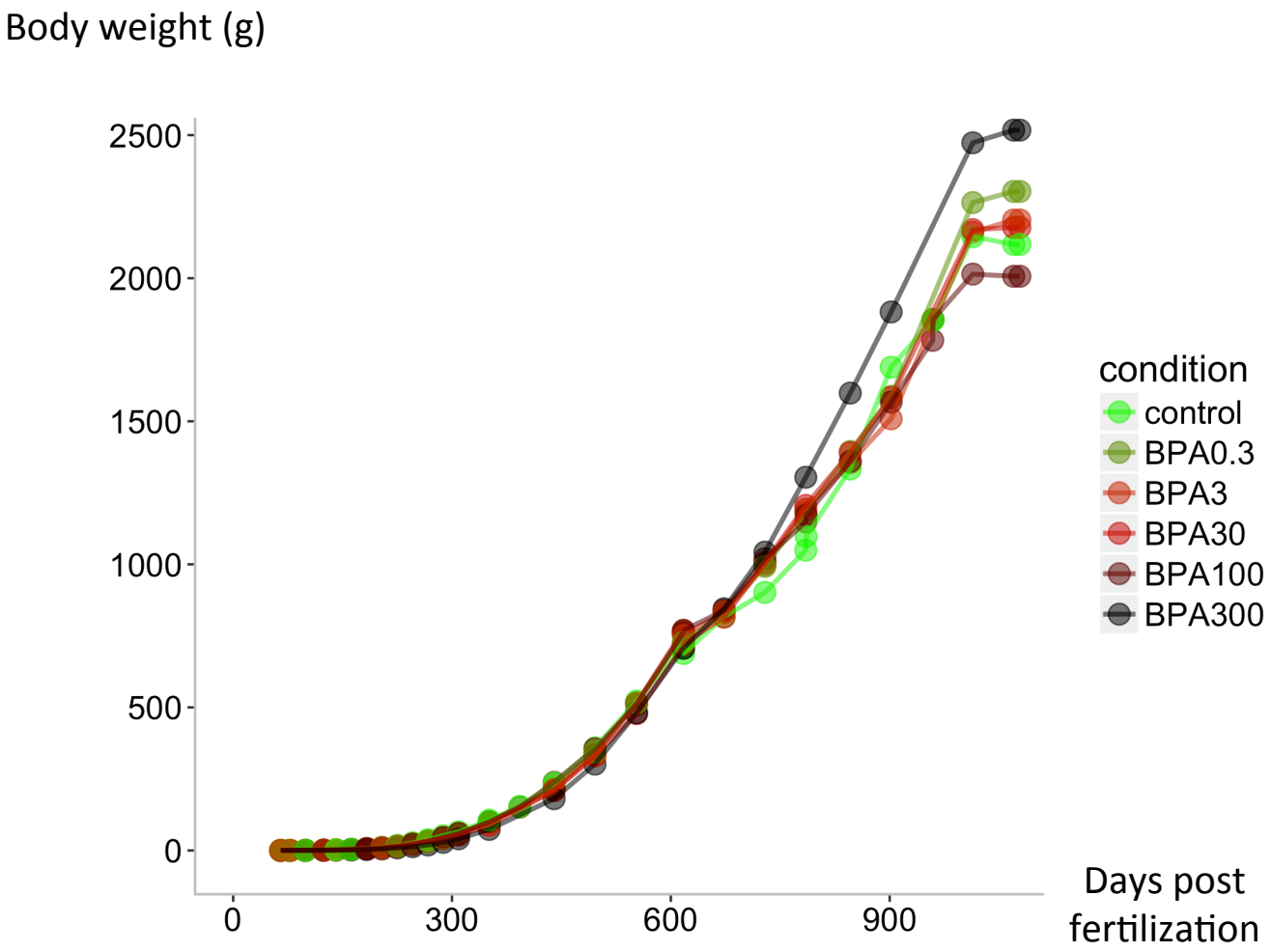


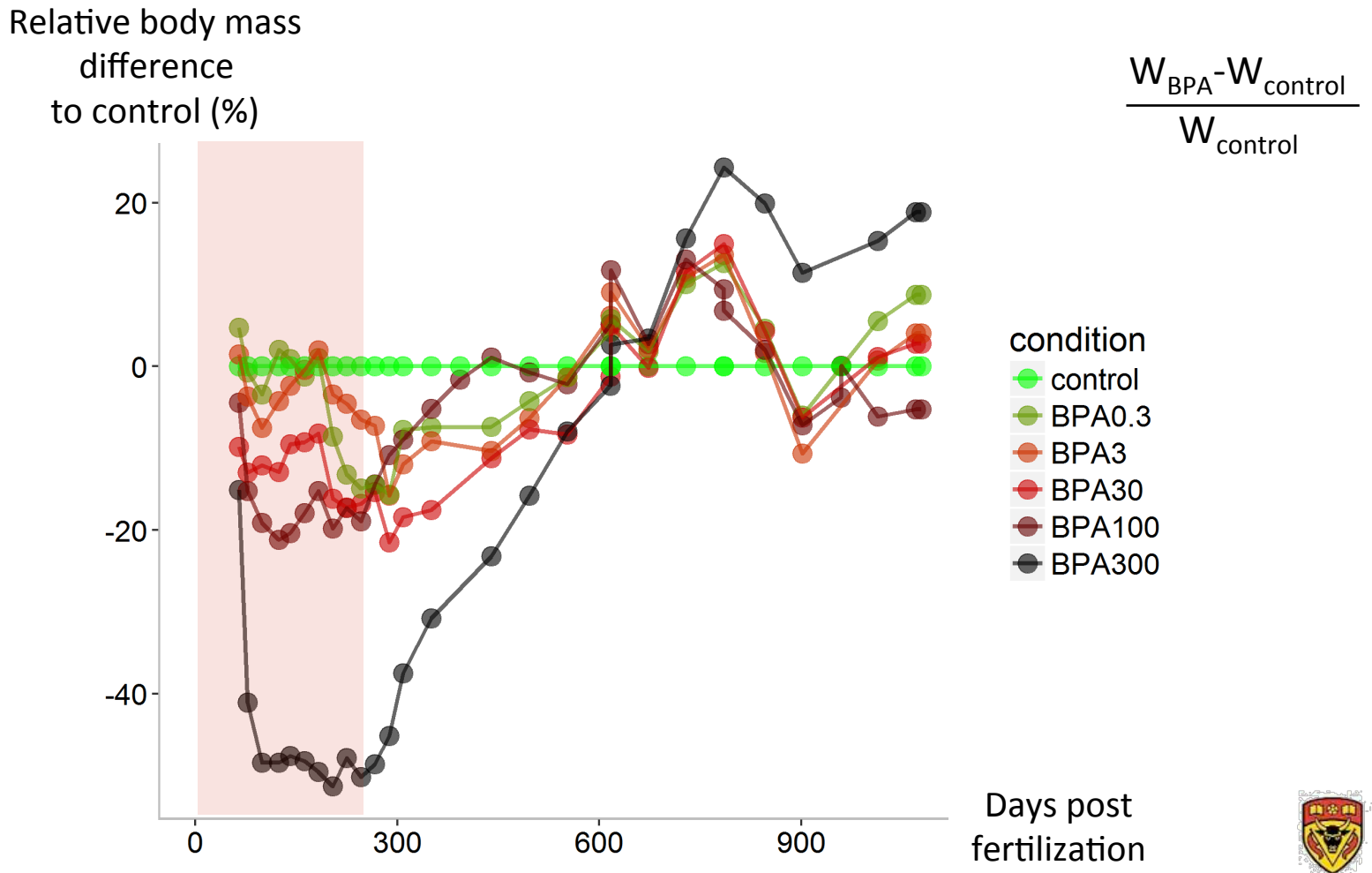
IMPRINTING BY BPA IN TROUT

Relative body mass difference to control (%)

$$\frac{W_{BPA}-W_{control}}{W_{control}}$$

Days post fertilization

IMPRINTING BY BPA IN TROUT



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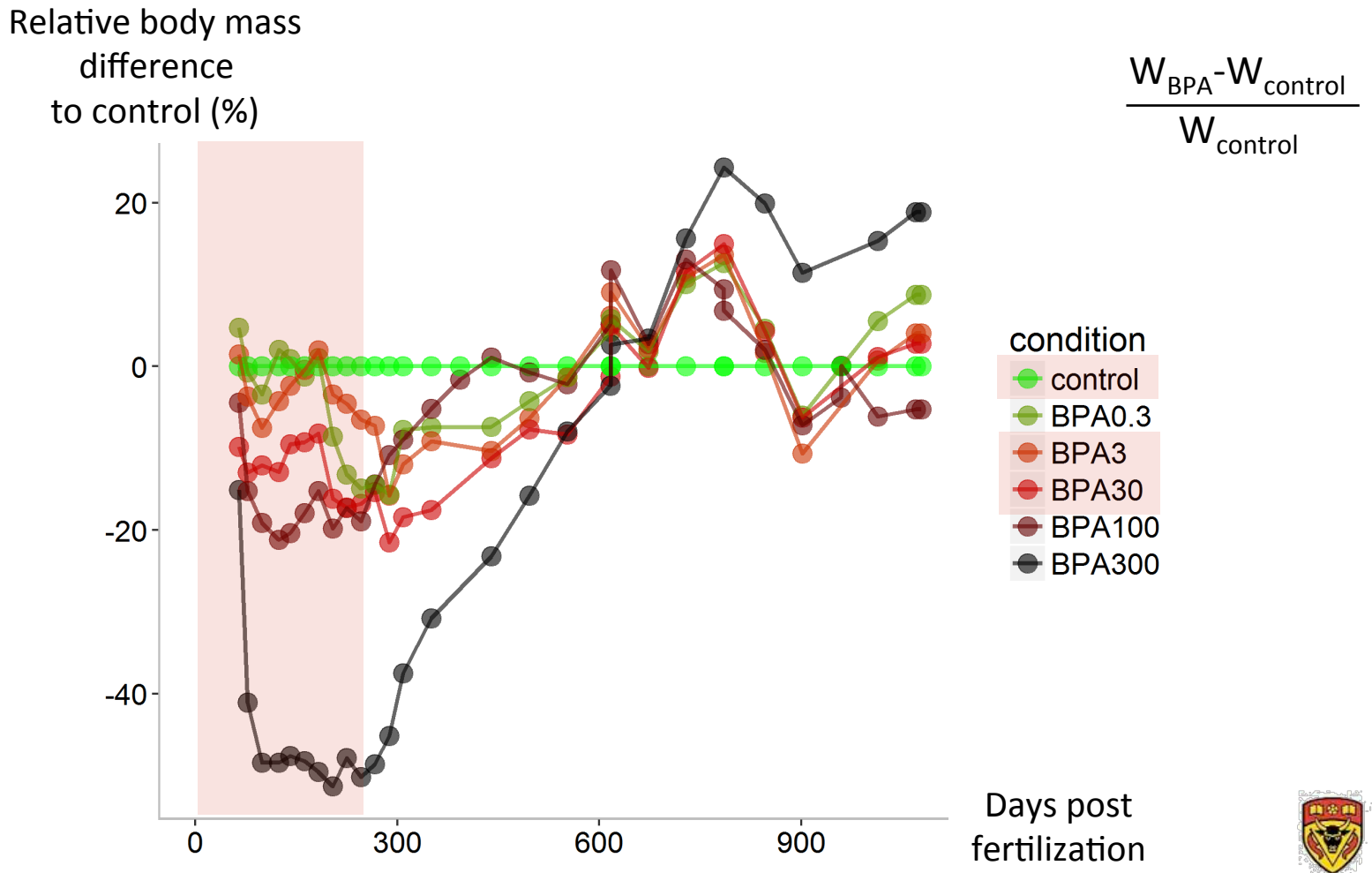

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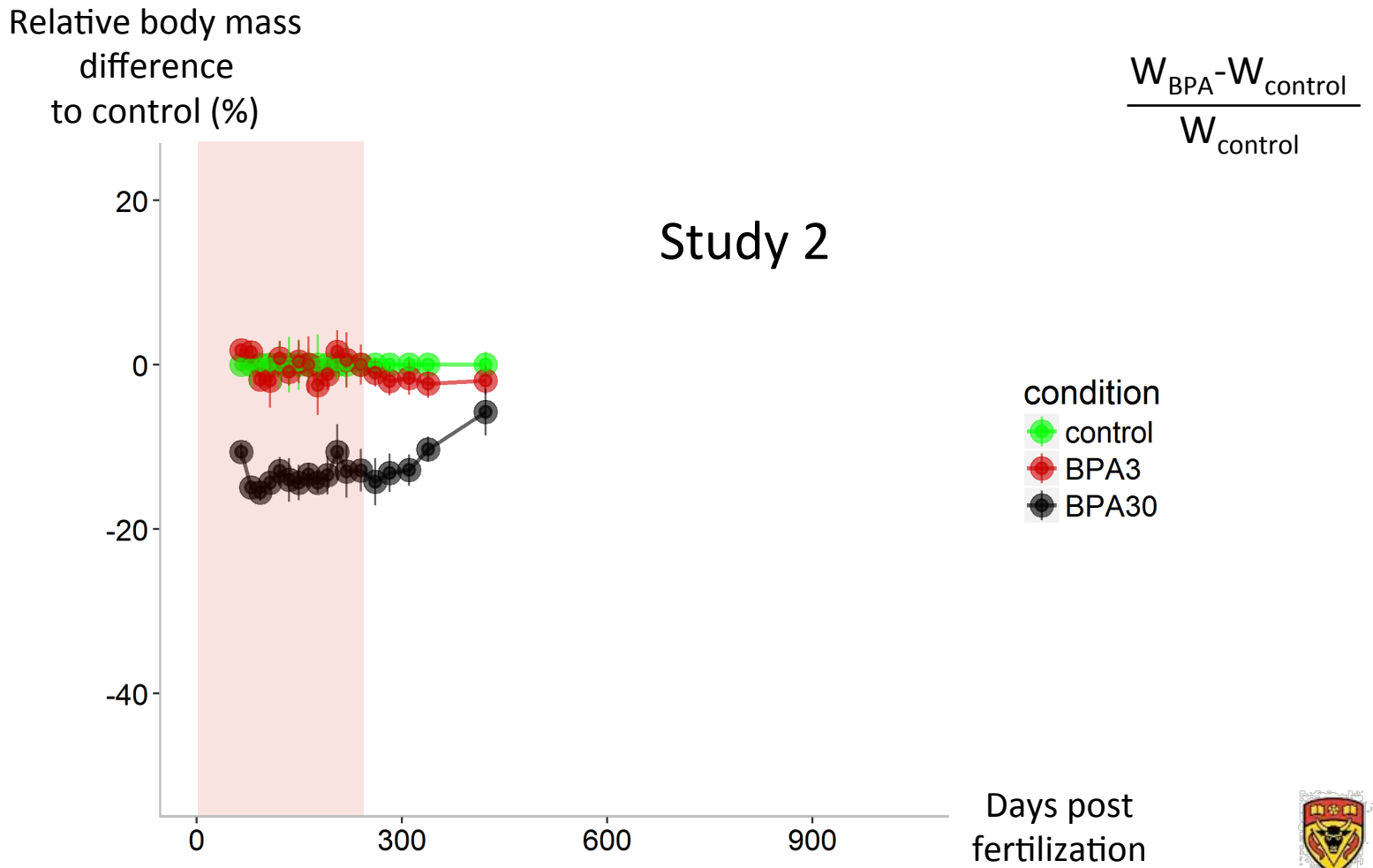

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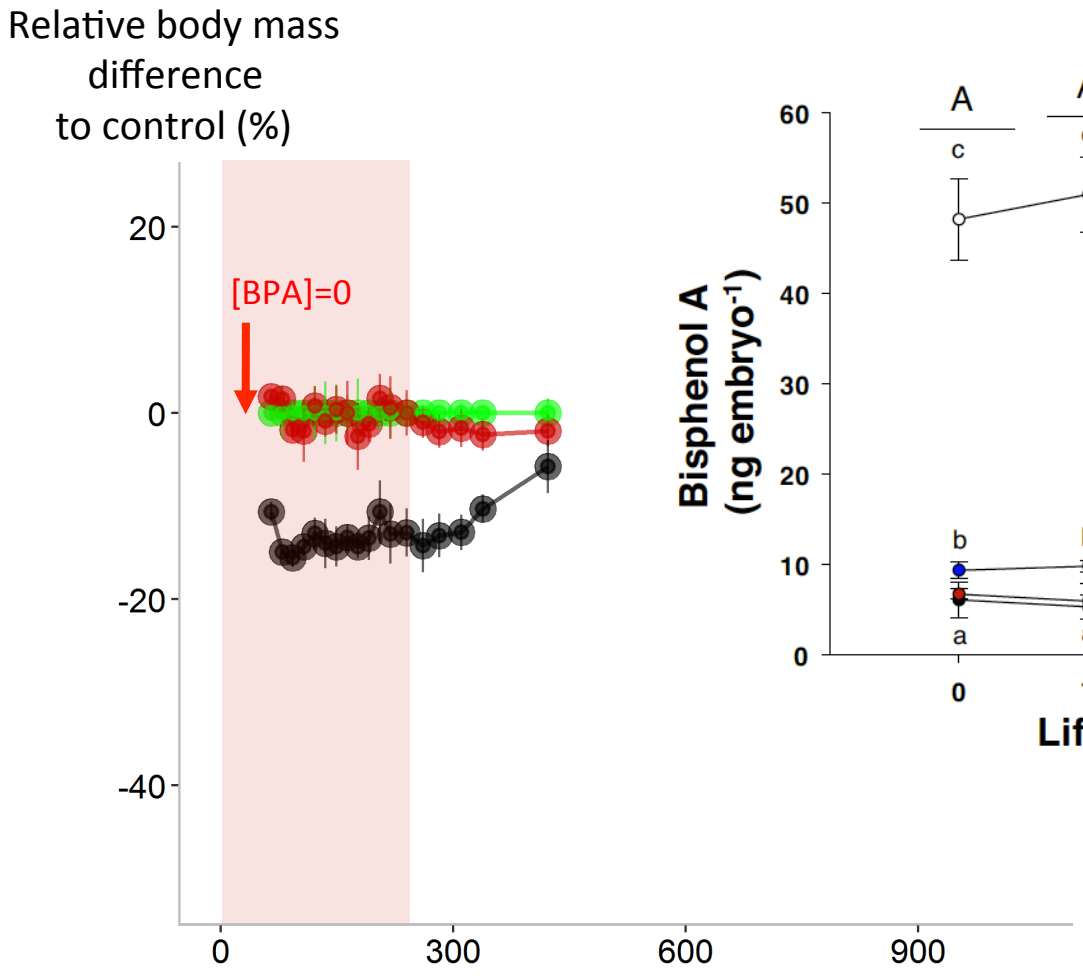
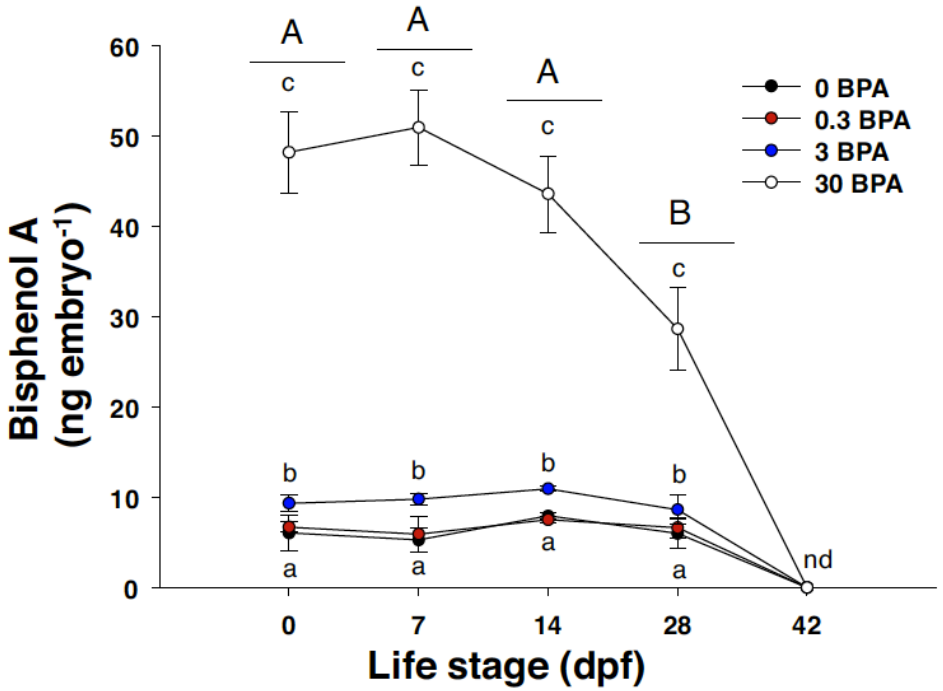
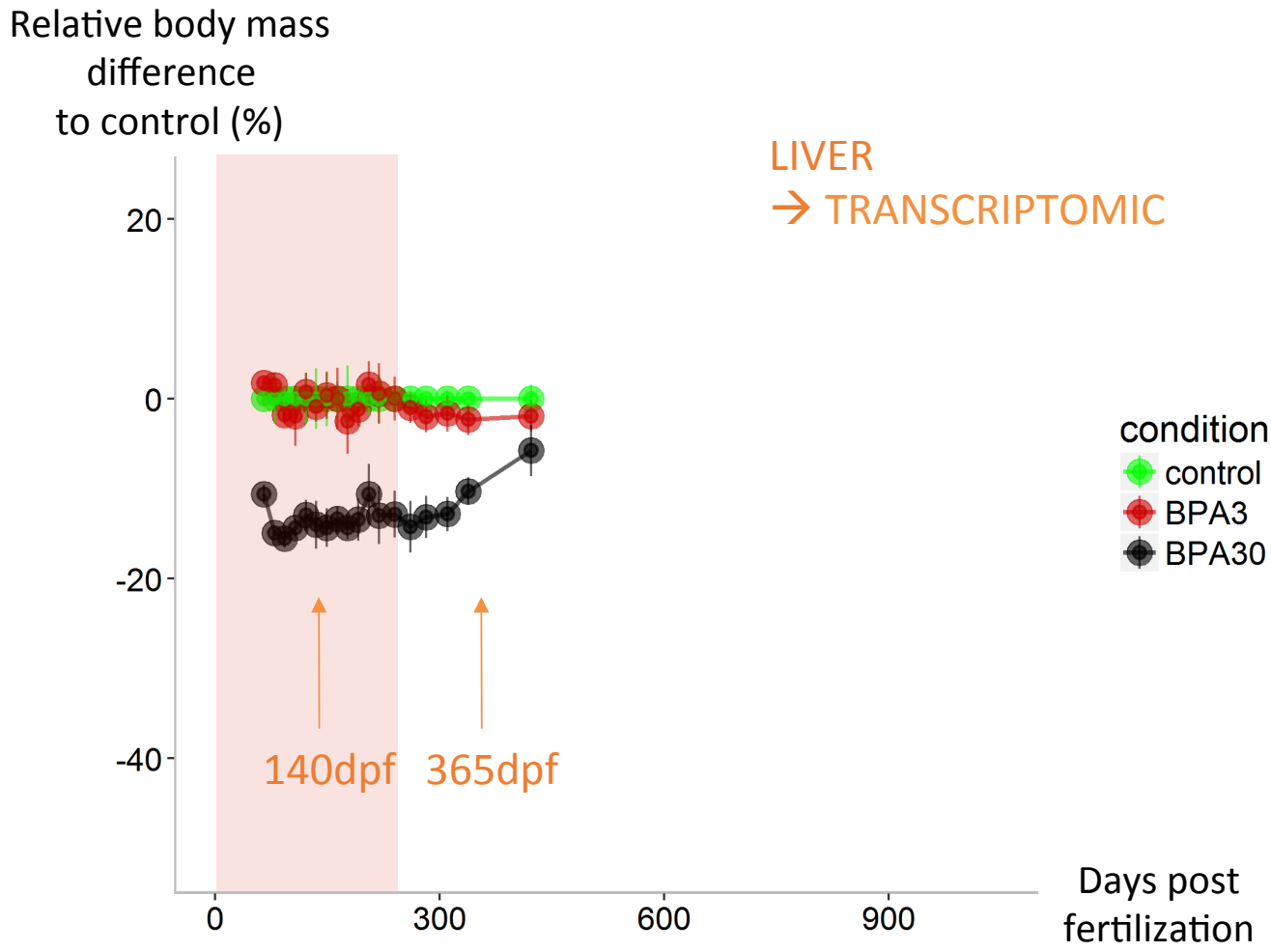




Birceanu et al. 2015

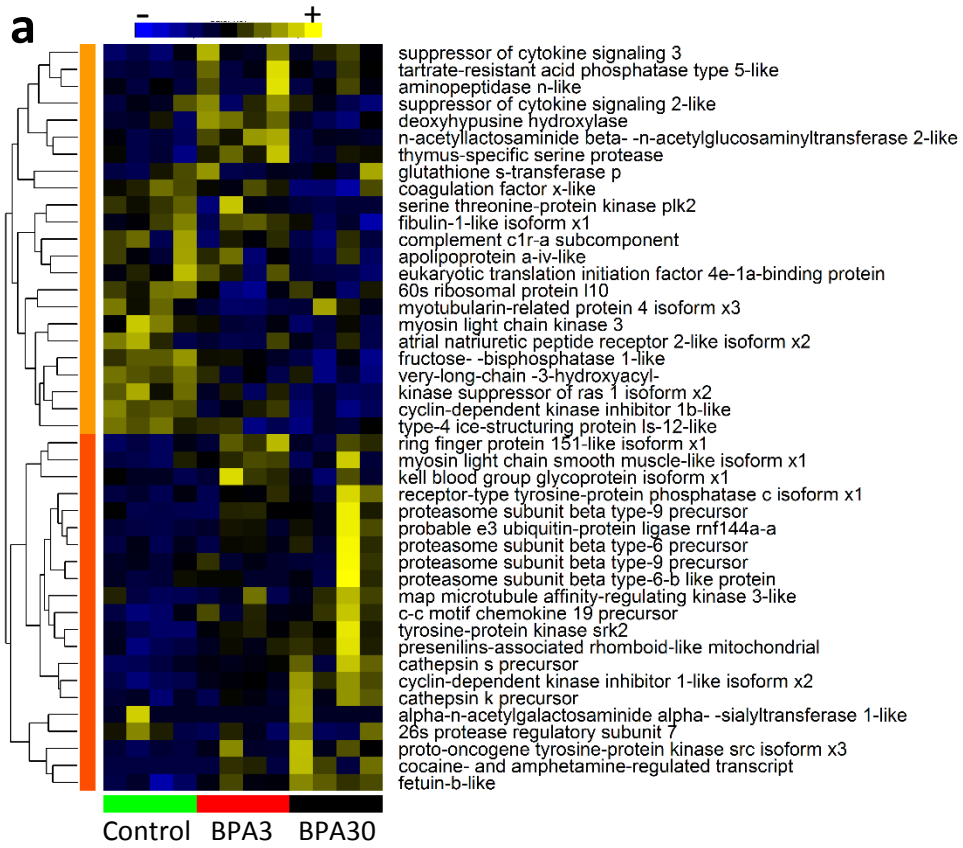
IMPRINTING BY BPA IN TROUT



LIVER
→ TRANSCRIPTOMIC

IMPRINTING BY BPA IN TROUT

140dpf



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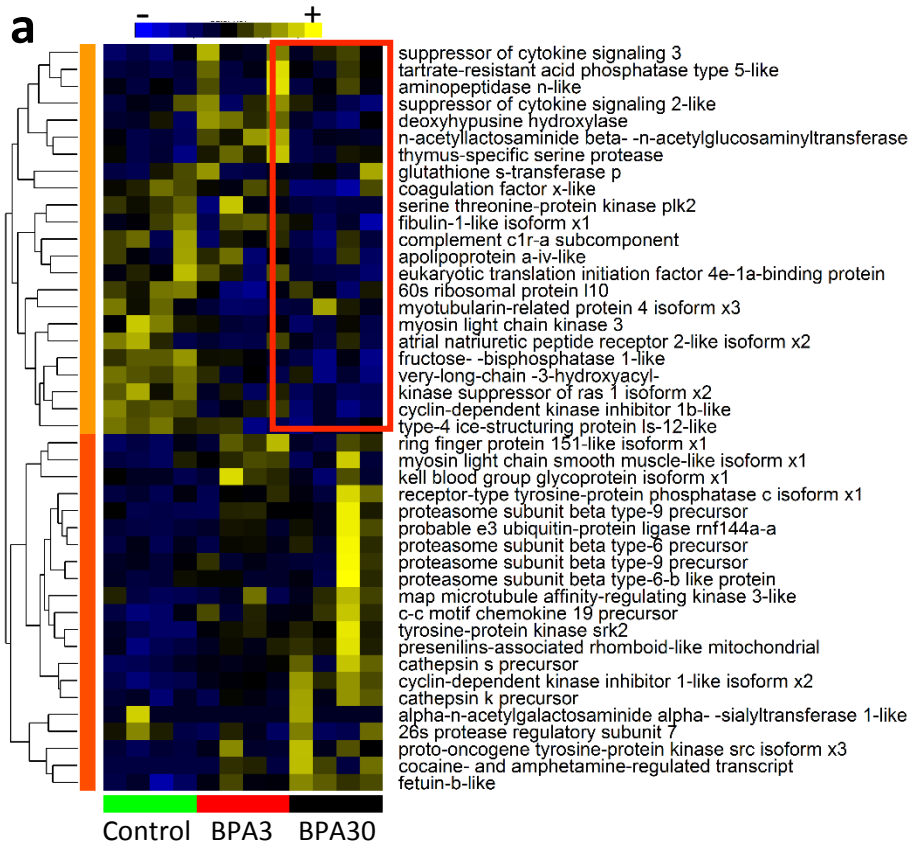
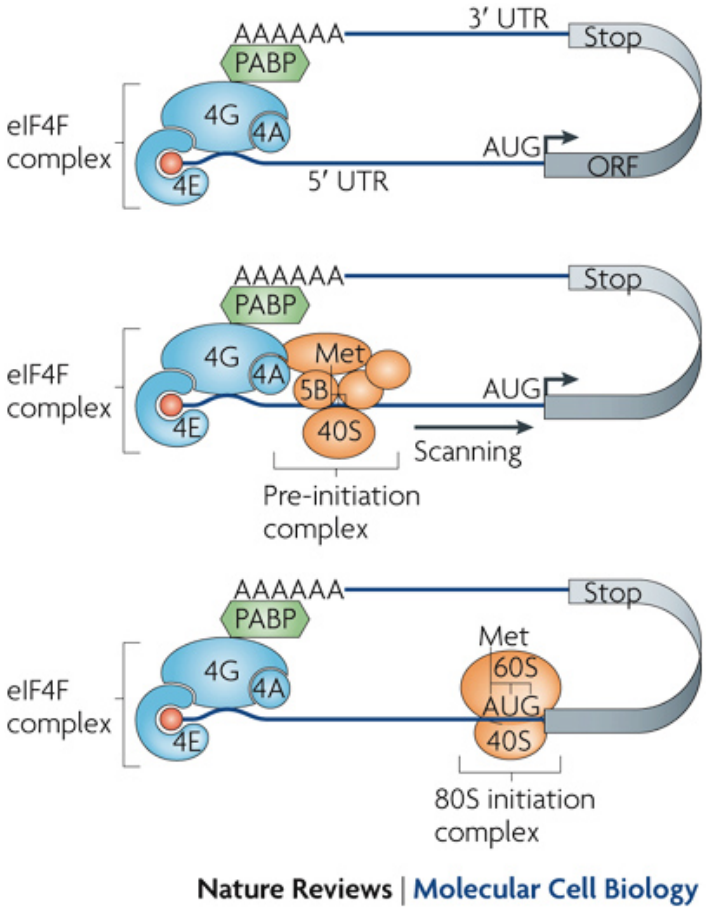
140dpf





From Besse and Ephrussi, 2008

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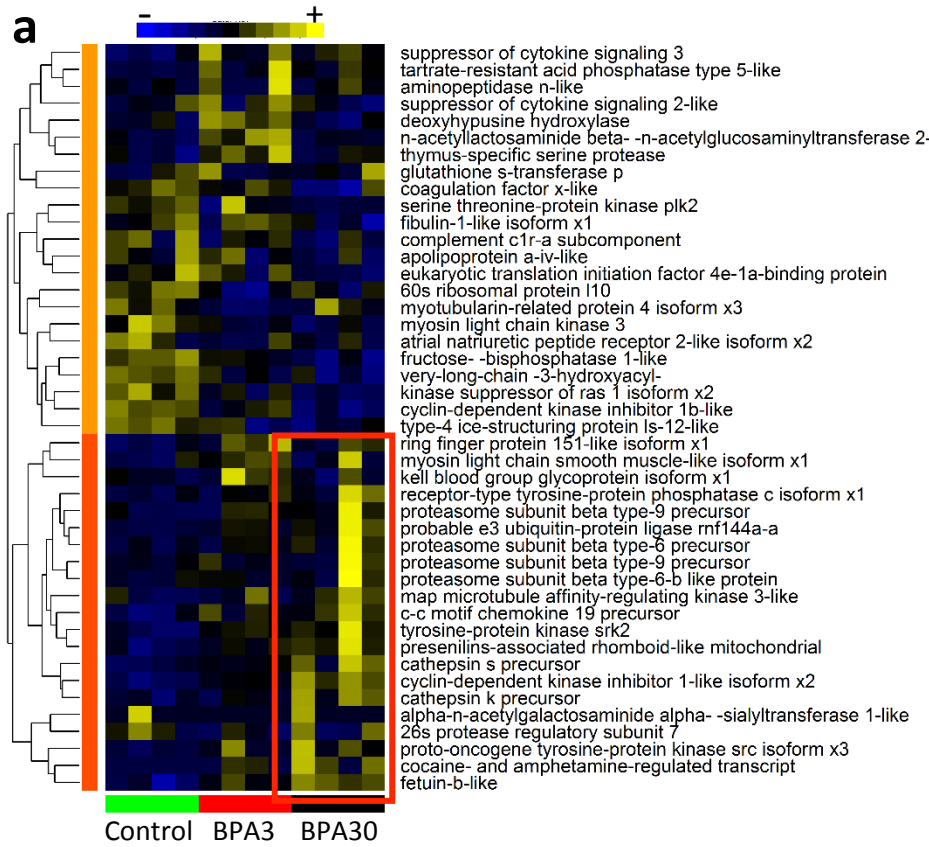
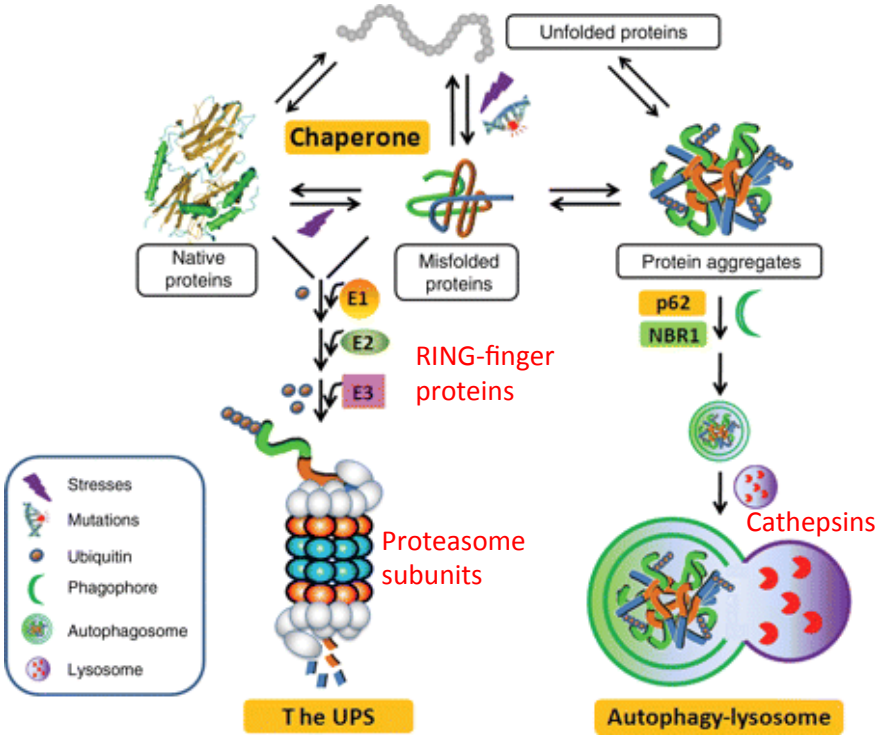
140dpf

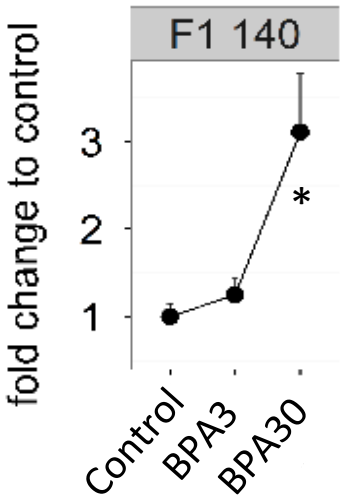




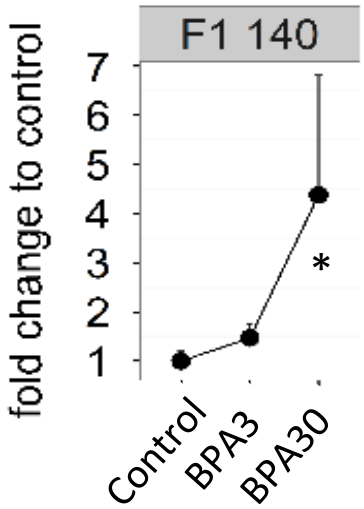
From Su and Wang, 2010

IMPRINTING BY BPA IN TROUT

cathepsin k precursor



proteasome subunit
beta type-6 precursor



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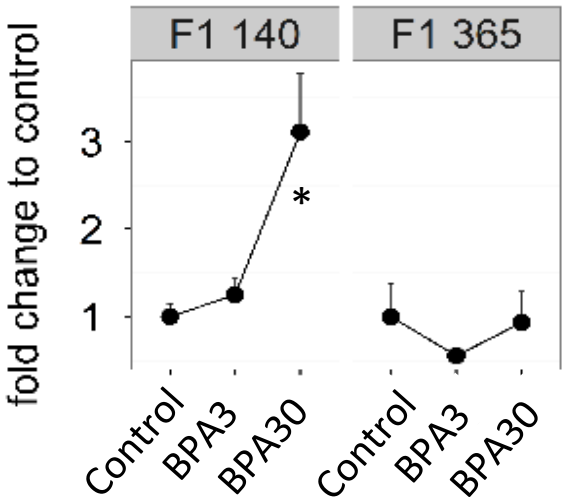

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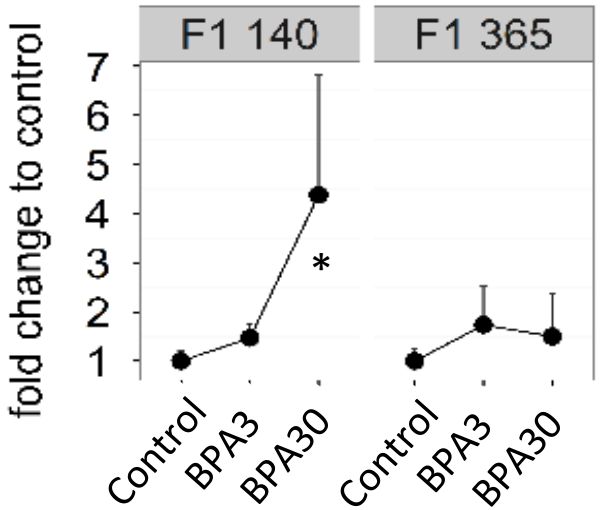

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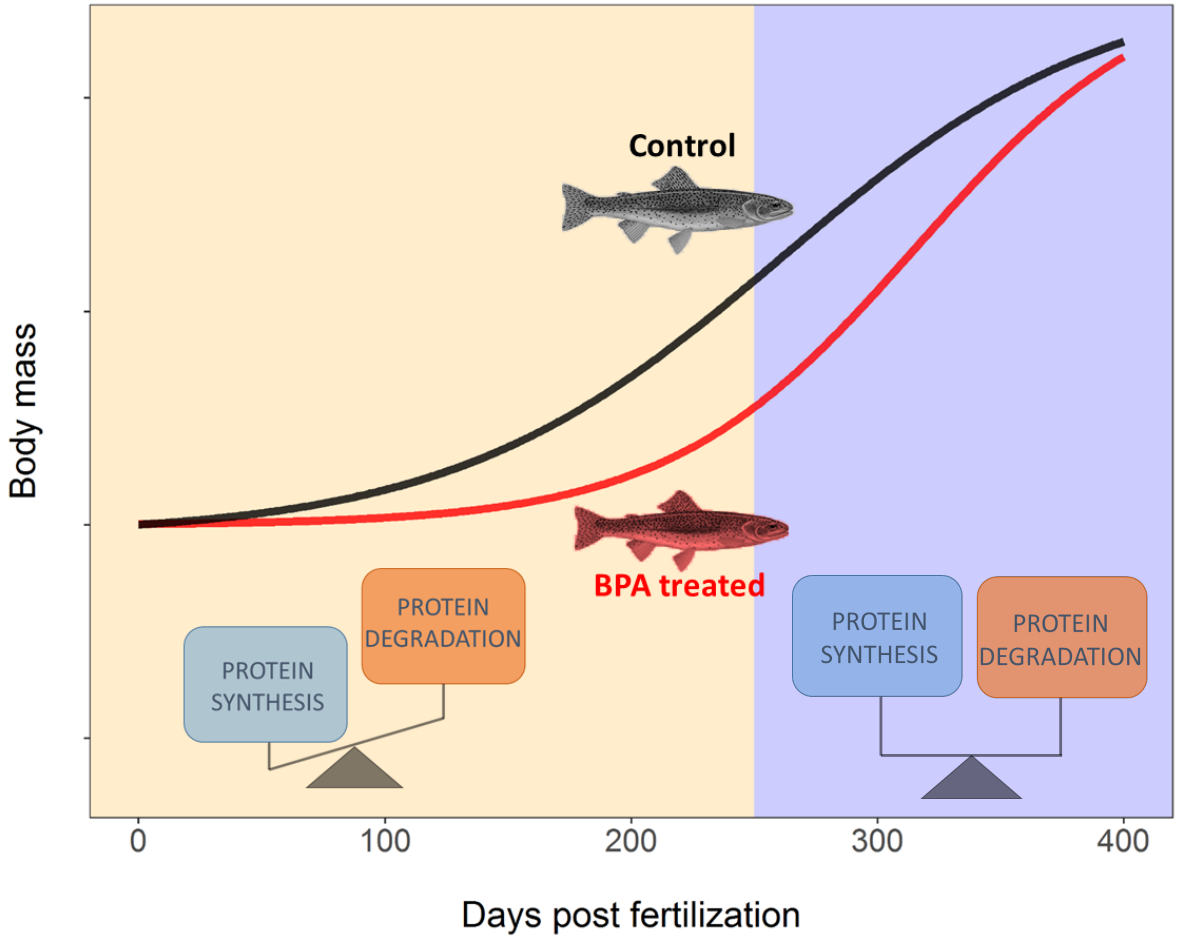

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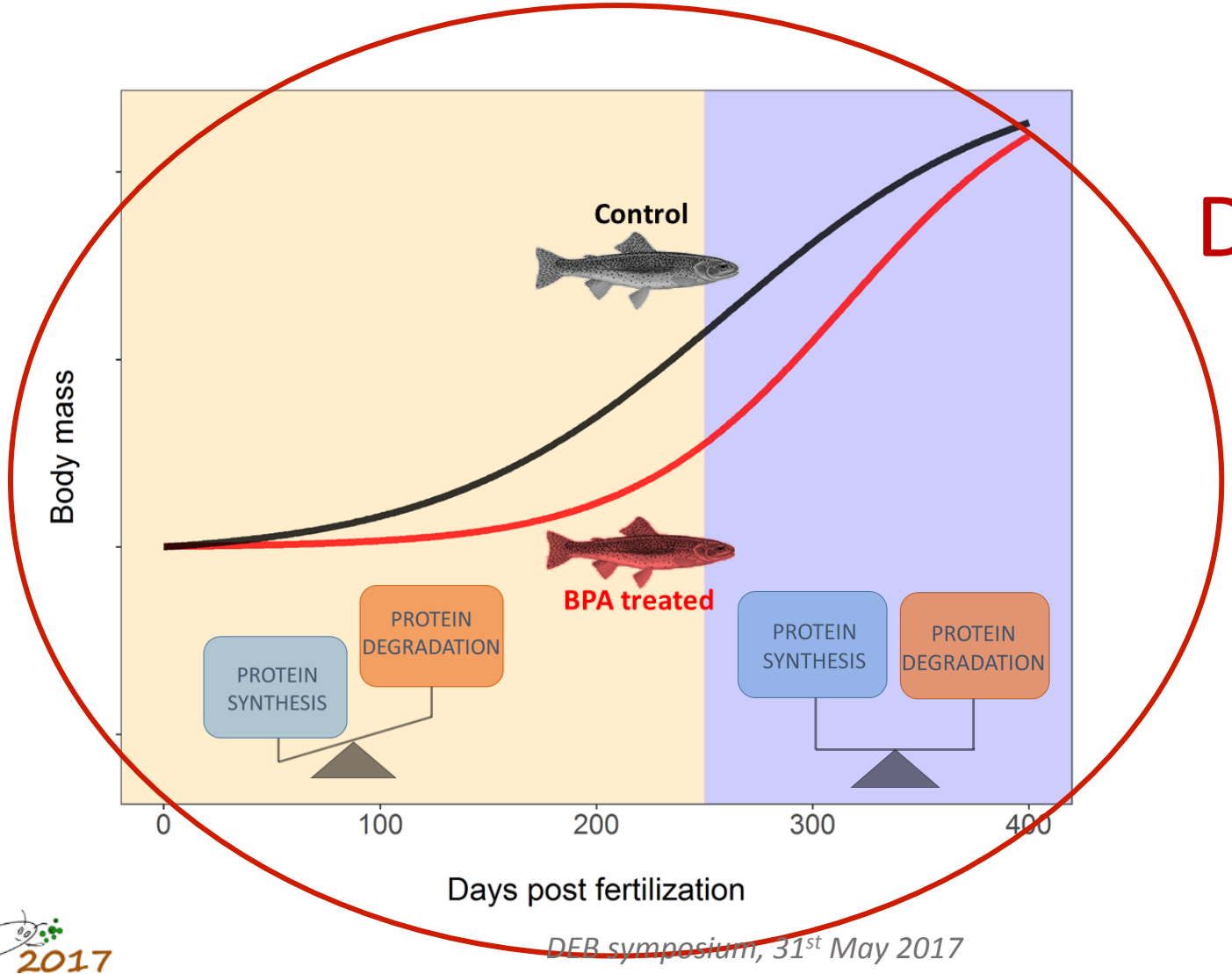
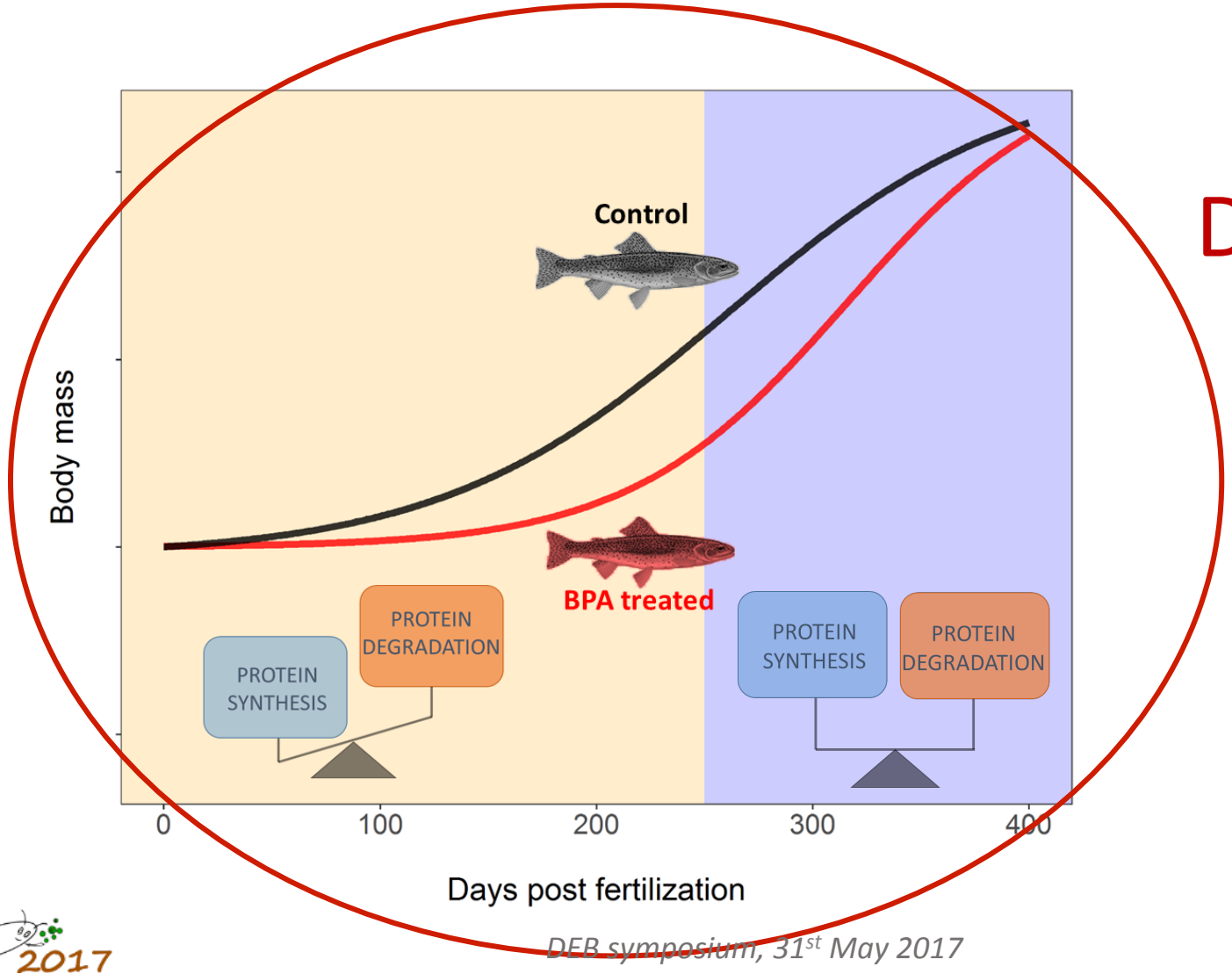


DEB

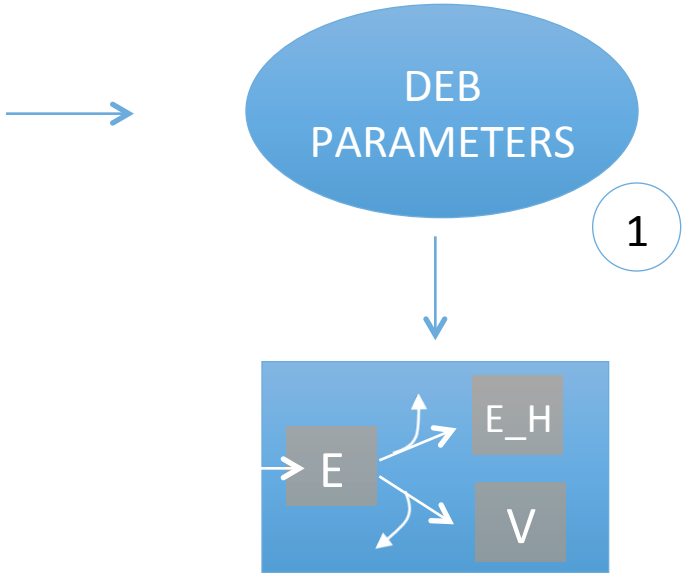
IMPRINTING BY BPA IN TROUT



DEB

GAME PLAN

DATA FROM LITTERATURE



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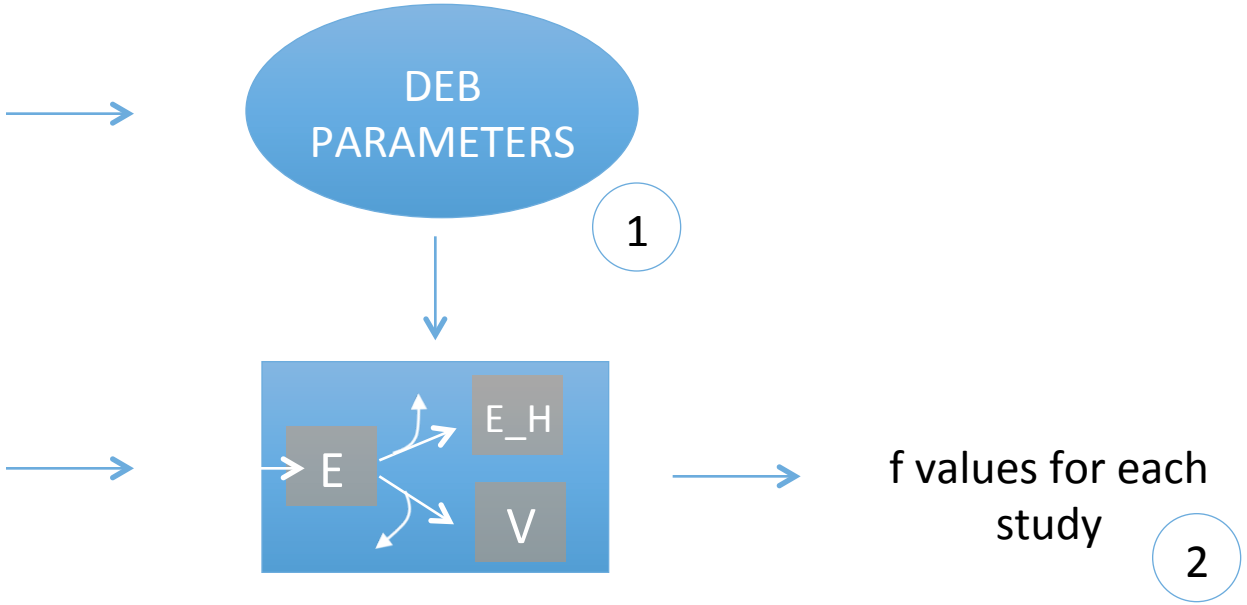
DATA FROM LITTERATURE

GROWTH DATA FROM CONTROLS



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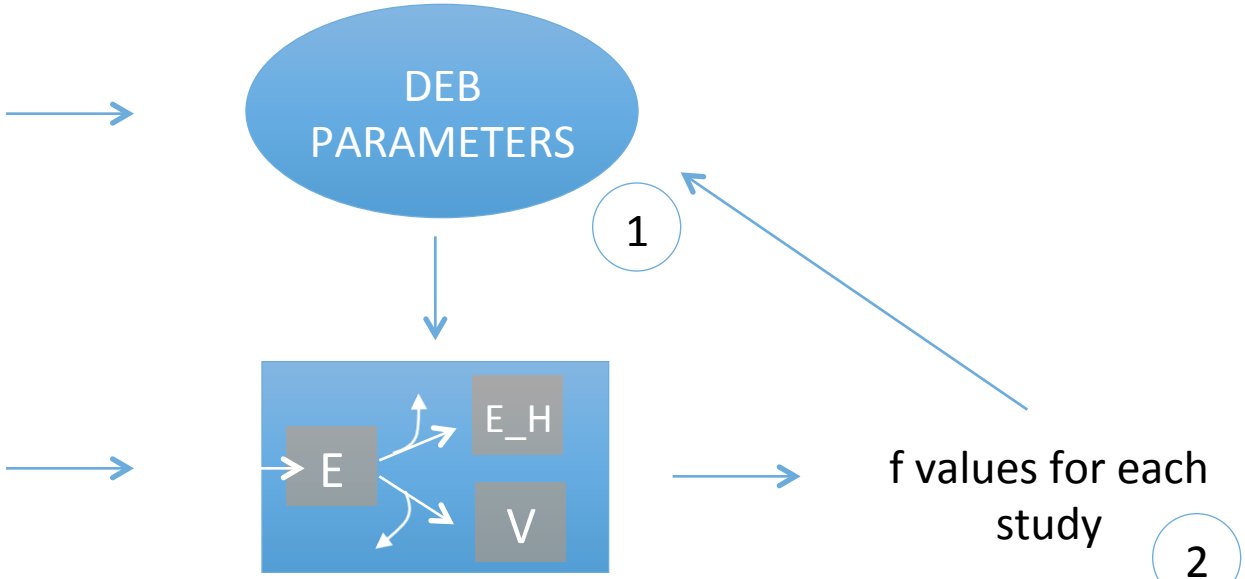


GROWTH DATA FROM CONTROLS

GROWTH DATA "BPA conditions"

CONTROL DEB FOR RAINBOW TROUT

12 studies

- YaniHisa2002
- ChenSnow2015
- BudyThie2002
- StraStut1997
- WeatGill1981
- FromRasm1991
- Vels1987
- DaviKenn2014
- NinnStev2006
- KieAls1998
- Wie1985

Fitted parameters

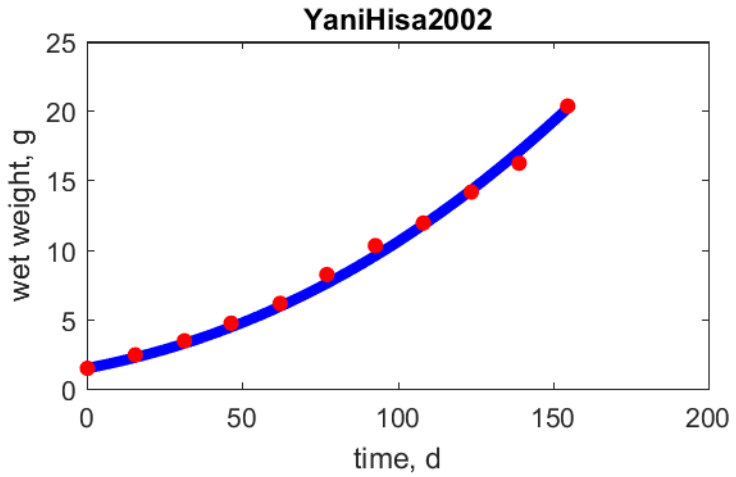
CONTROL DEB FOR RAINBOW TROUT

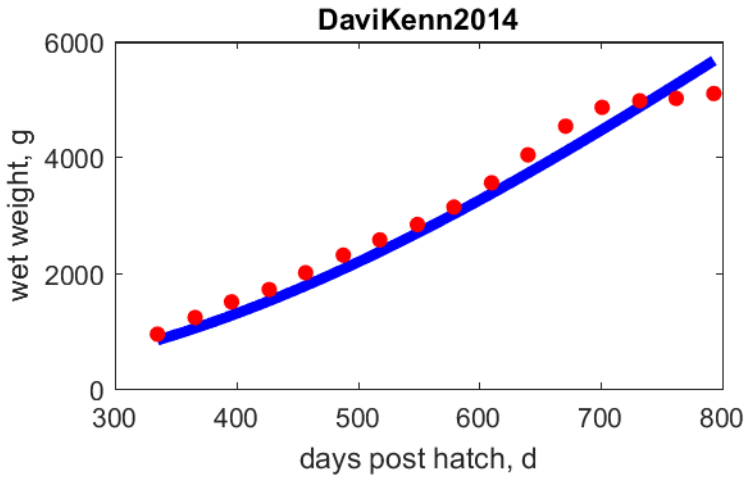
Table 1: Primary parameters at reference temperature (15.5 deg. C) - t

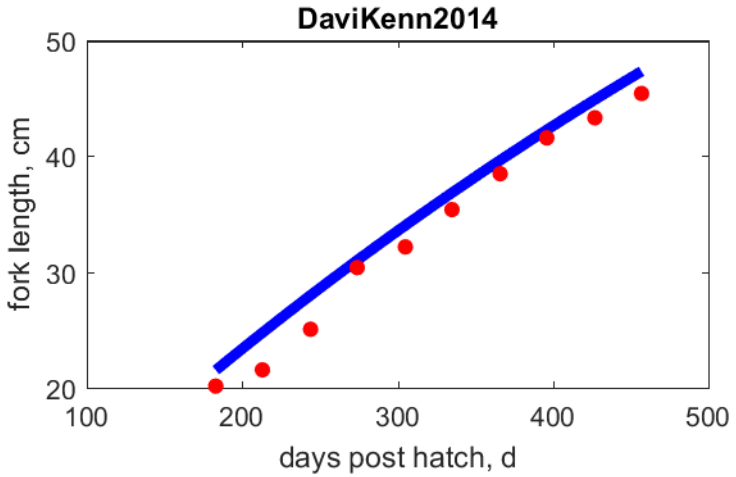
Symbol	Value	Unit	Name
$\{\dot{p}_{Am}\}$	3381.55	J/d/cm^2	max. surface area spec. assim. rate
F_m	6.5	l/d/cm^2	max spec searching rate
K_X	0.8	-	digestion efficiency of food to reserve
K_P	0.1	-	faecation efficiency of food to faeces
v	0.023877	cm/d	energy conductance
K	0.5599	-	allocation fraction to soma
K_R	0.95	-	reproduction efficiency
p_M	370.4783	J/d/cm^3	vol-spec somatic maint
pT	0	J/d/cm^2	surf-spec somatic maint
kJ	0.002	1/d	maturity maint rate coefficient
E_G	5237.7	J/cm^3	spec cost for structure
E_{Hb}	57.37	J	maturity at birth
E_{Hj}	770.1	J	maturity at metam
E_{Hp}	4.879 10^6	J	maturity at puberty
h_a	3.004 10^{-24}	1/d^2	Weibull aging acceleration
s_G	10	-	Gompertz stress coefficient

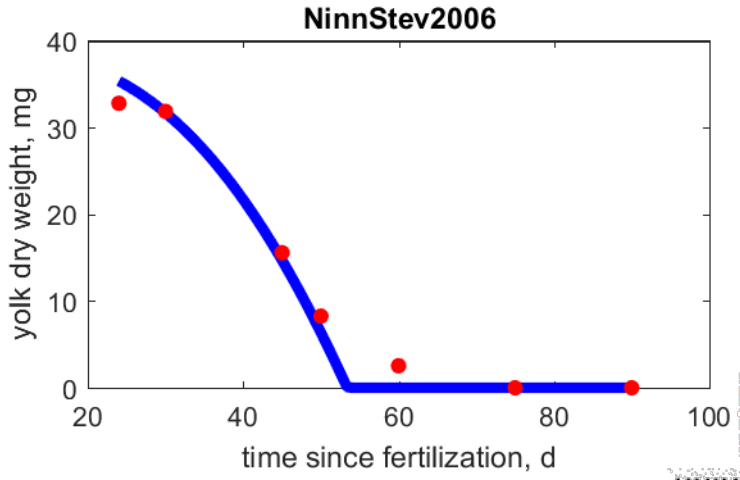
MRE = 0.082

CONTROL DEB FOR RAINBOW TROUT









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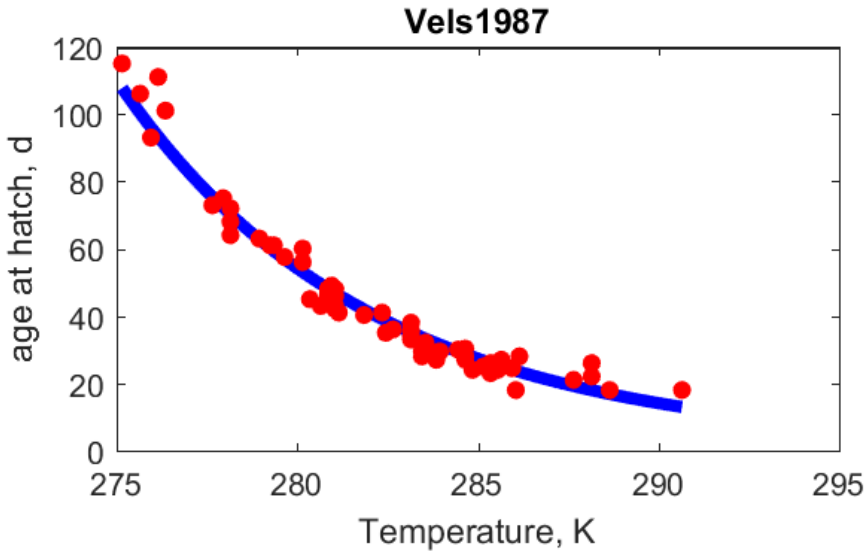

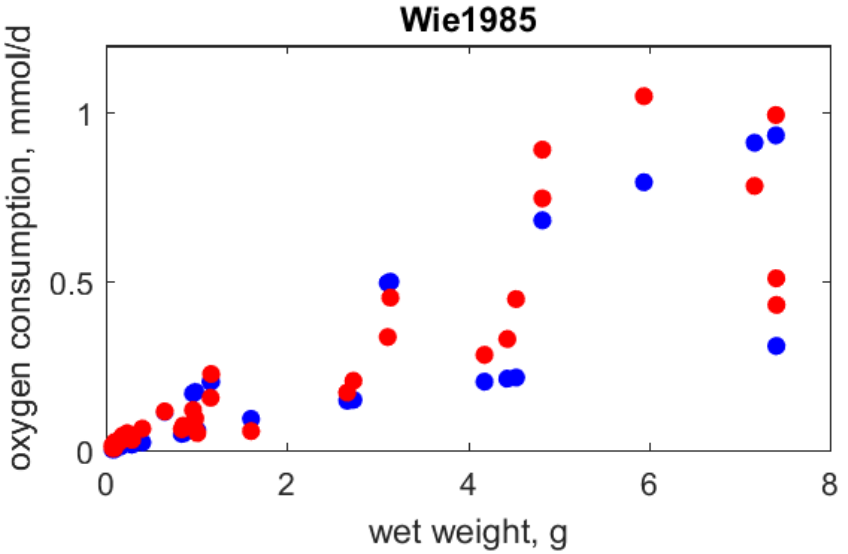

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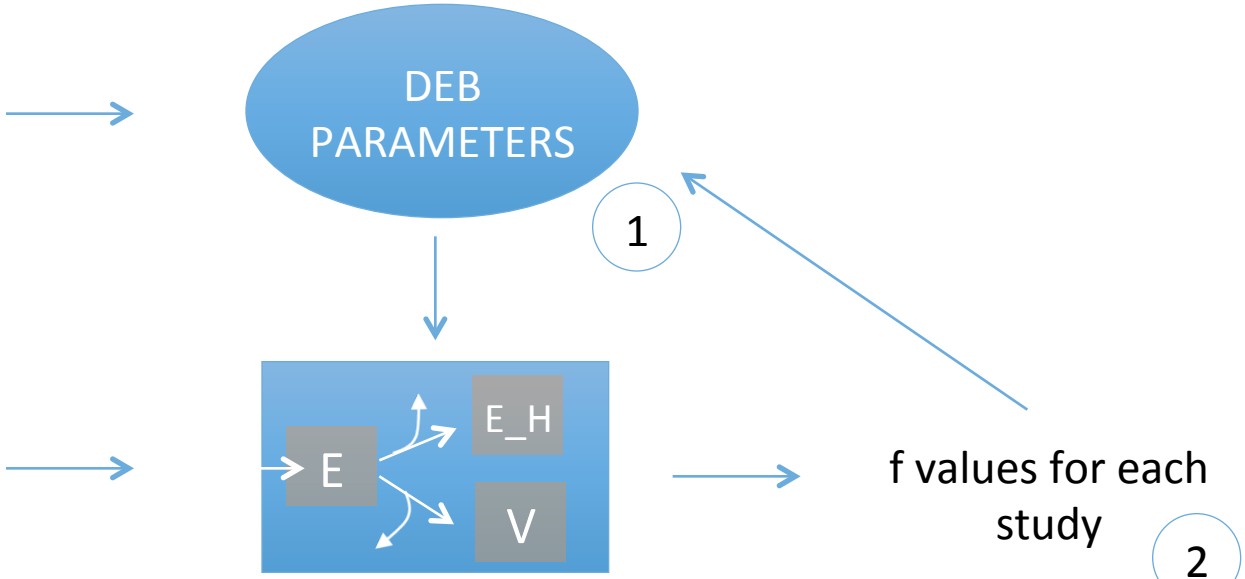
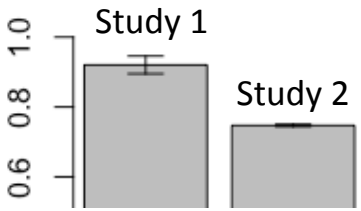


GROWTH DATA FROM CONTROLS

GROWTH DATA "BPA conditions"

Scaled functional responses



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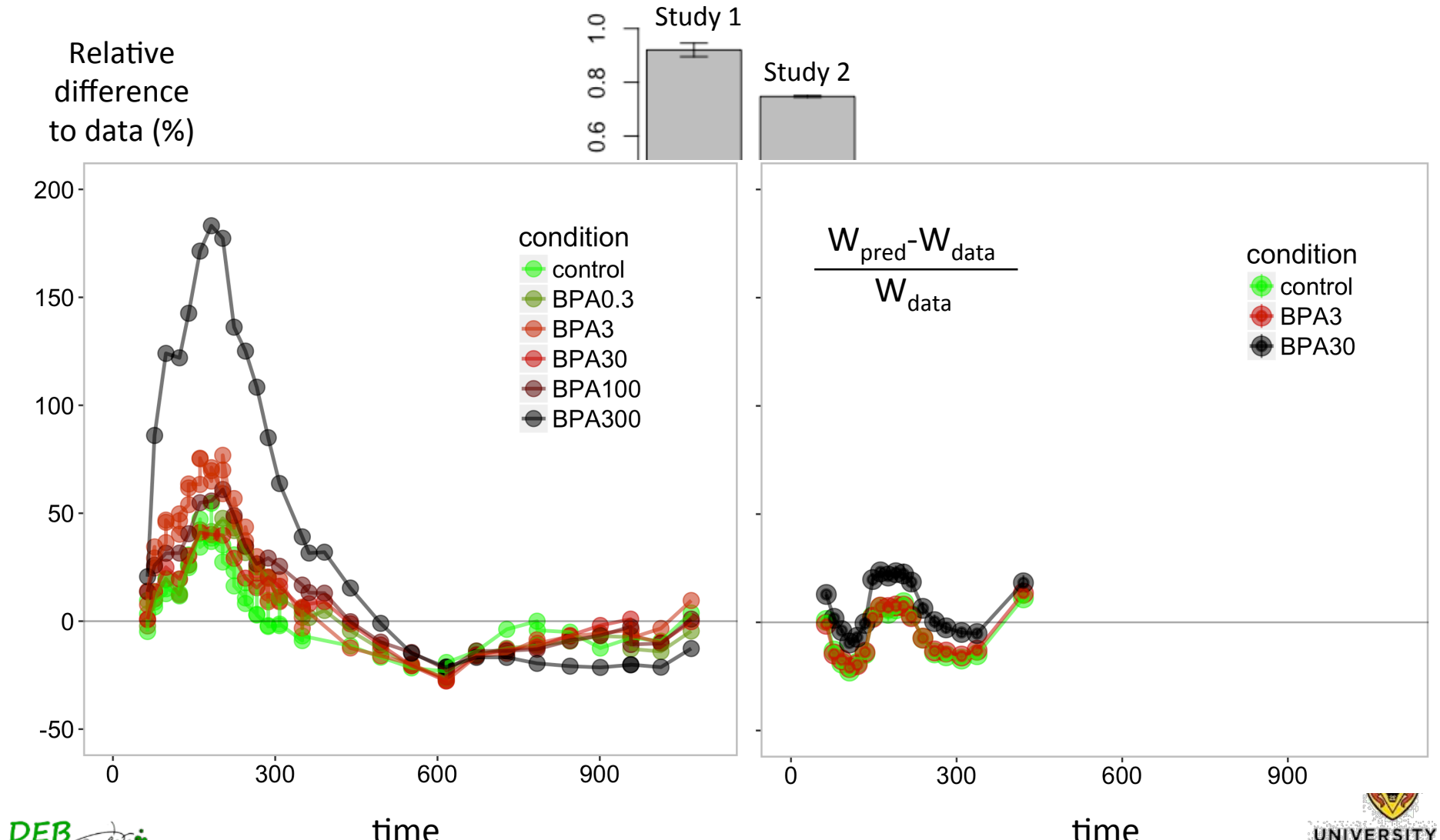

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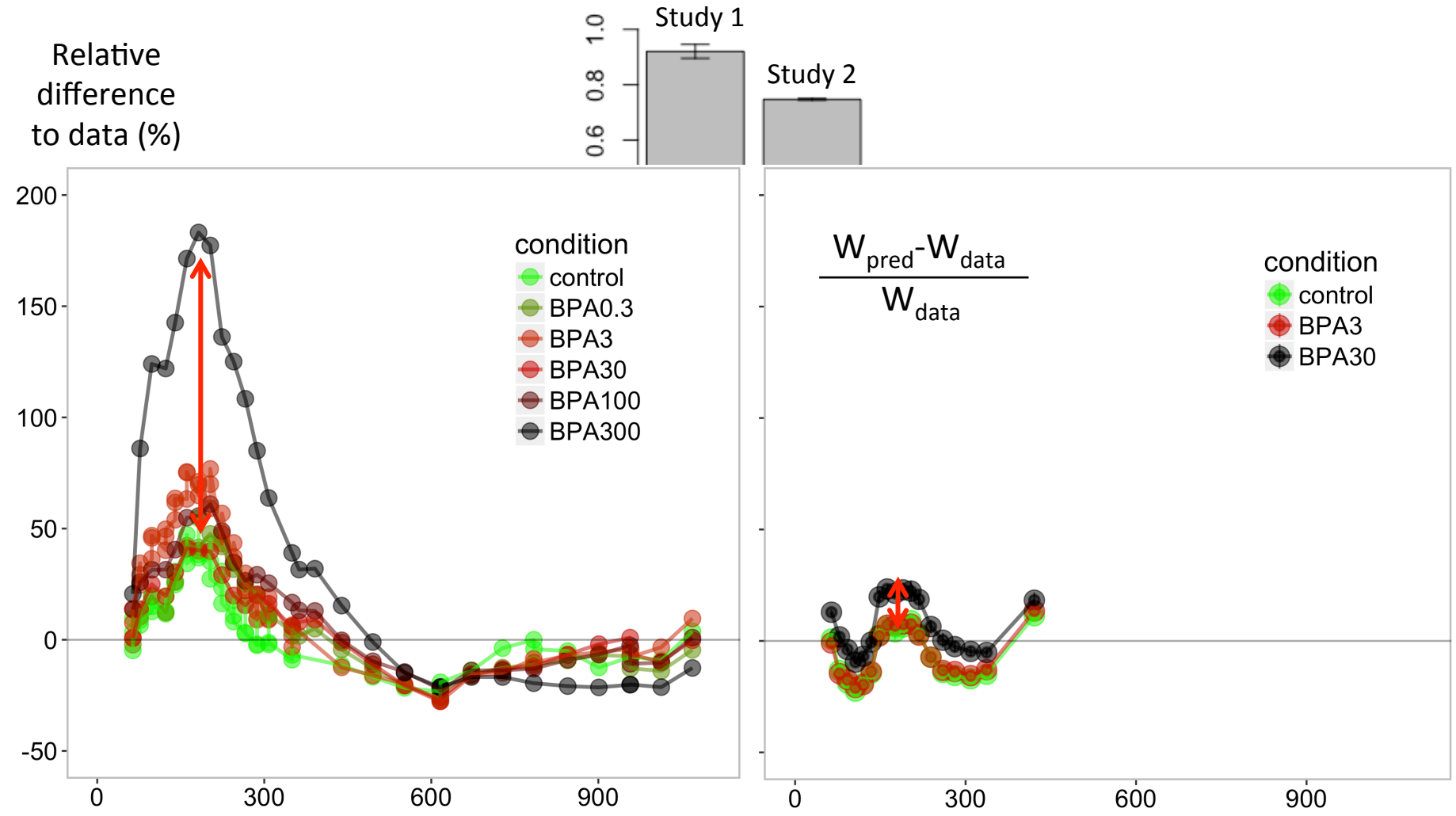

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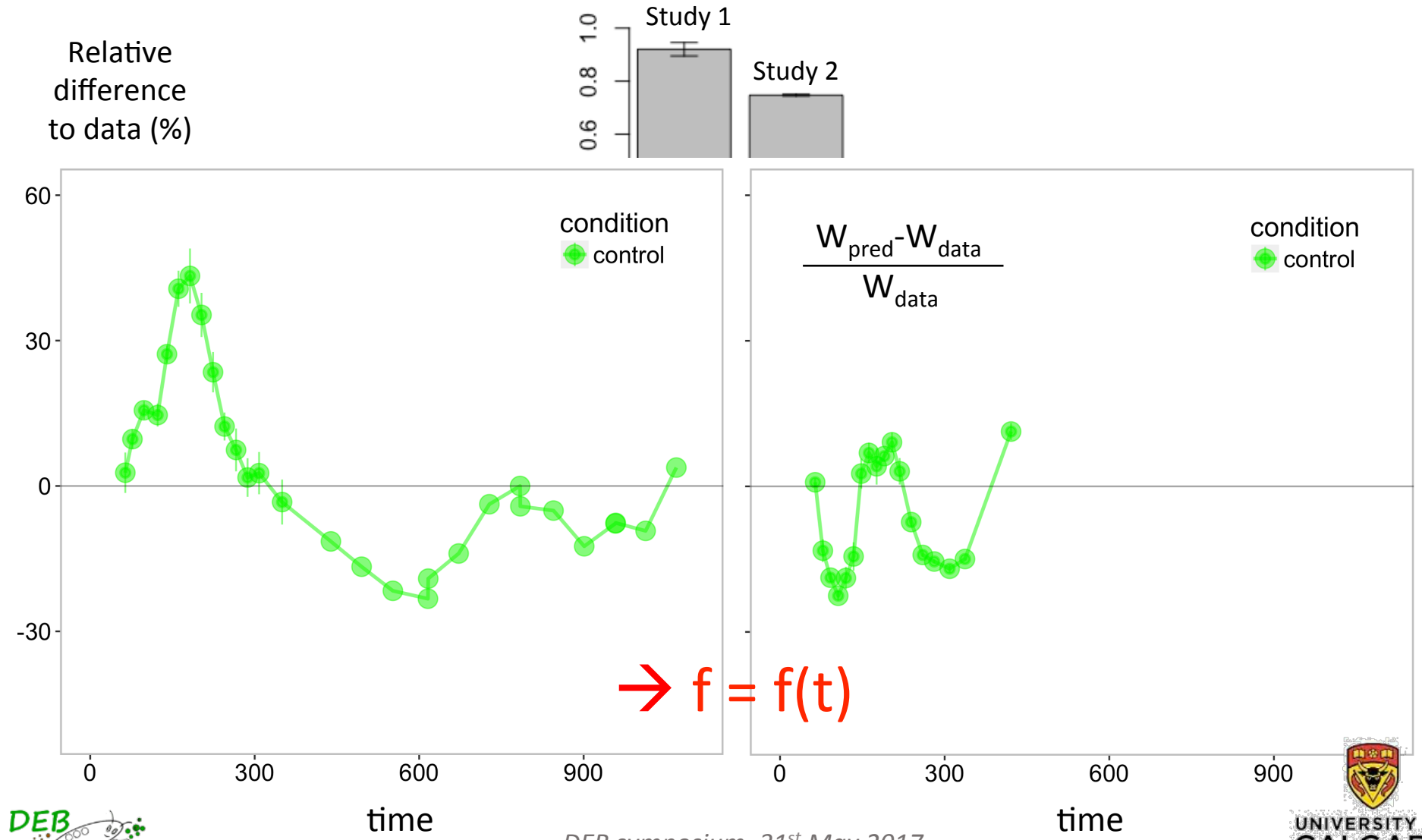

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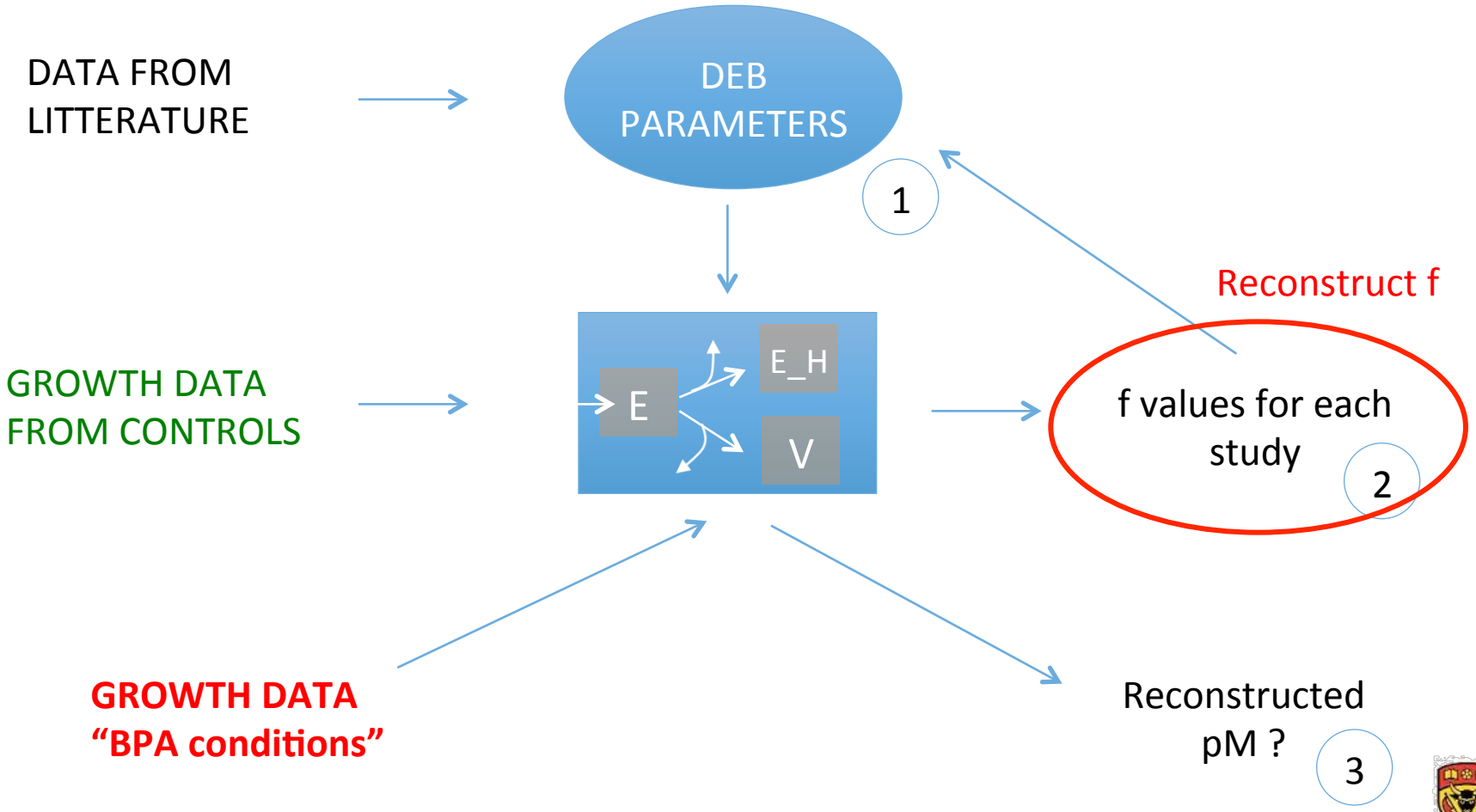

DATA FROM LITTERATURE
DEB PARAMETERS
1
Reconstruct f
GROWTH DATA FROM CONTROLS
E
E_H
V
f values for each study
2
GROWTH DATA "BPA conditions"
Reconstructed pM ?
3

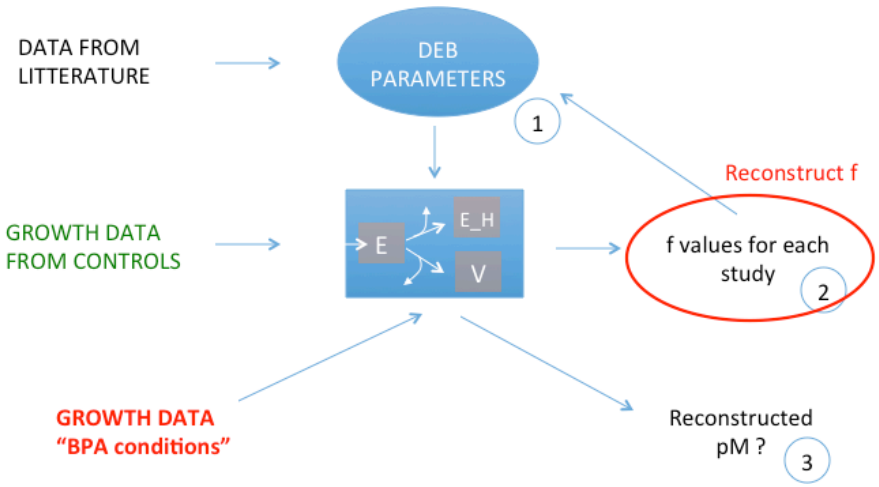
CONCLUSIONS

What we learned so far:

- Both studies had probably different food supplies

- Food varies over time for both studies

- An other DEB parameter varies over time



AKNOWLEDGEMENTS

Dr. VIJAYAN

The stress lab

Dr. AUGUSTINE

NSERC CRSNG

Forskningsrådet