Assessing the Effects of Parental Traits On the Production of Hatchery Spring Chinook Salmon Minijacks

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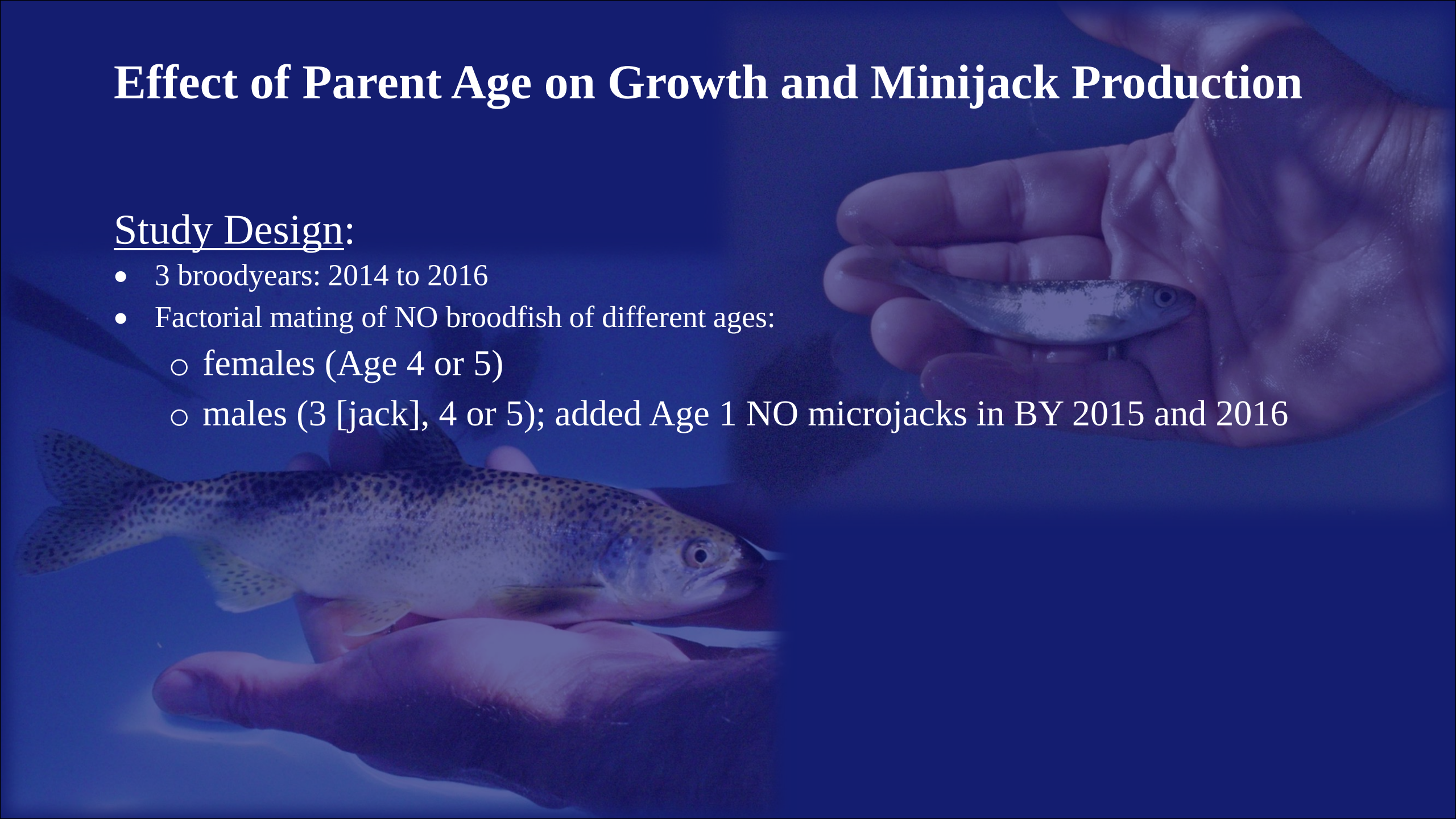
Effect of Parent Age on Growth and Minijack Production

Study questions:

- Is the proportion of minijacks produced by natural origin (NO) Yakima River spring Chinook broodstock affected by parental age and other phenotypic traits?
- Is body size of fry at emergence (swim up) and at smolt stage affected by parental age or other parental phenotypic traits?

Effect of Parent Age on Growth and Minijack Production



Study Design:

- 3 broodyears: 2014 to 2016
- Factorial mating of NO broodfish of different ages:
  - females (Age 4 or 5)
  - males (3 [jack], 4 or 5); added Age 1 NO microjacks in BY 2015 and 2016

Effect of Parent Age on Growth and Minijack Production

Hatchery Origin
Age 2 Minijack

Natural Origin
Age 1 Microjack
Matures in first year

Effect of Parent Age on Growth and Minijack Production

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BY14	**Females**	
Males	Age 4	Age 5
Age 3 Jack	200 eggs	200 eggs
Age 4	200 eggs	200 eggs
Age 5	200 eggs	200 eggs

BY15 & BY16	**Females**	
Males	Age 4	Age 5
Age 1 (micro-jack)	200 eggs	200 eggs
Age 3 Jack	200 eggs	200 eggs
Age 4	200 eggs	200 eggs
Age 5	200 eggs	200 eggs

Effect of Parent Age on Growth and Minijack Production

Females

Males

	Age	4	5	4	5	4	5	4	5
Age	Carc ID	F14-01	F14-02	F14-03	F14-04	F14-05	F14-06	F14-07	F14-08
3	M14-01								
4	M14-02								
5	M14-03								
3	M14-04								
4	M14-05								
5	M14-06								
3	M14-07								
4	M14-08								
5	M14-09								
3	M14-10								
4	M14-11								
5	M14-12								

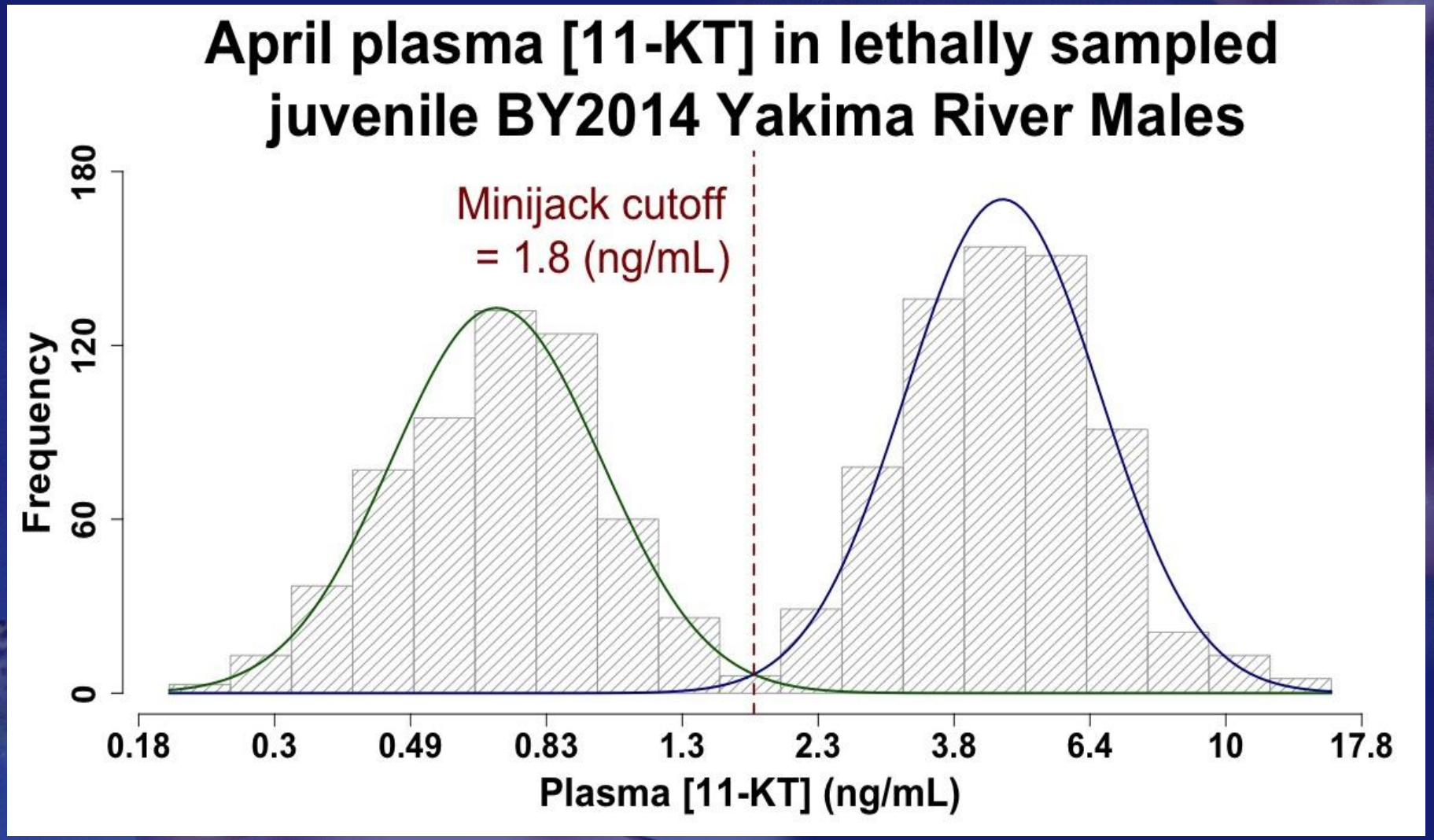
Effect of Parent Age on Growth and Minijack Production

Study Design:

- 3 broodyears: 2014 to 2016
- Factorial mating of NO broodfish of different ages:
  - females (Age 4 or 5)
  - males (3 [jack], 4 or 5); added Age 1 NO microjacks in BY 2015
- Rear juveniles (50 fry per mating) to smolt stage (April) in common environment
- Blood samples collected for 11-KT assays
- Tissue samples collected for genotyping and parentage analysis
- **One Time for BY 2014**

– Live sampled juveniles 11KT, PIT tagged and then reared to full maturity (Sept)

– to confirm April 11-KT measures reflect actual male maturation (minijack) status in September – draft manuscript in prep with L. Medeiros lead author



Established a maturation threshold ("cutoff") of 1.8 ng/mL in fish lethally sampled in April of 2016 (n = 1,224). [Slide produced by L. Medeiros.]

BY 2014 Sampling Completed

Number

1,254 - smolts sampled April 2016

459 - PIT tagged April, sacrificed Sept 2016

1,414 - smolts with data for both 11-KT + genotypes

57 - full sib progeny groups with both parents of known age, (n=1,170; average = 21 males/progeny group)

BY 2015

- All factorial crosses made
- Smolts were sampled April 2017
- 11-KT and genotype analyses completed by Fall 2017

BY 2016

- All factorial crosses made
- Smolts will be sampled April 2018
- 11-KT and genotype analyses completed by Fall 2018

Fry Samples

BY 2014

Number

370 - NO fry sampled March 2015

5 fry per factorial mating; parents of known age, length, body wt, egg size, etc.

BY 2015

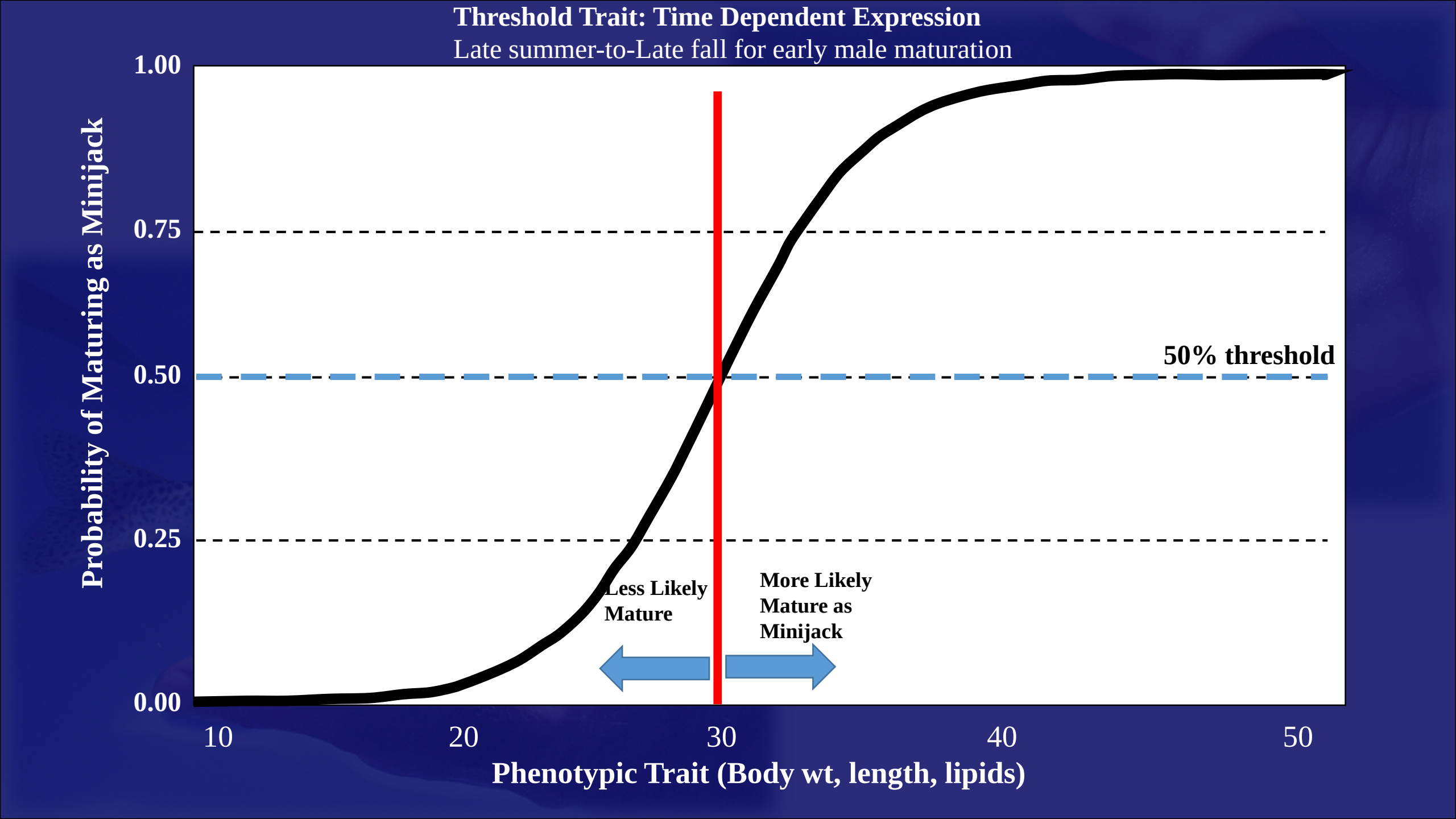
Number

305 - NO fry sampled March 2016

BY 2016

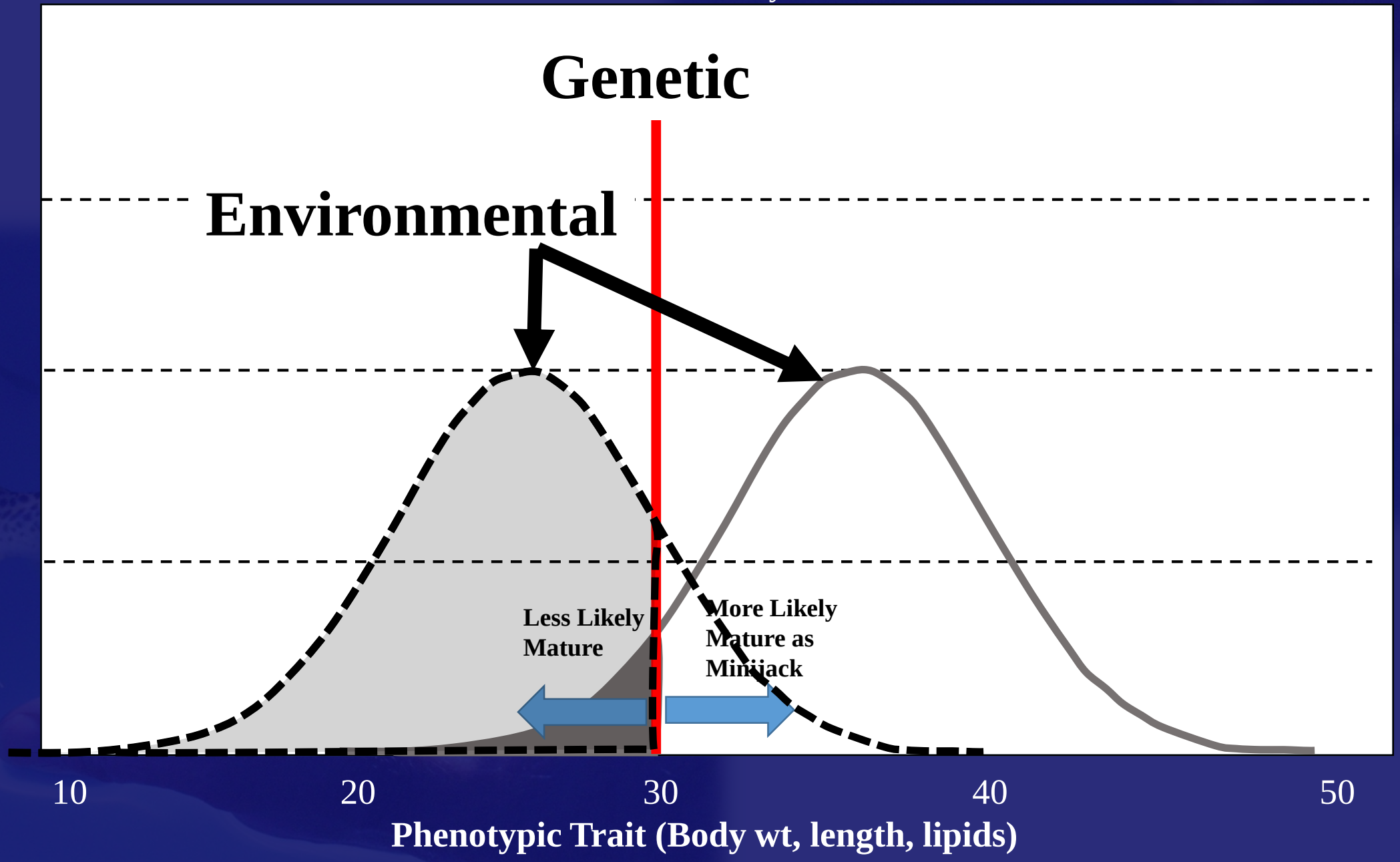
Number

xxx - NO fry sampled March 2017

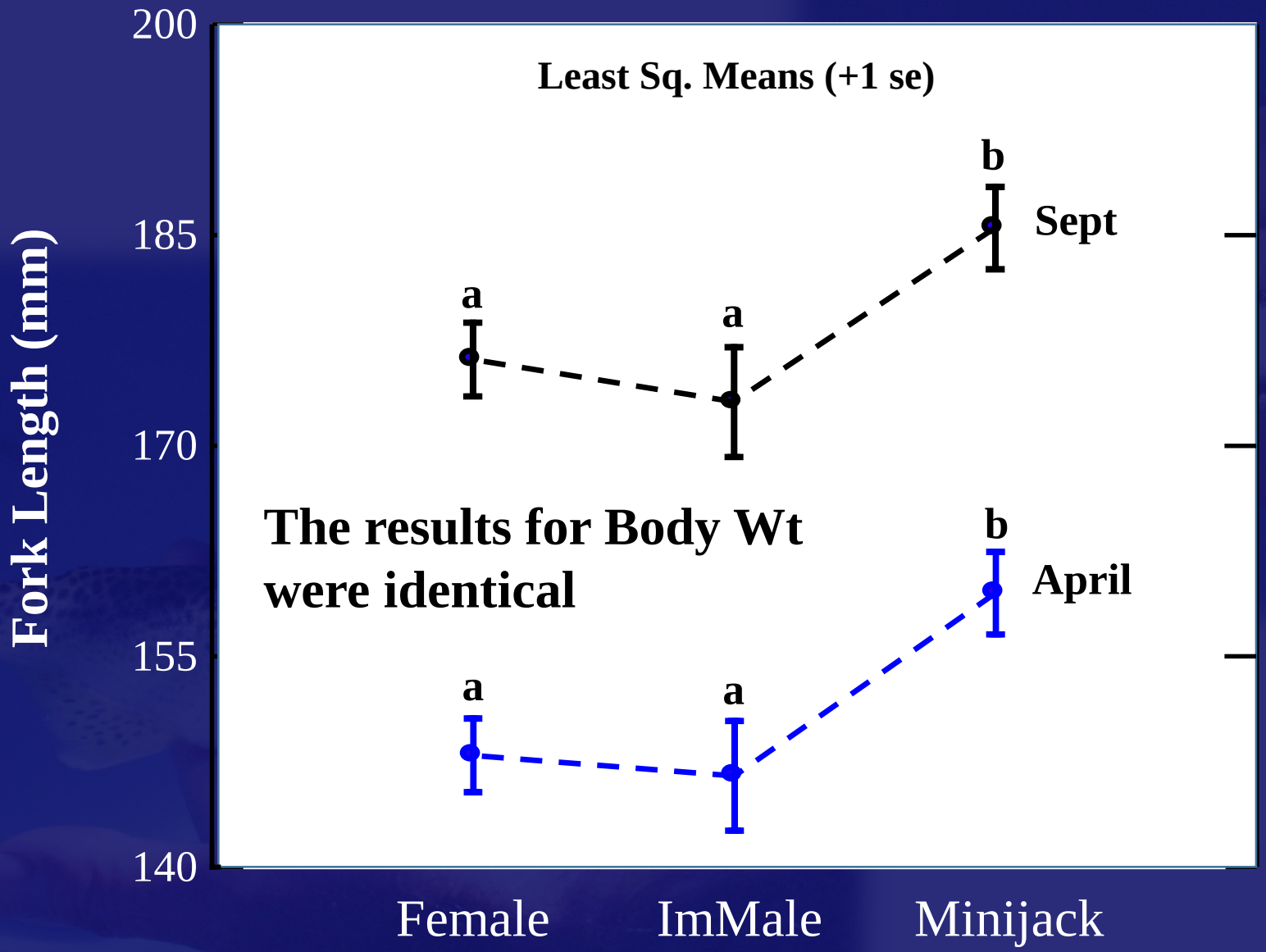

Threshold Trait: Time Dependent Expression
Late summer-to-Late fall for early male maturation
1.00
0.75
0.50
0.25
0.00
Probability of Maturing as Minijack
50% threshold
Less Likely Mature
More Likely Mature as Minijack
10
20
30
40
50
Phenotypic Trait (Body wt, length, lipids)

Threshold Trait: Time Dependent Expression

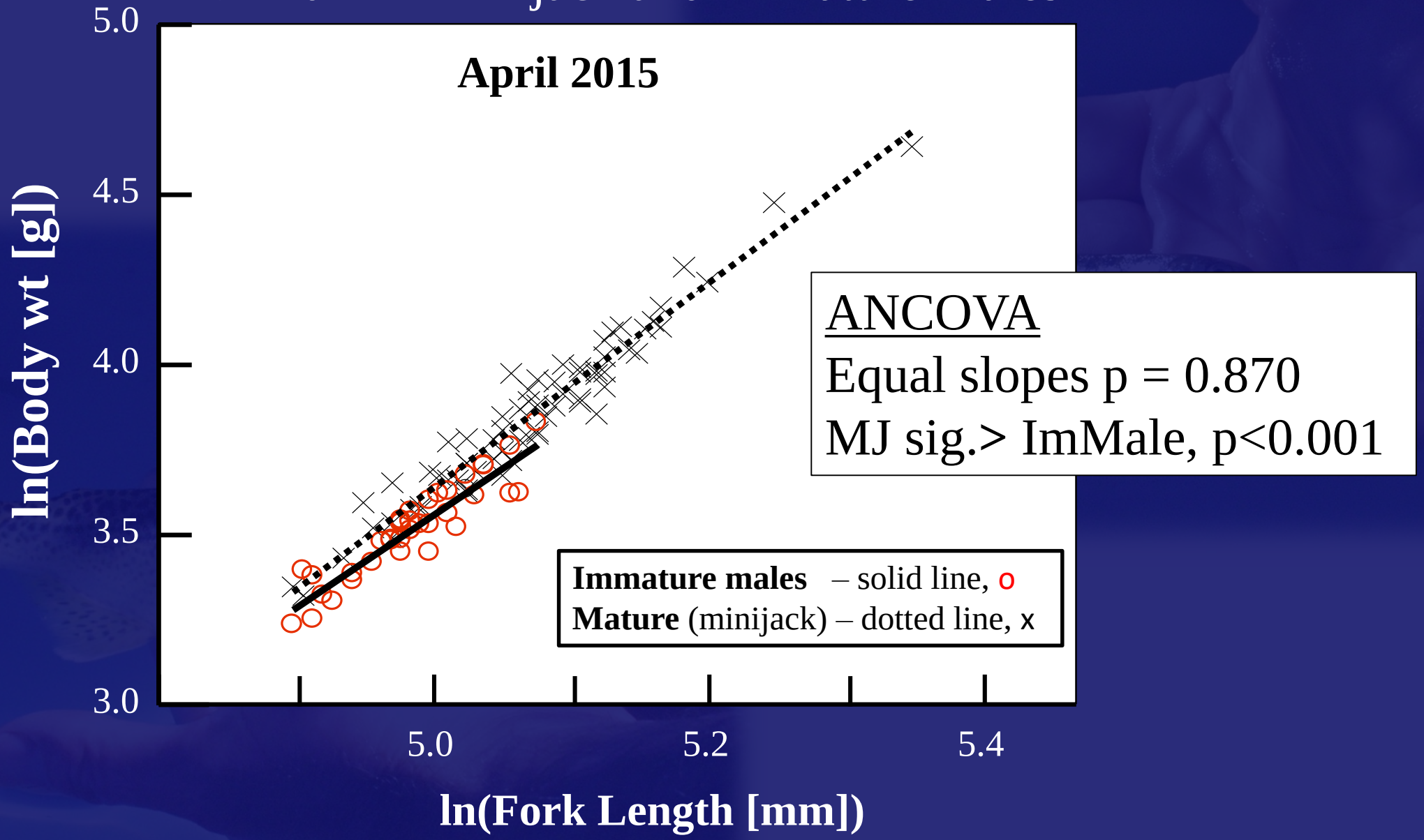
Late summer-to-Late fall for early male maturation



BY14 Smolt Data



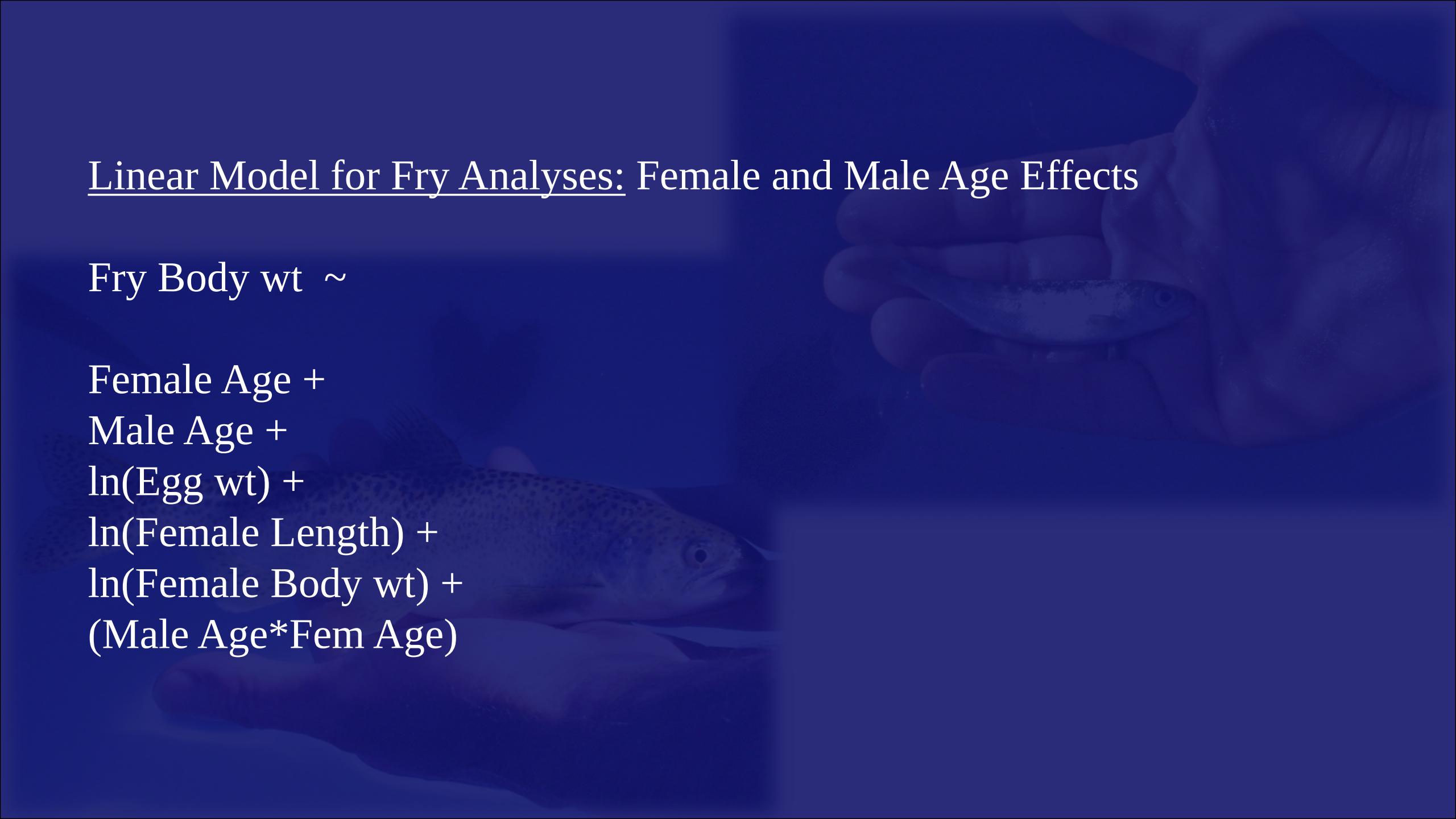
BY2014 – Minijack and Immature Males



ANCOVA

Equal slopes p = 0.870

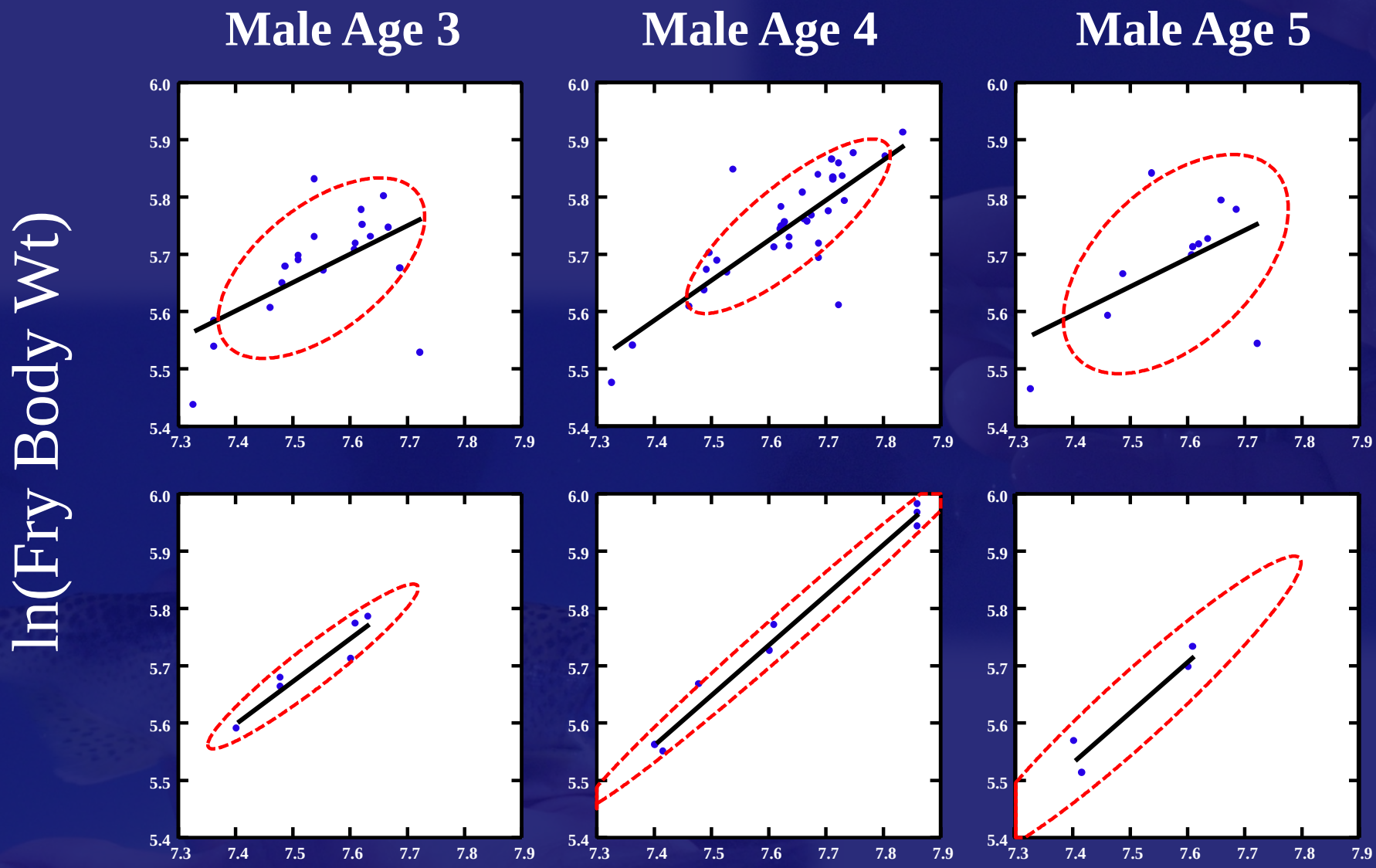
MJ sig.> ImMale, p<0.001

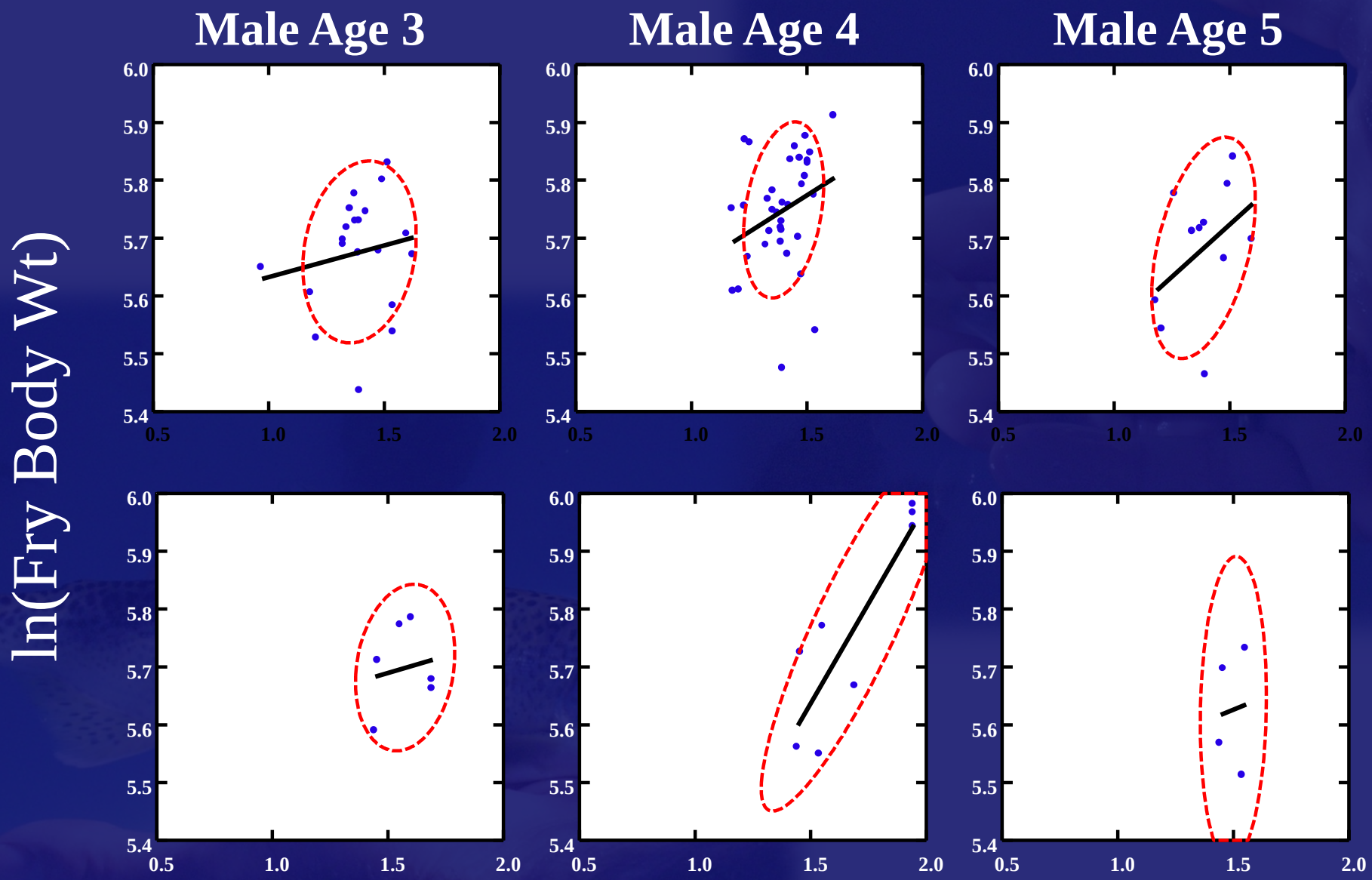


Linear Model for Fry Analyses: Female and Male Age Effects

Fry Body wt ~

Female Age +
Male Age +
ln(Egg wt) +
ln(Female Length) +
ln(Female Body wt) +
(Male Age*Fem Age)


Male Age 3
Male Age 4
Male Age 5
ln(Fry Body Wt)
ln(Egg wt)
Female Age 4
Female Age 5
6.0
5.9
5.8
5.7
5.6
5.5
5.4
7.3
7.4
7.5
7.6
7.7
7.8
7.9


Male Age 3
Male Age 4
Male Age 5
ln(Fry Body Wt)
ln(Female Body Wt)
Female Age 4
Female Age 5
6.0
5.9
5.8
5.7
5.6
5.5
5.4
0.5
1.0
1.5
2.0

Linear Model for Fry

Fry Body wt ~

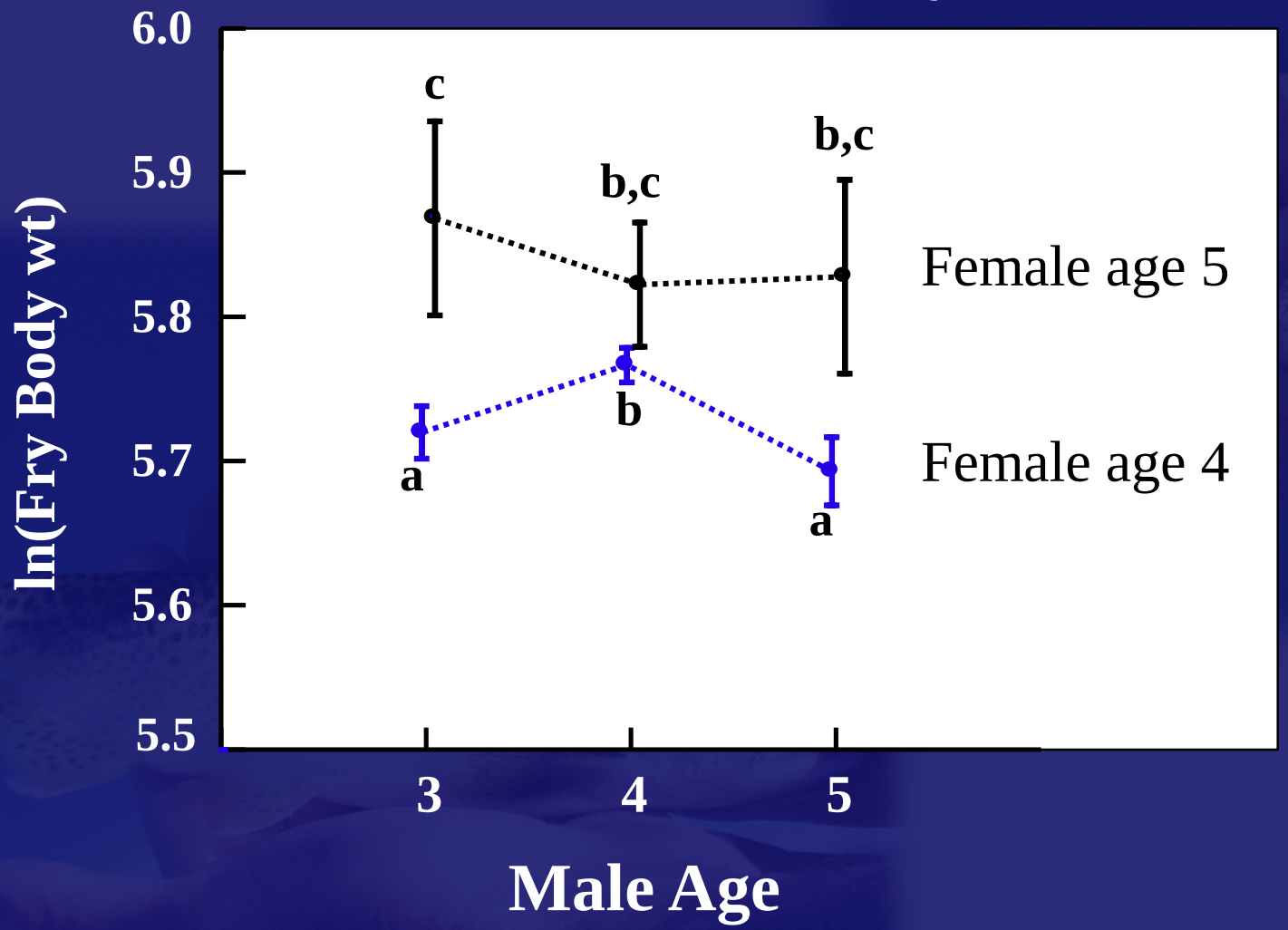
Female Age +
Male Age +
ln(Egg wt) +
ln(Female Length) +
ln(Female Body wt) +
(Male Age*Fem Age)

BY2014

Analysis of Variance

Source	Type III SS	df	Mean Squares	F-ratio	p-value
Female Age	0.09039	1	0.09039	21.65248	0.00001
Male Age	0.01498	2	0.00749	1.79431	0.16846
ln(Egg W)	0.13667	1	0.13667	32.73858	<0.00001
LN_POHP (female)	0.18481	1	0.18481	44.27144	<0.00001
LN_BW (female)	0.34511	1	0.34511	82.66974	<0.00001
Male Age*Fem Age	0.03724	2	0.01862	4.46057	0.01253
Error	1.00606	241	0.00417		

BY2014 Fry


6.0
5.9
5.8
5.7
5.6
5.5
ln(Fry Body wt)
c
b,c
b,c
b
a
a
3
4
5
Male Age
Female age 5
Female age 4

Logistic Regression Model Minijack:

Pr(Mature as MJ) ~ JuvMale FL* + JuvMale BdWt*

* These are phenotypic data from individual juvenile males. Once parentage analysis is completed we can identify all the Adult related traits for that individual male.

Full Juvenile Model:

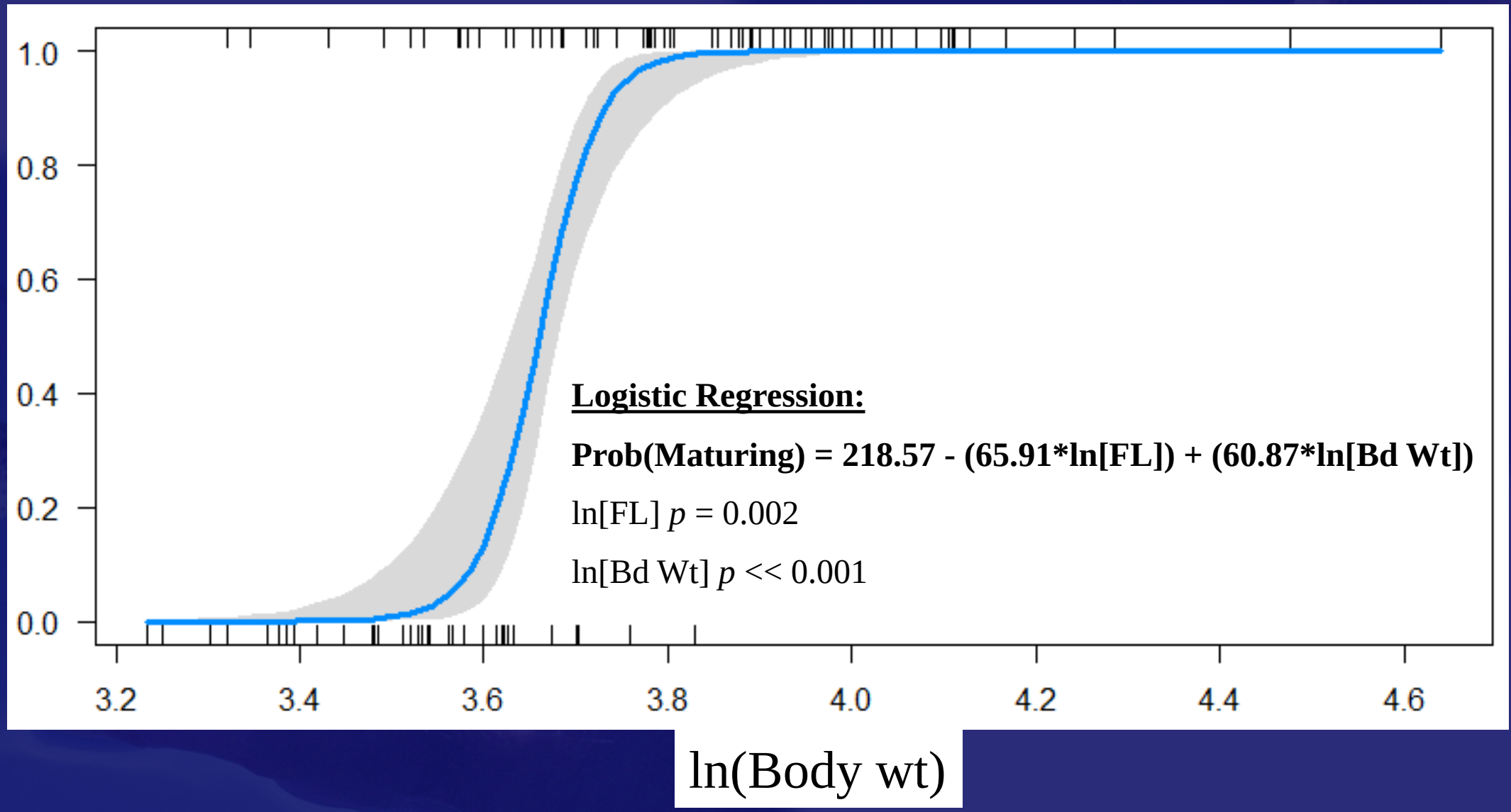
Prob(Mature as MiniJk) ~ ln(Male FL) + ln(Male Bd Wt)

BY2014 Logistic Regression Model selection table:

Intercept	lnBW	lnFL	df	logLik	AICc	delta	weight
218.6000	30.870	-65.91	3	-34.831	75.9	0.00	0.998
-34.7300	9.644		2	-42.052	88.2	12.32	0.002
-106.9000		21.40	2	-51.364	106.8	30.95	0.000
0.5671			1	-68.723	139.5	63.59	0.000

Output from *dredge* option in *MuMin* package (R software)

BY14 Minijack April Samples



Logistic Regression Model:

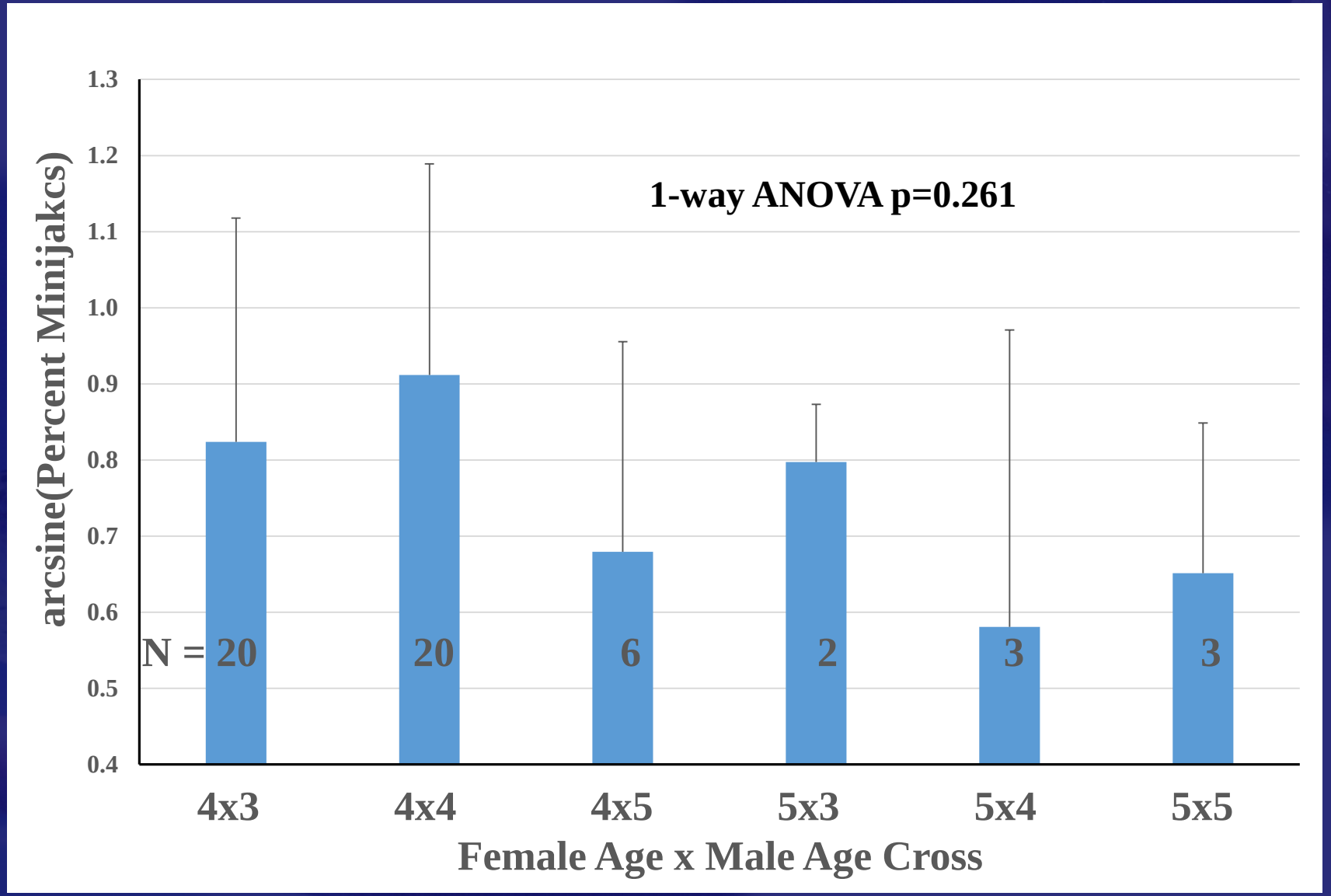
Pr(Mature as MJ) ~ JuvMale FL + JuvMale BdWt +

Next Step Include Adult Traits

Sire age + Dam age + Sire FL+ Sire BdWt + Dam FL + Dam BdWt +

Dam Egg wt + Fry Condition Factor

BY2014 arcsin(Percent Minijacks) + 1 sd



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CRITFC personnel:

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