Report: Testing hybrid vigor in the lab in response to Eimeria

Alice

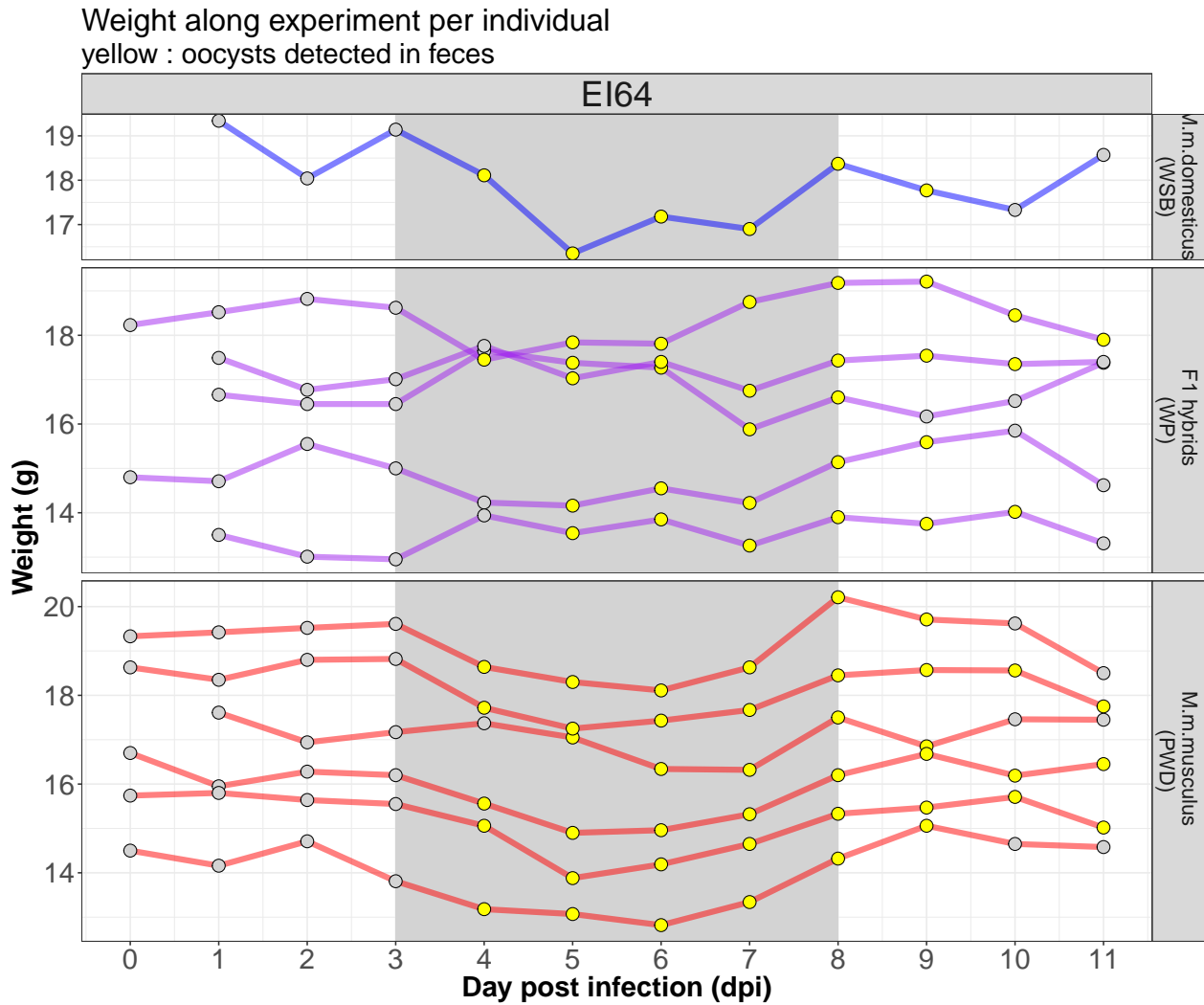*28 August 2018*

Contents
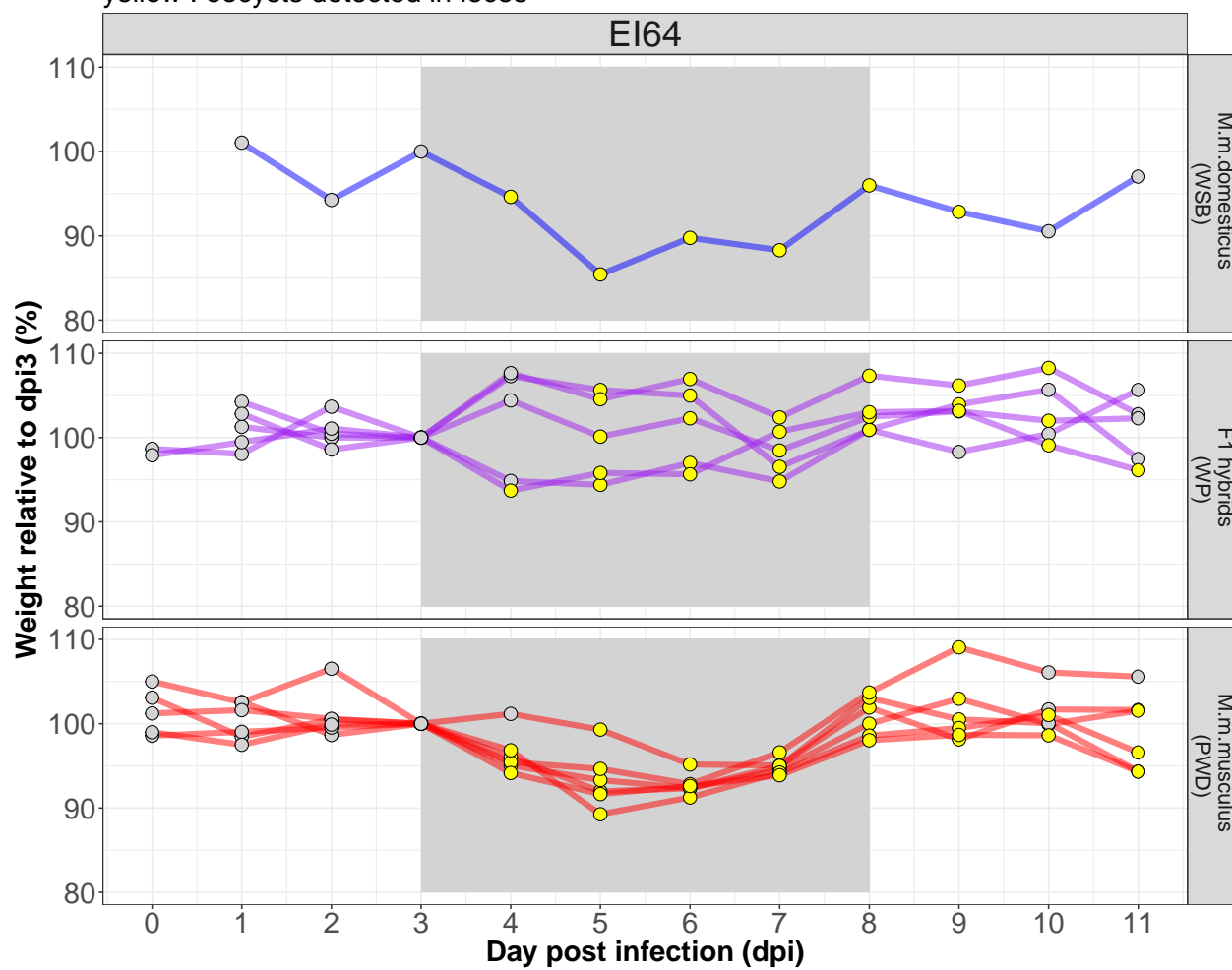
Expe_001, March 2017, Francisca's experiment. infection with E64 and Eflab

1. Weight loss

Weight along experiment per individual
yellow : oocysts detected in feces

Relative weight along experiment compared to dpi3
yellow : oocysts detected in feces

EI64

M.m.domesticus (WSB)
F1 hybrids (WP)
M.m.musculus (PWD)

Weight relative to dpi3 (%)

Day post infection (dpi)

Mean relative weight along experiment compared to dpi3

For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).

Maximum weigth loss during the symptomatic phase
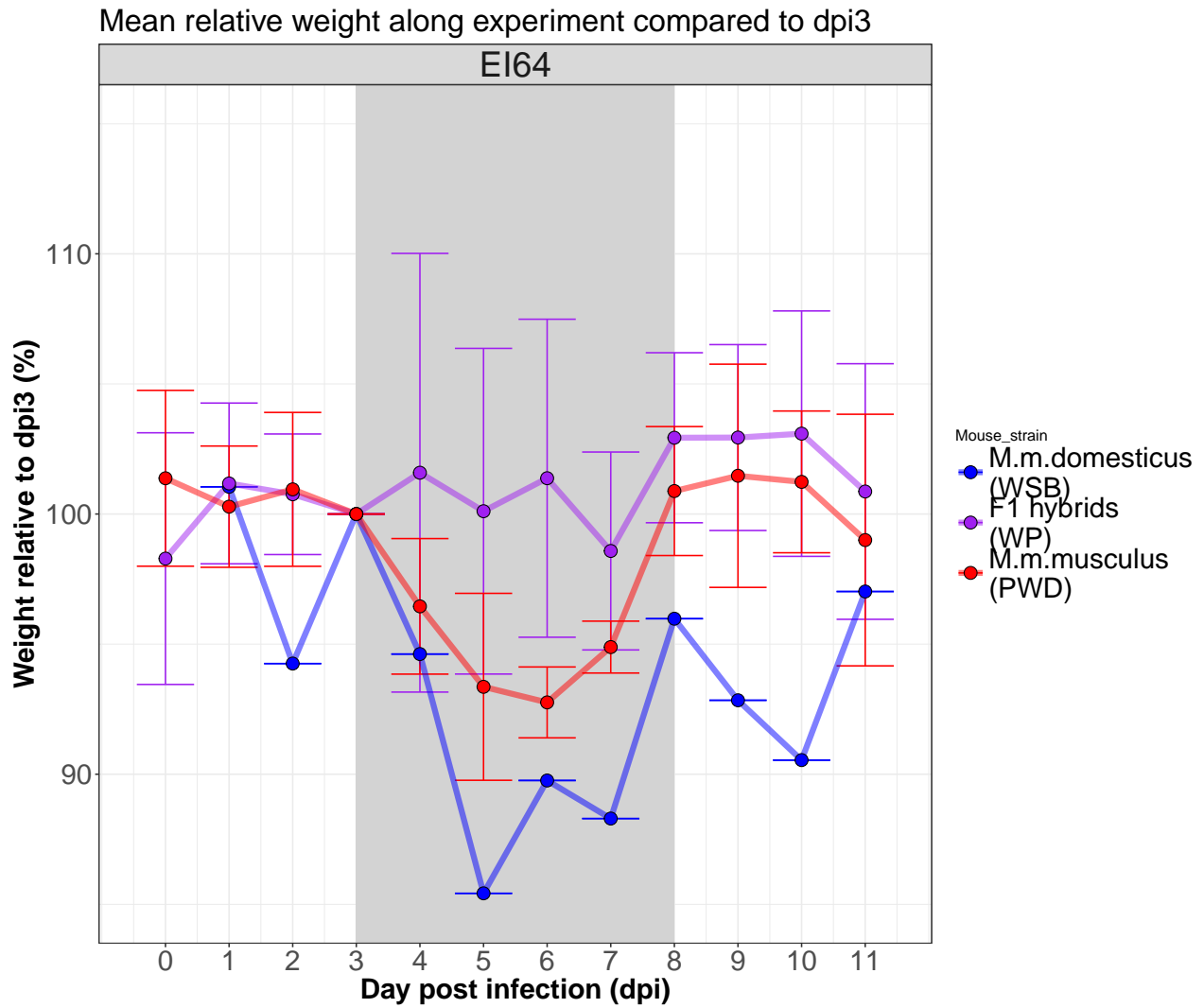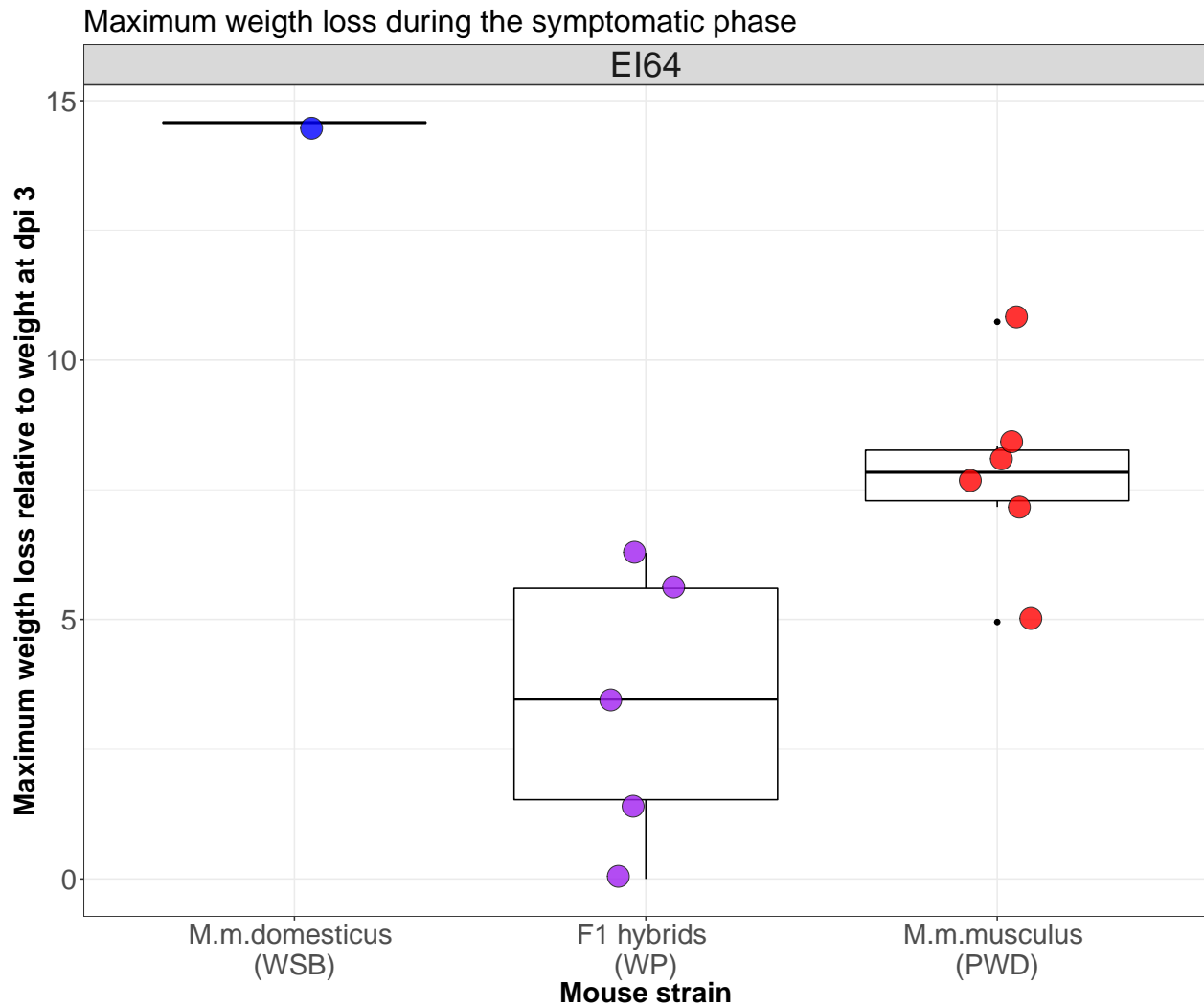

```
##
## Call:
## lm(formula = relativeWeight ~ Mouse_strain, data = max.loss_001)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.9271 -0.9534 -0.0448  0.9445  3.3754
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                       96.625      1.008  95.836 7.44e-15
## Mouse_strainM.m.domesticus \n(WSB) -11.201      2.470  -4.536  0.00141
## Mouse_strainM.m.musculus \n(PWD)    -4.437      1.365  -3.250  0.00999
##
## (Intercept)                     ***
## Mouse_strainM.m.domesticus \n(WSB) **
## Mouse_strainM.m.musculus \n(PWD)    **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.254 on 9 degrees of freedom
```
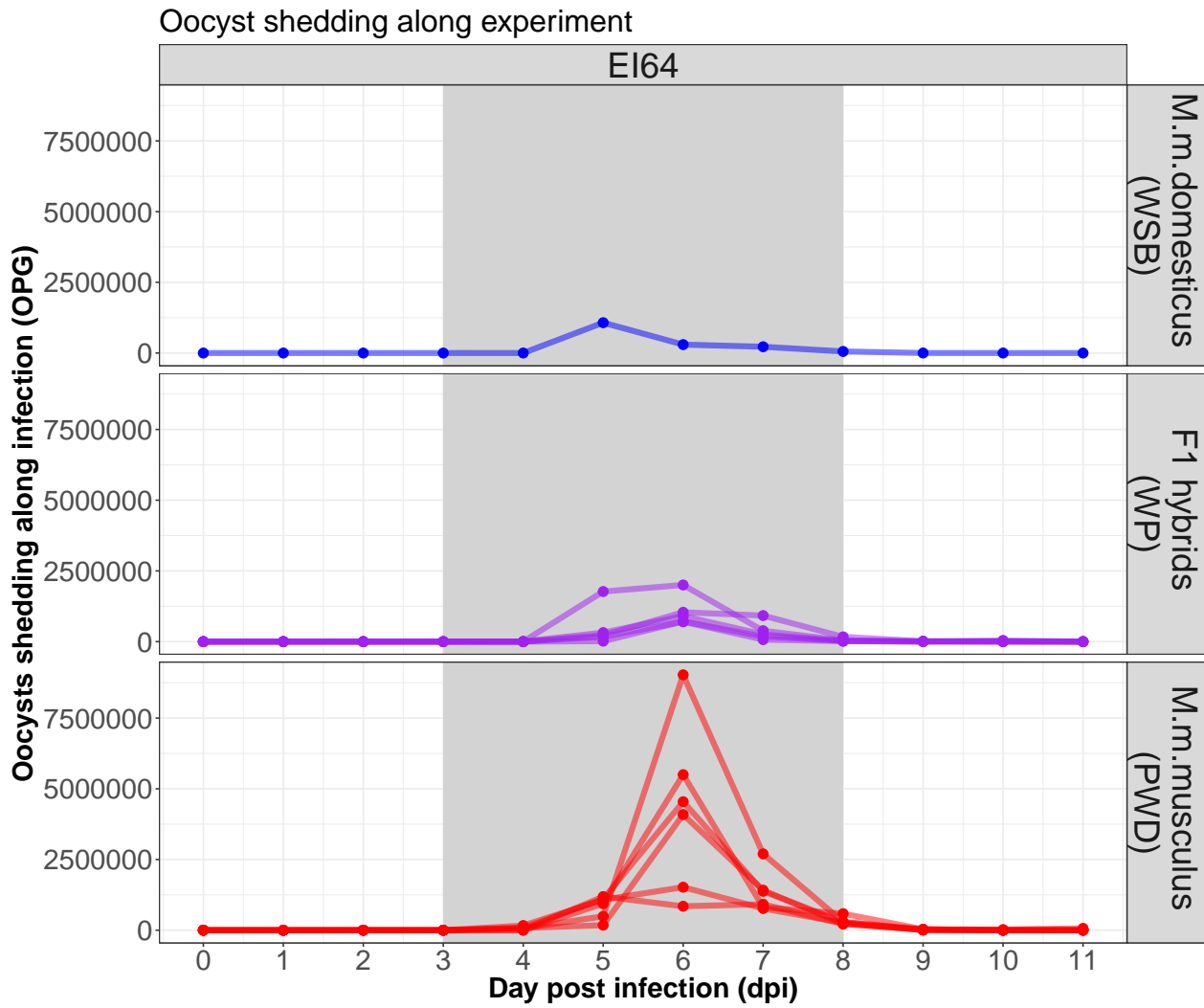
```
## Multiple R-squared:  0.7311, Adjusted R-squared:  0.6714
## F-statistic: 12.24 on 2 and 9 DF,  p-value: 0.002711
```

2. Parasite shedding

Oocyst shedding along experiment

Mean oocysts shedding along experiment

Sum of oocysts shed along the experiment
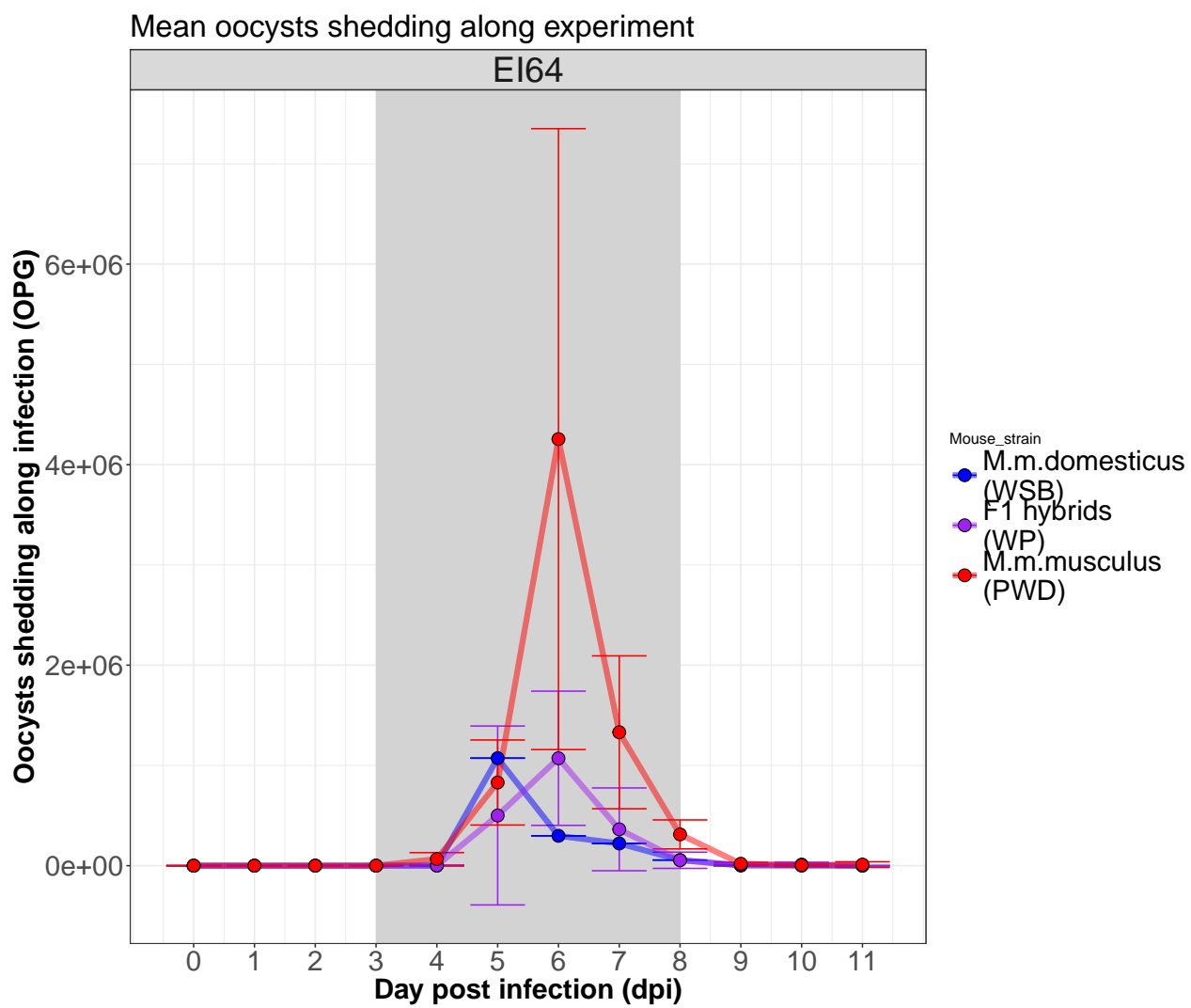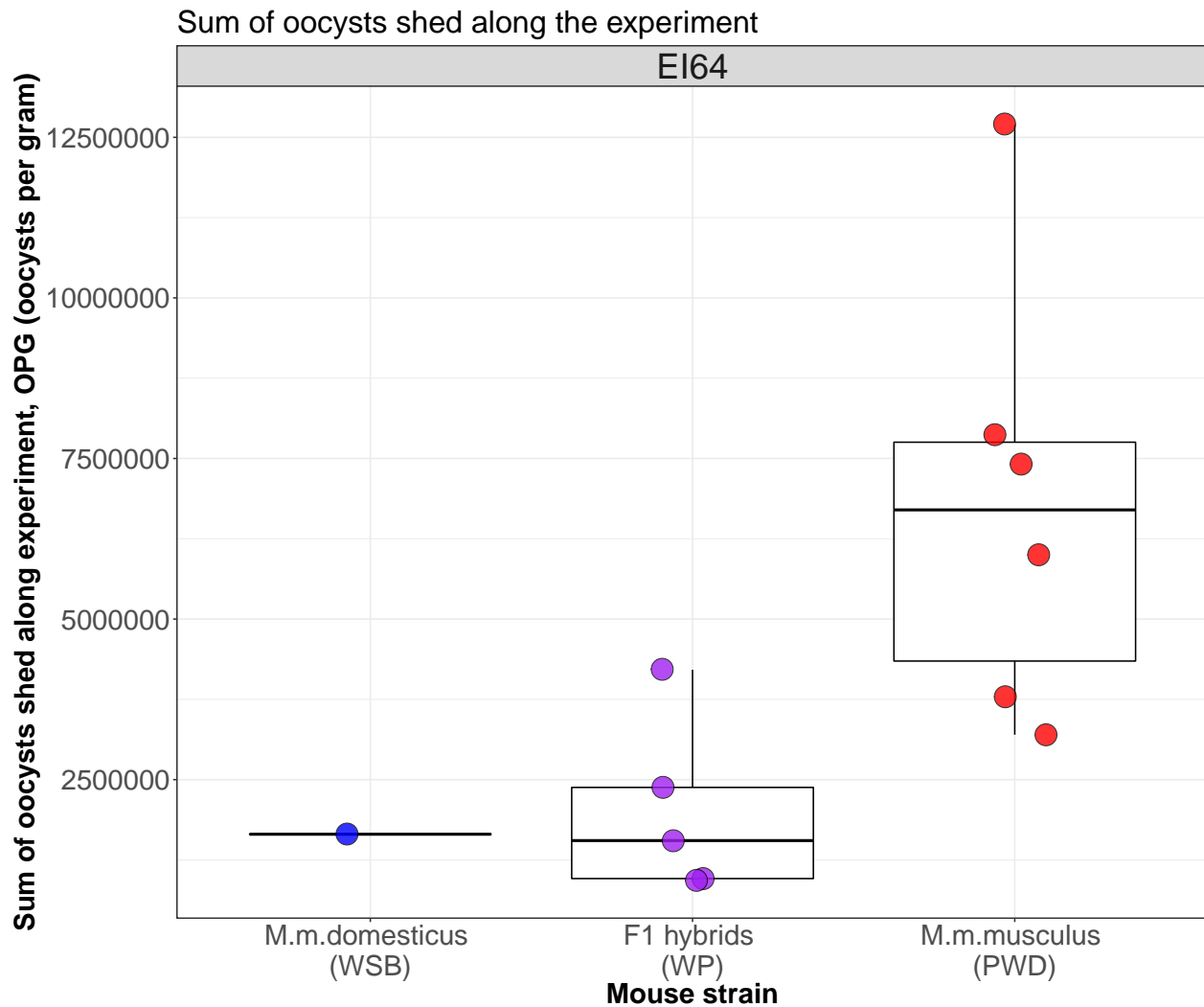
```
##
## Call:
## lm(formula = sum.oo ~ Mouse_strain, data = sum.oocysts_001)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3628205 -1053694  -228126   693597  5872235
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     2007347    1214692   1.653   0.1328
## Mouse_strainM.m.domesticus \n(WSB)  -357449    2975376  -0.120   0.9070
## Mouse_strainM.m.musculus \n(PWD)    4820216    1644701   2.931   0.0167 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2716000 on 9 degrees of freedom
## Multiple R-squared:  0.5187, Adjusted R-squared:  0.4117
## F-statistic: 4.849 on 2 and 9 DF,  p-value: 0.03724
```

3. Comparison host/parasite proxy
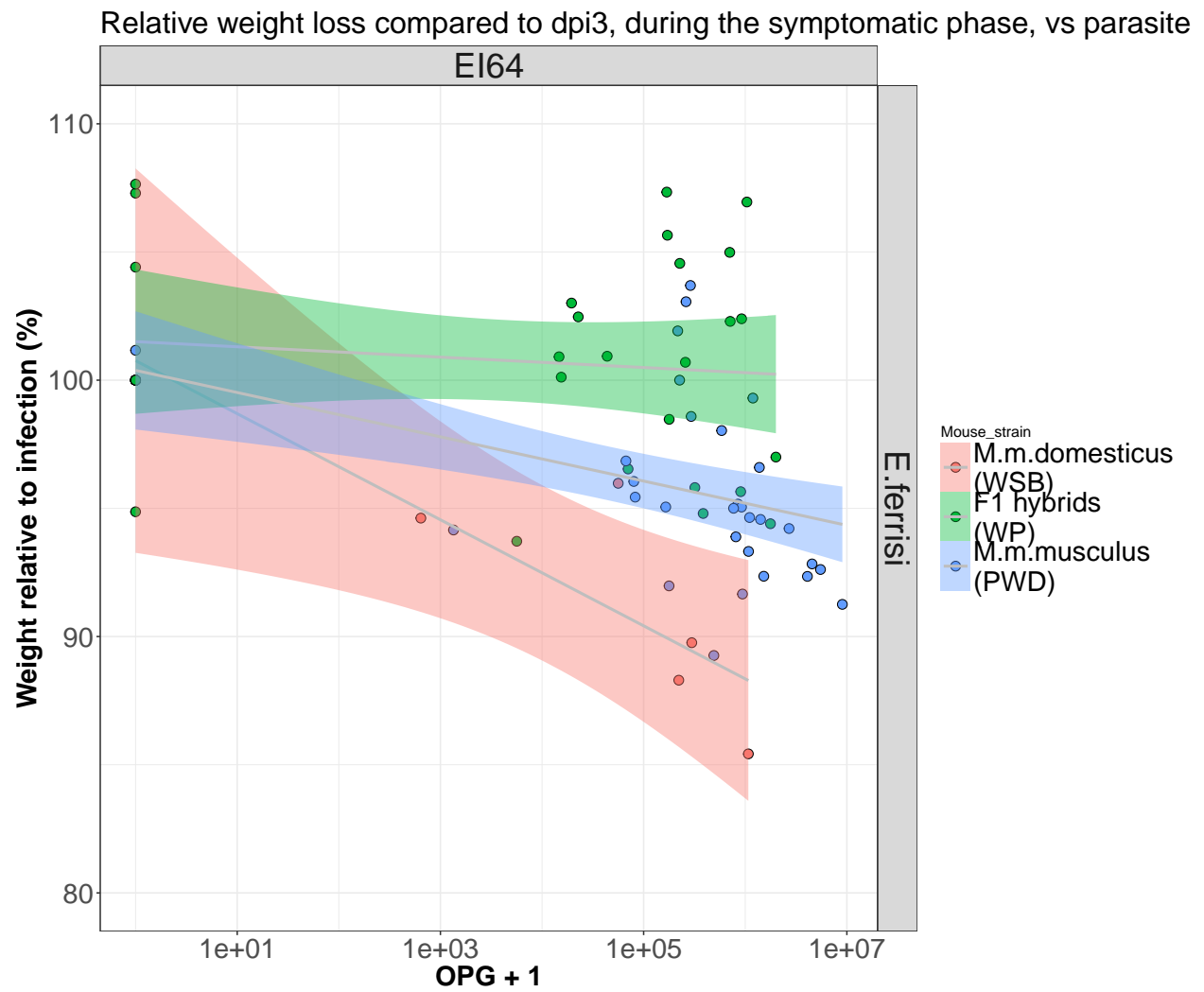

Figure 1: Weight as a function of OPG
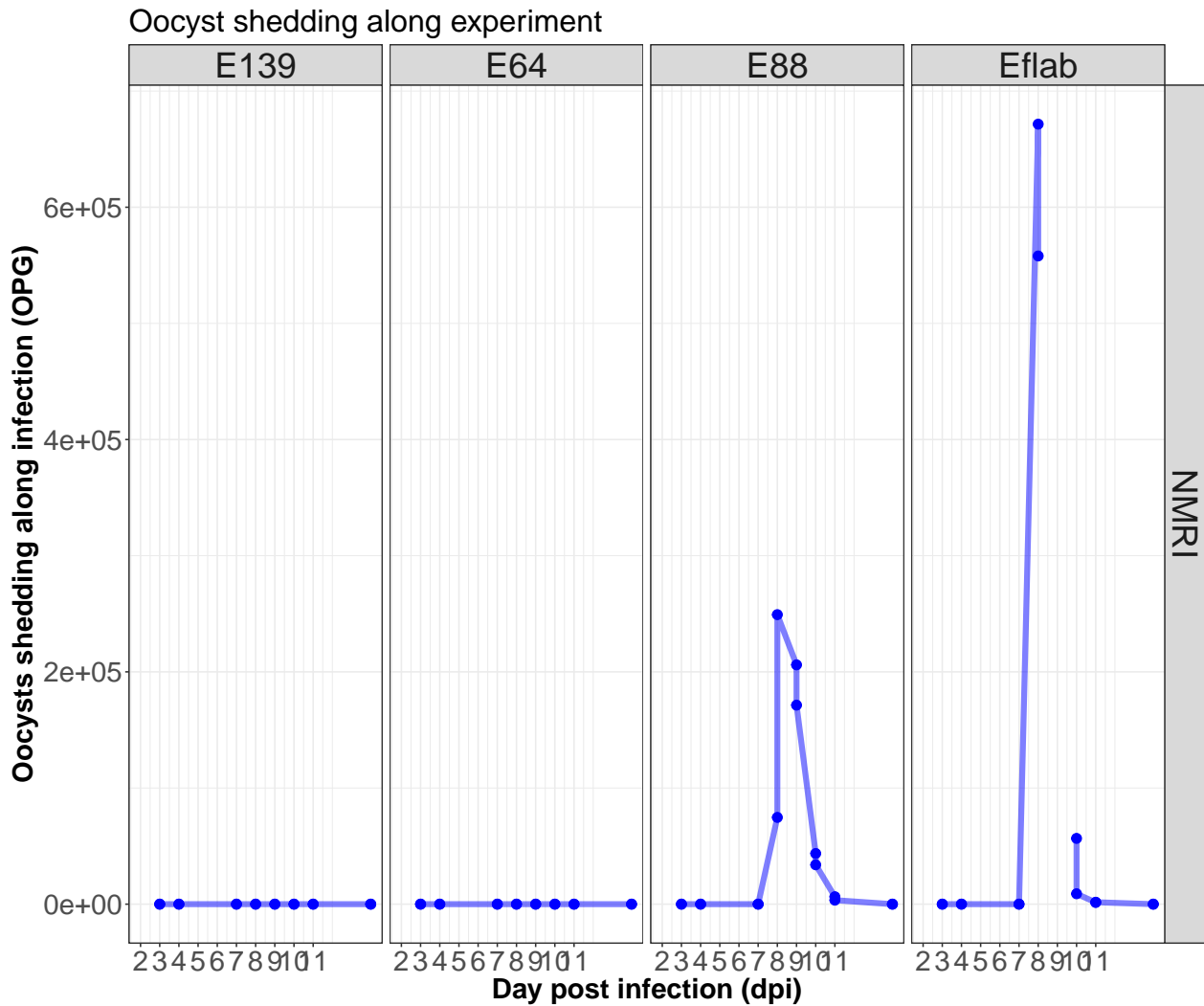
Pass001: Nov 2017, passaging 4 isolates (some missing data)

(Eflab, E88, E139, E64) in NMRI. 2 mice per cage. Only OPG recorded

Parasite shedding

Oocyst shedding along experiment

Expe_002: March 2018, NMRI mice infected with 4 *Eimeria* strains (Eflab, E88, E139, E64)

1. Weight loss

Weight along experiment per individual
yellow : oocysts detected in feces
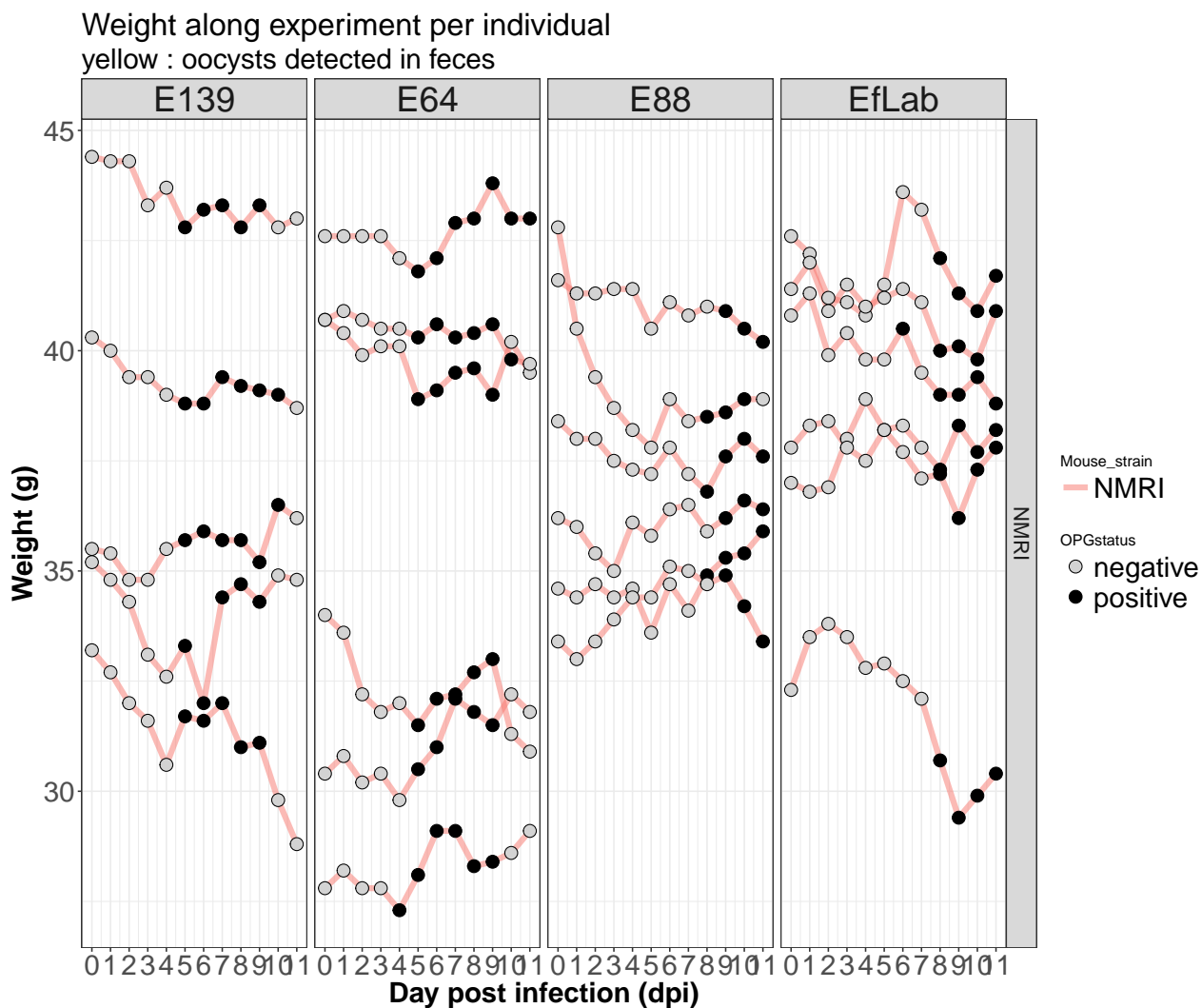
Relative weight along experiment compared to dpi0
yellow : oocysts detected in feces

Mean relative weight along experiment compared to dpi0

2. Parasite shedding

Oocyst shedding along experiment

Mean oocysts shedding along experiment

3. Comparison host/parasite proxy

Relative weight loss compared to dpi0, during the symptomatic phase, vs parasite
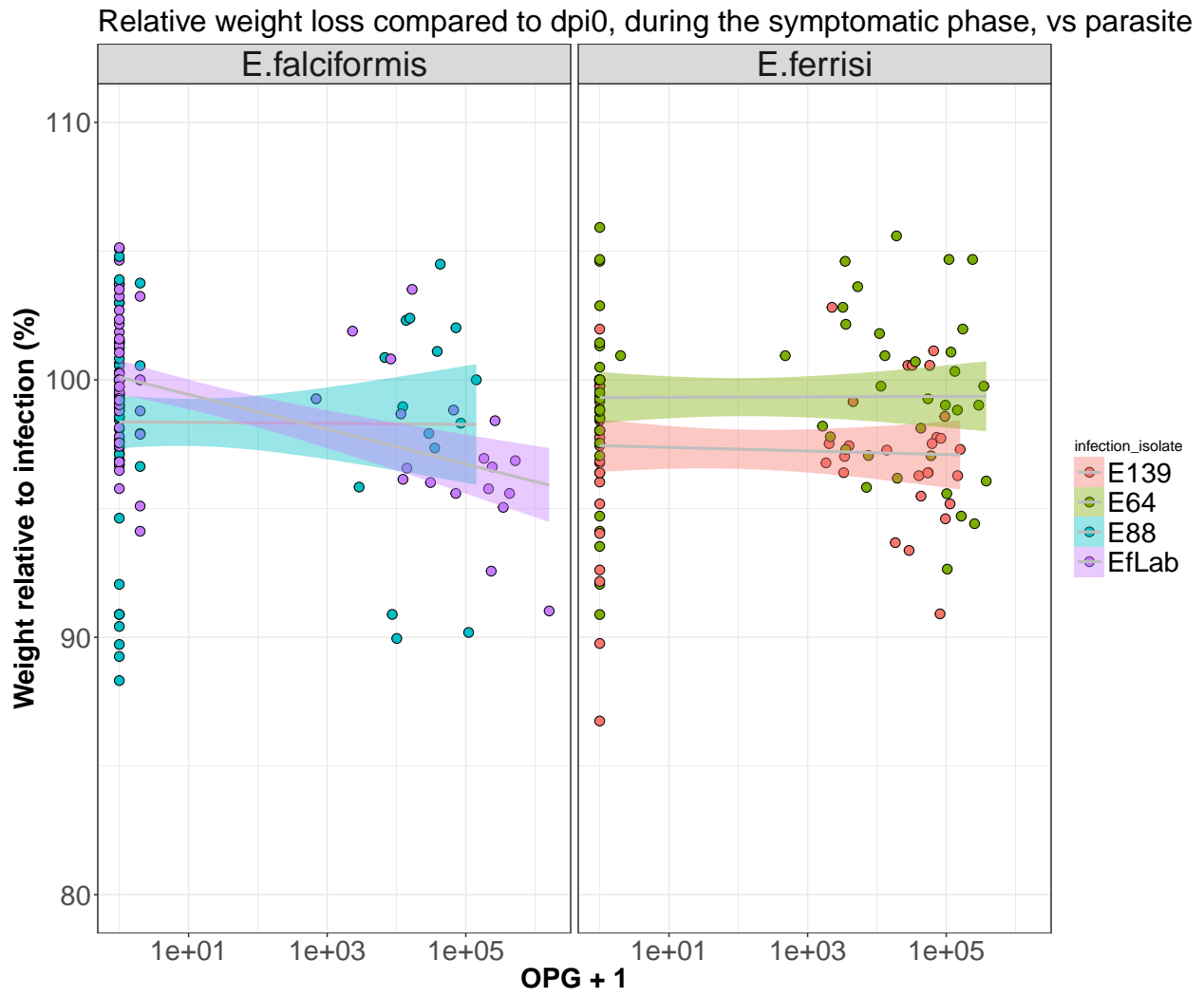
Figure 2: Weight as a function of OPG

Expe_003 & Expe_004, April-May 2018, first batch Parental strains (F0) BUSNA, STRA, SCHUNT, PWD, infection with Eferrisi (E64 and E139) [2 batches]

1. Weight loss

Weight along experiment per indiidual
yellow : oocysts detected in feces
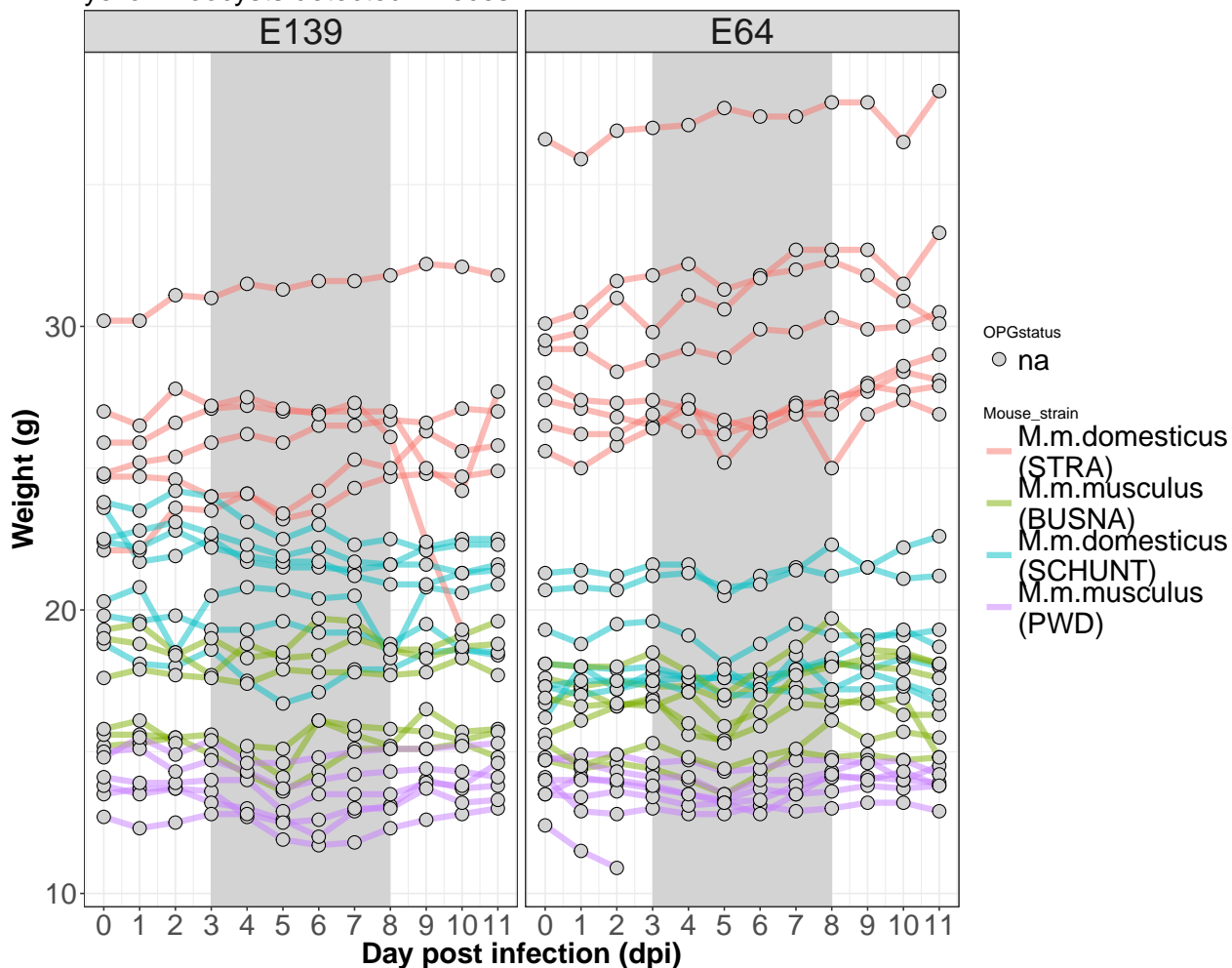
Relative weight along experiment compared to dpi3
yellow : oocysts detected in feces

Mean relative weight along experiment compared to dpi3

For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).

Maximum weigth loss during the symptomatic phase
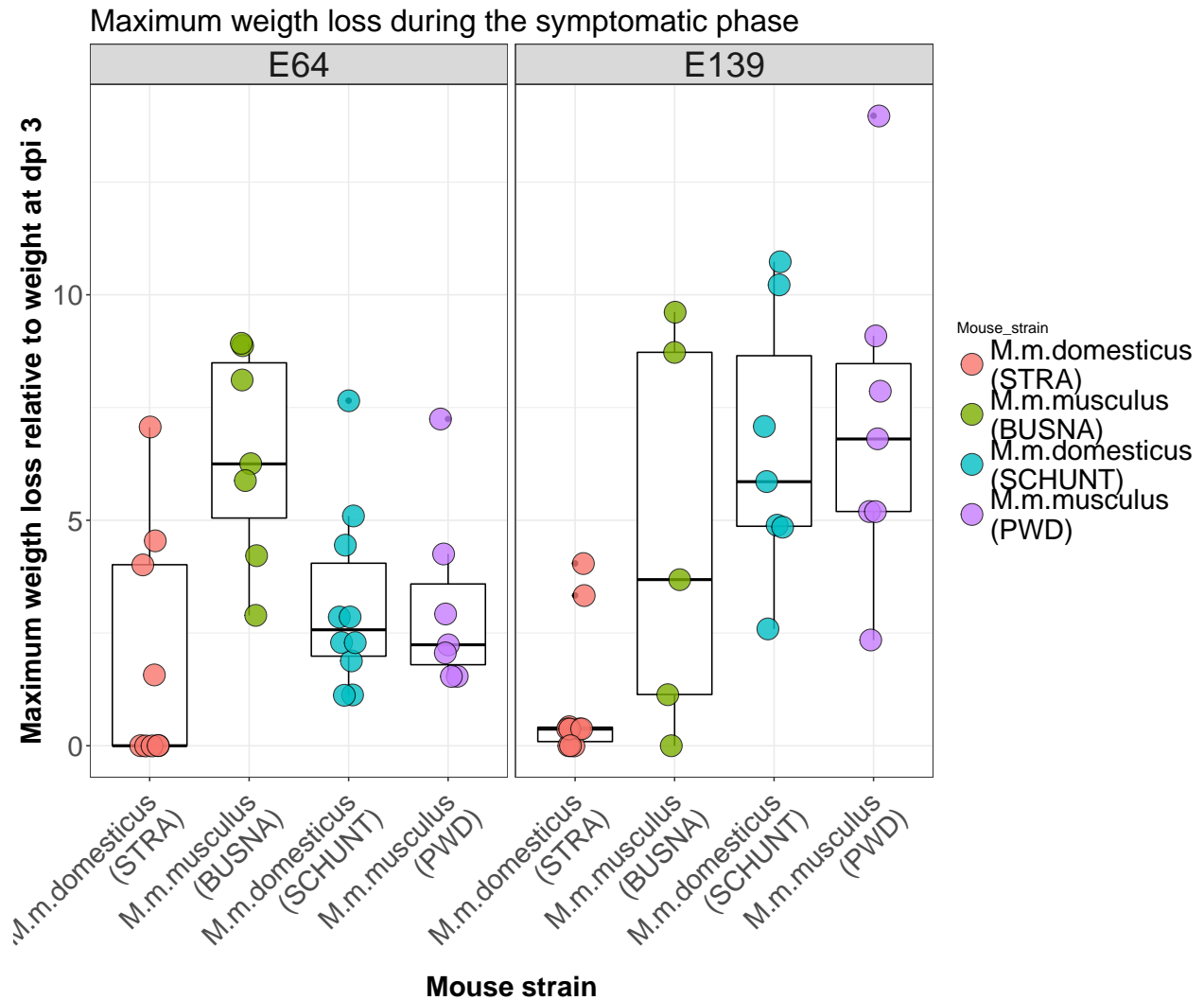
```
##
## Call:
## lm(formula = relativeWeight ~ Mouse_strain, data = max.loss_003_4)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.8101 -2.3330  0.9961  1.9204  5.6927
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         98.6066     0.6760 145.870  < 2e-16
## Mouse_strainM.m.musculus \n(BUSNA)  -4.2993     1.0865  -3.957 0.000209
## Mouse_strainM.m.domesticus \n(SCHUNT) -3.1843   0.9837  -3.237 0.001999
## Mouse_strainM.m.musculus \n(PWD)    -3.7671     1.0378  -3.630 0.000601
##
## (Intercept)                        ***
## Mouse_strainM.m.musculus \n(BUSNA) ***
## Mouse_strainM.m.domesticus \n(SCHUNT) **
## Mouse_strainM.m.musculus \n(PWD)   ***
## ---
```
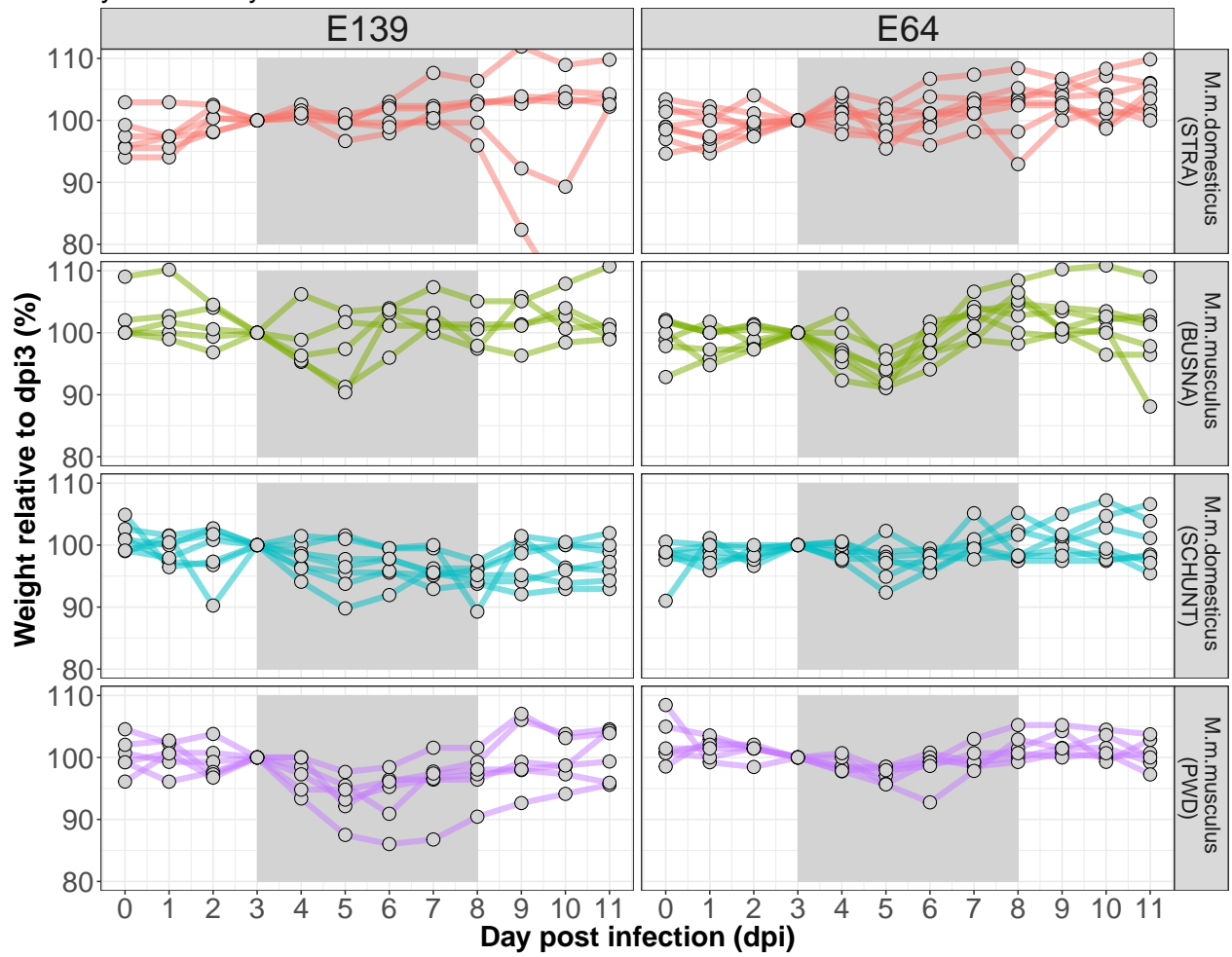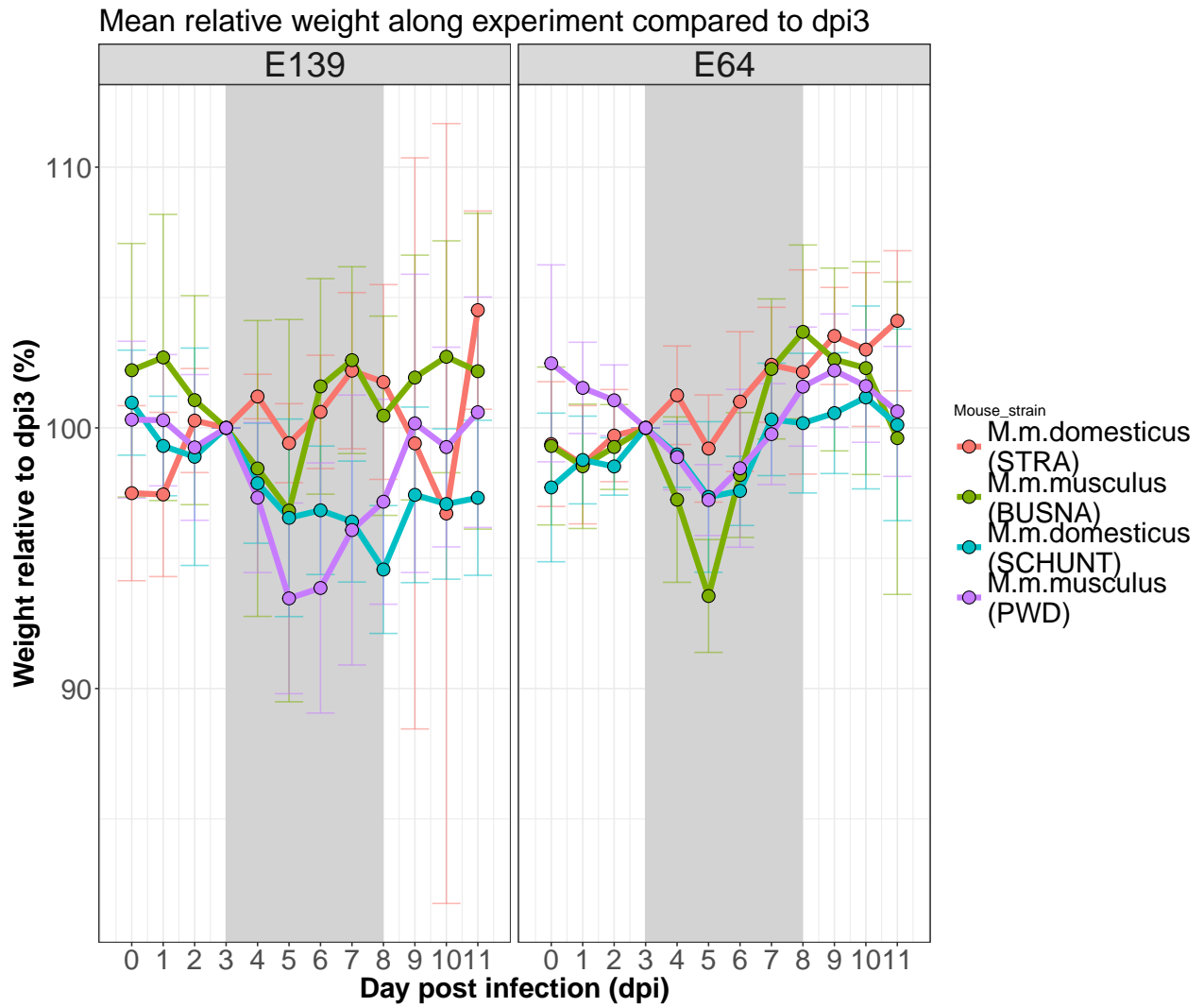
```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.947 on 58 degrees of freedom
## Multiple R-squared:  0.2717, Adjusted R-squared:  0.234
## F-statistic: 7.212 on 3 and 58 DF,  p-value: 0.0003403
```

2. Parasite shedding
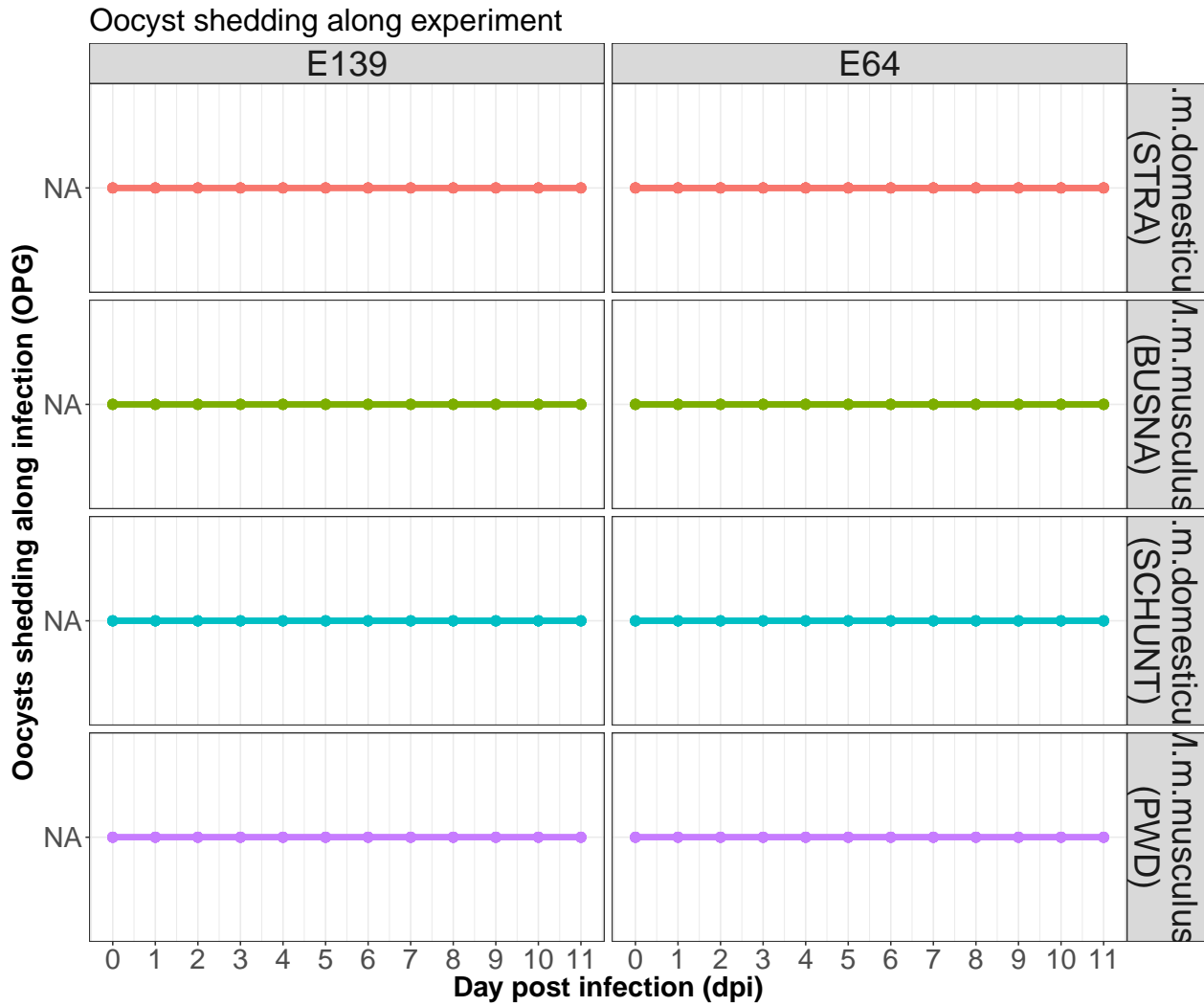
Oocyst shedding along experiment

Mean oocysts shedding along experiment

Oocysts shedding along infection (OPG)

Day post infection (dpi)

E139 | E64

M.m.domesticus (STRA)
M.m.musculus (BUSNA)
M.m.domesticus (SCHUNT)
M.m.musculus (PWD)

Sum of oocysts shed along the experiment
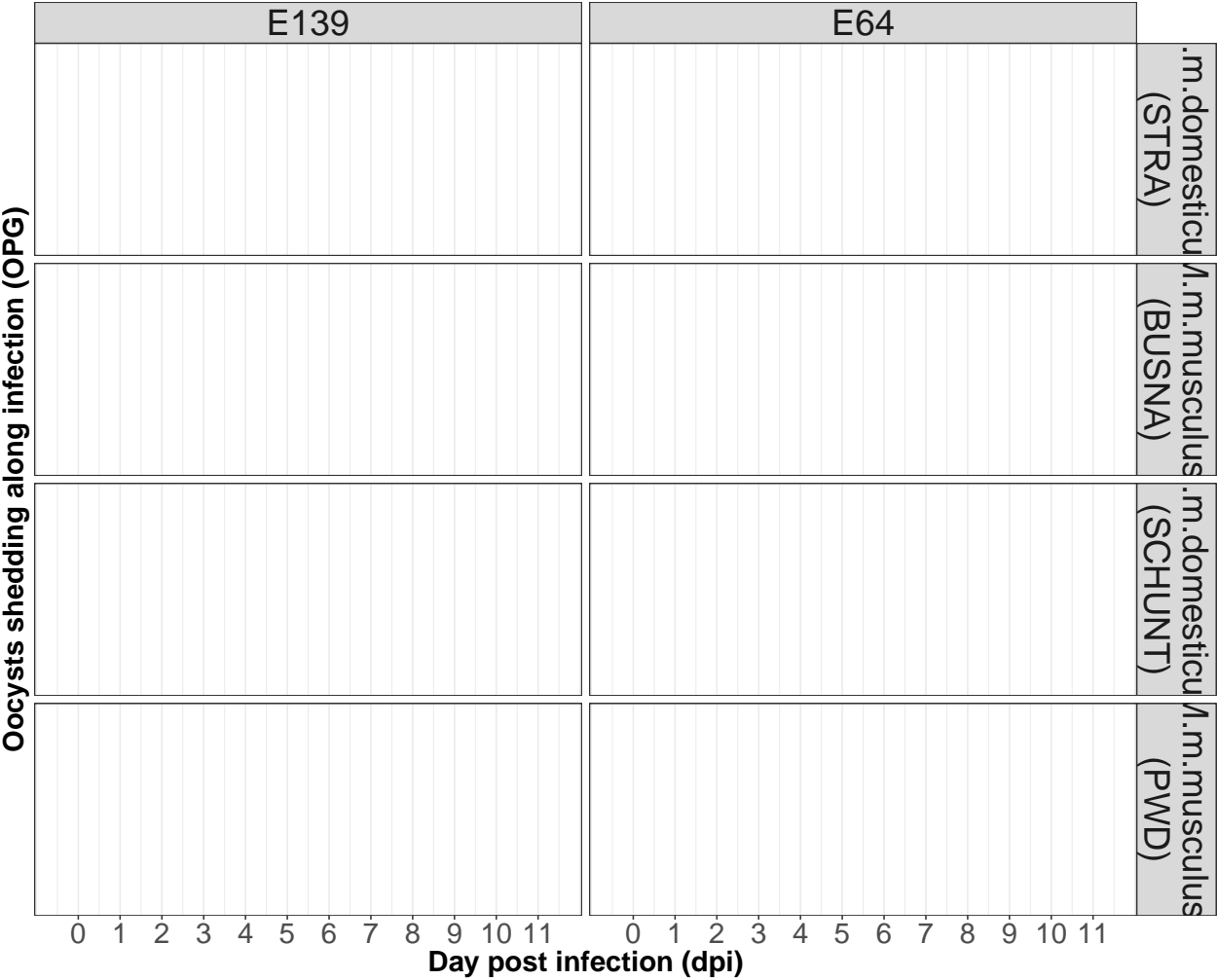
```
##
## Call:
## lm(formula = sum.oo ~ Mouse_strain, data = sum.oocysts_003_4)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##      0      0      0      0      0
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                               0          0      NA       NA
## Mouse_strainM.m.musculus \n(BUSNA)        0          0      NA       NA
## Mouse_strainM.m.domesticus \n(SCHUNT)     0          0      NA       NA
## Mouse_strainM.m.musculus \n(PWD)          0          0      NA       NA
##
## Residual standard error: 0 on 51 degrees of freedom
## Multiple R-squared:    NaN,  Adjusted R-squared:    NaN
## F-statistic:   NaN on 3 and 51 DF,  p-value: NA
```
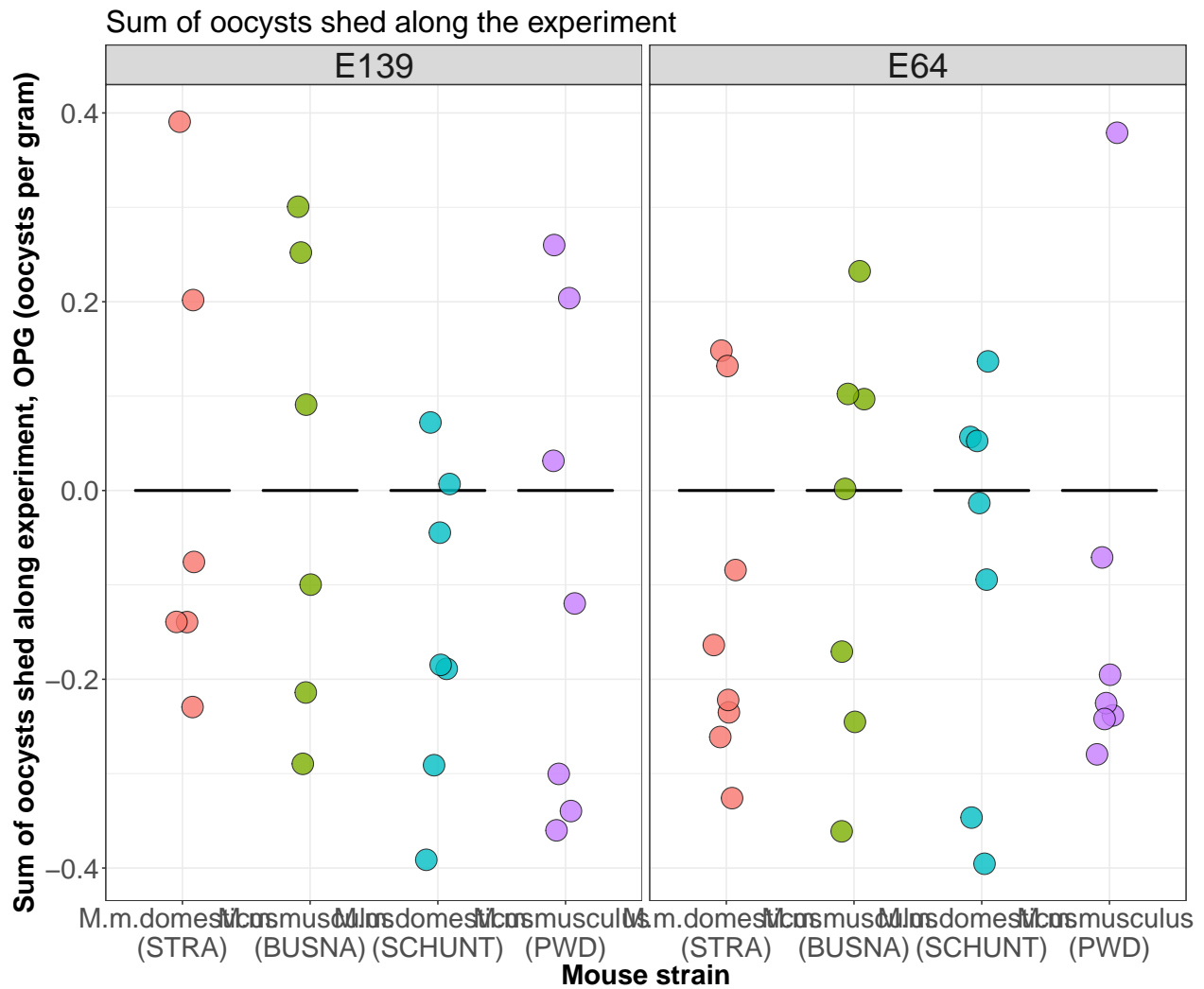
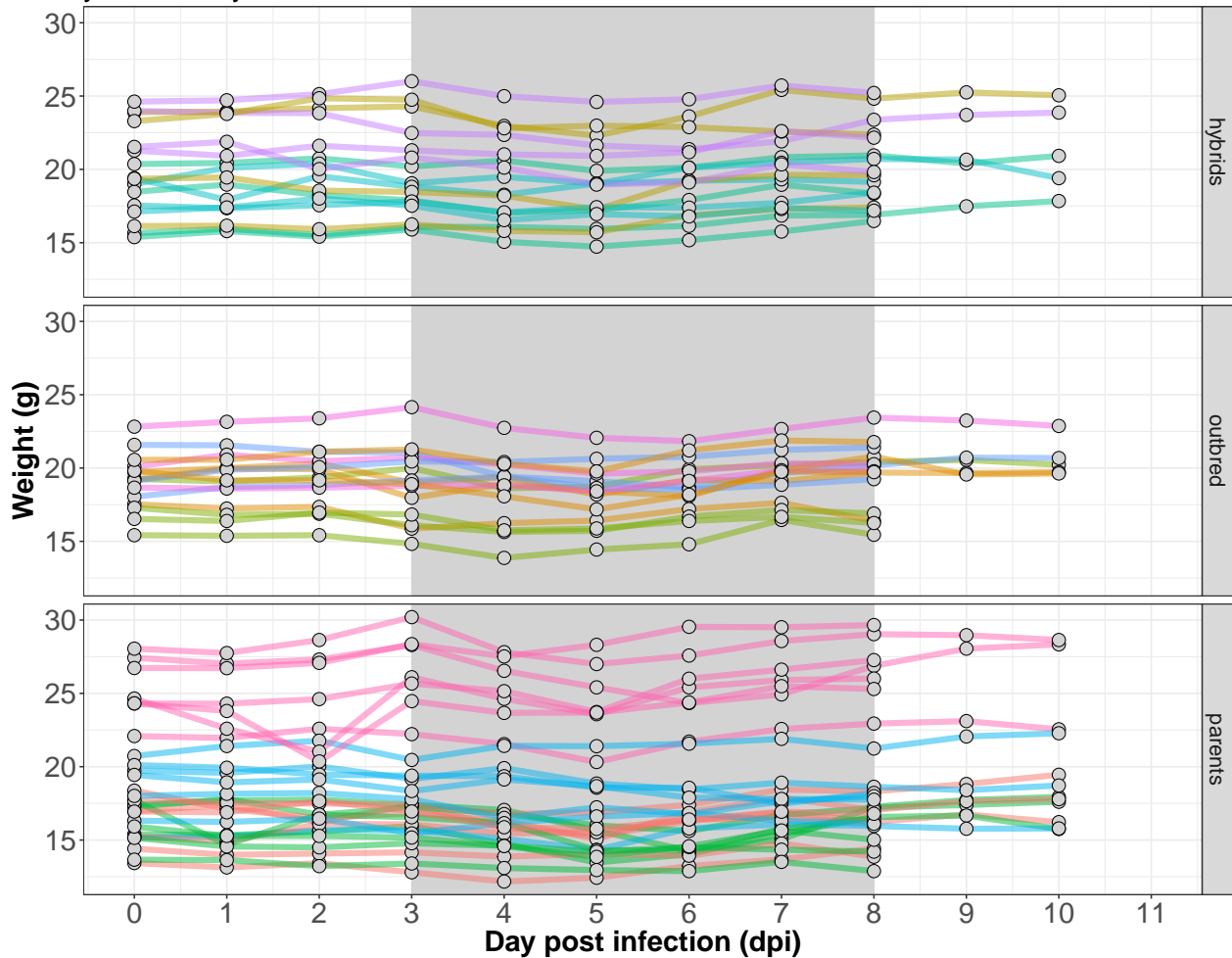# Expe_005, July 2018, FULL experiment (parents, intra specific and inter species hybrids) BUSNA, STRA, SCHUNT, PWD, infection with Eferrisi and Efalciformis (E64 and E88)

1. Weight loss

Eimeria ferrisi

Weight along experiment per individual (E64)
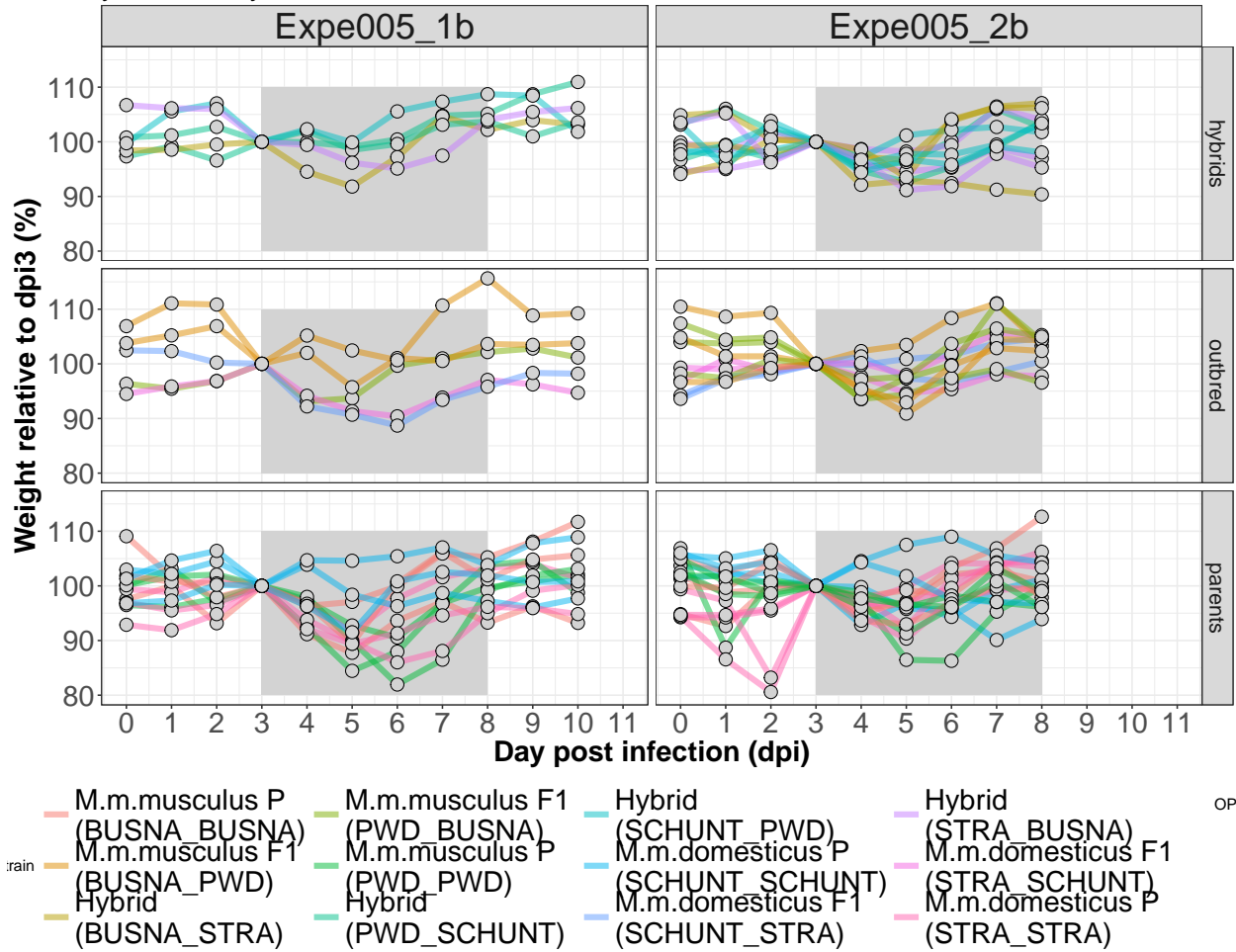yellow : oocysts detected in feces

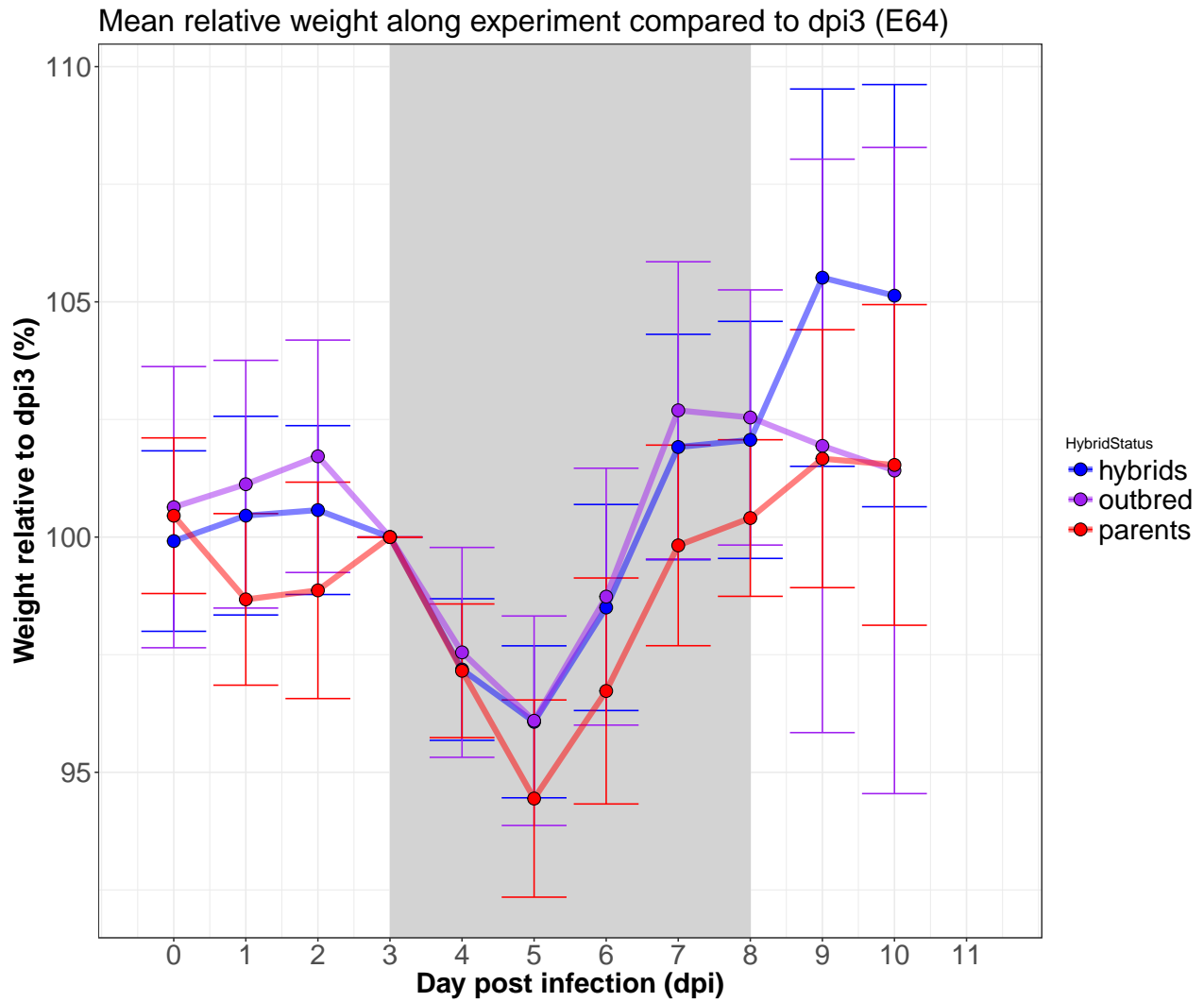# Relative weight along experiment compared to dpi3 (E64)
yellow : oocysts detected in feces

Mean relative weight along experiment compared to dpi3 (E64)
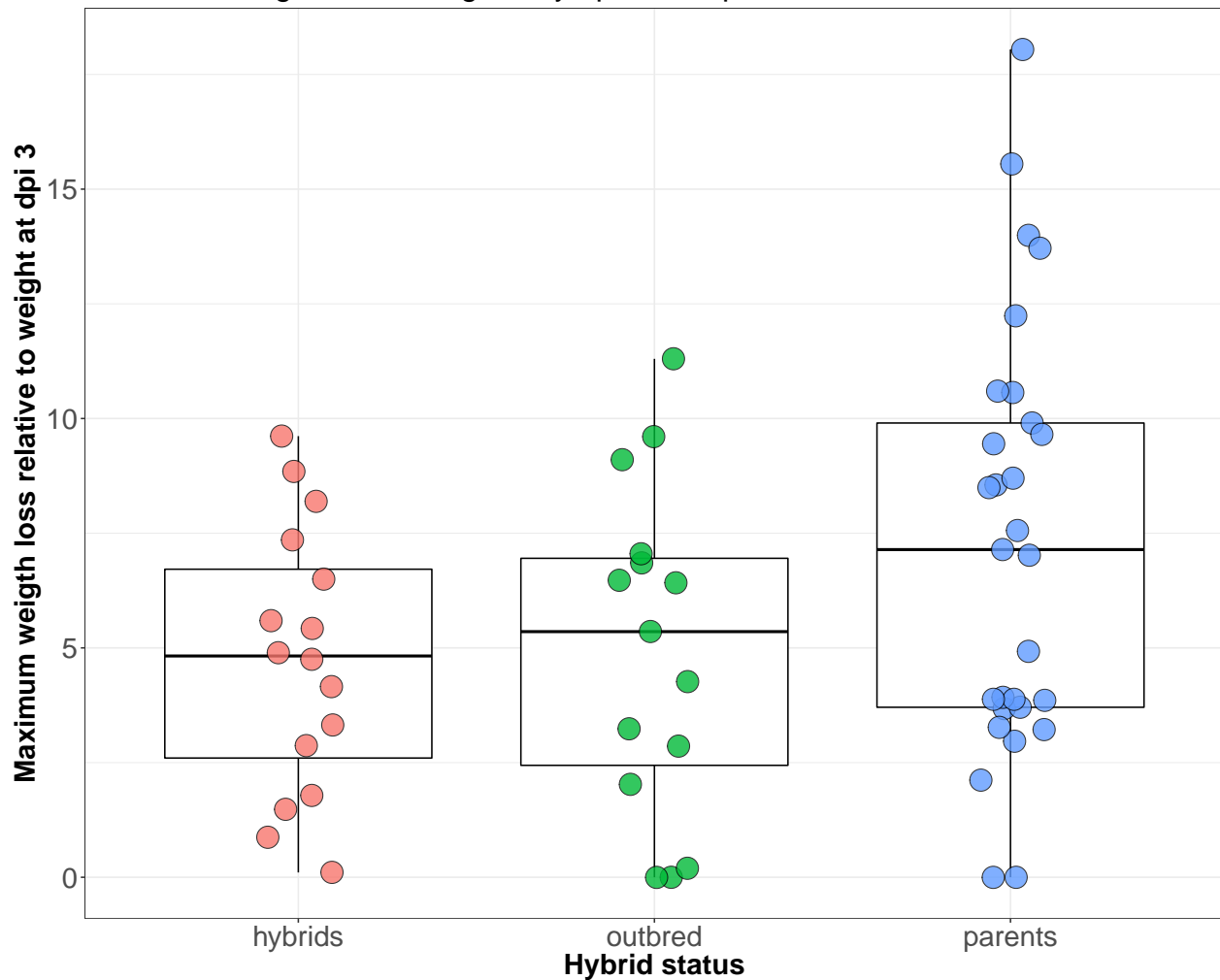
For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).

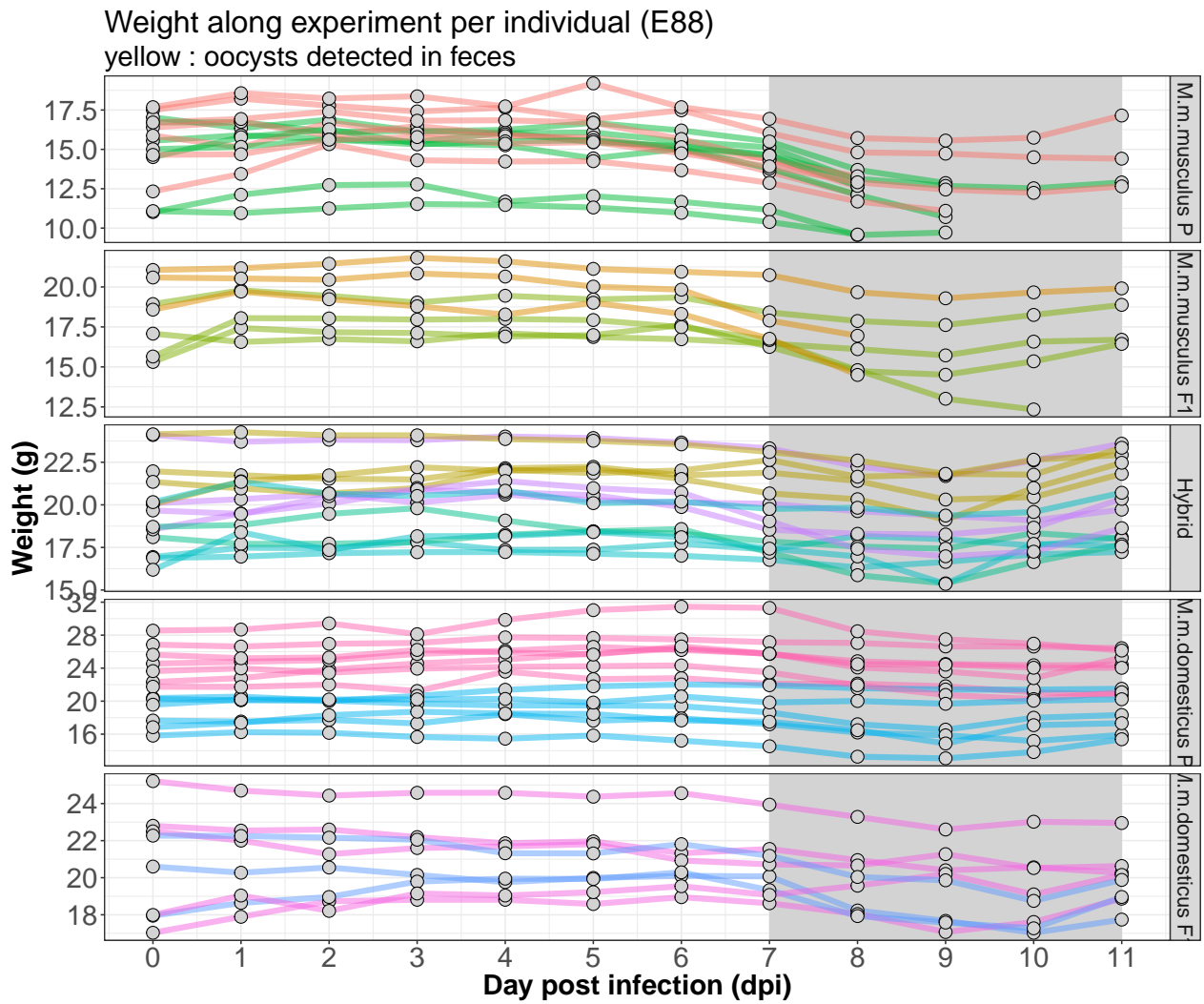Maximum weigth loss during the symptomatic phase


```
## 
## Call:
## lm(formula = relativeWeight ~ HybridStatus, data = max.loss_005_E64)
## 
## Residuals:
##     Min     1Q  Median     3Q     Max
## -10.784  -2.451  -0.088   3.381   7.262
## 
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          95.2644     0.9968  95.569   <2e-16 ***
## HybridStatusoutbred  -0.2467     1.4330  -0.172   0.8639
## HybridStatusparents  -2.5264     1.2417  -2.035   0.0466 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 3.987 on 57 degrees of freedom
## Multiple R-squared:  0.08785,    Adjusted R-squared:  0.05585
## F-statistic: 2.745 on 2 and 57 DF,  p-value: 0.07275
## 
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
```

```
## lmerModLmerTest]
## Formula: relativeWeight ~ HybridStatus + 1 | Mouse_strain
##    Data: max.loss_005_E64
##
## REML criterion at convergence: 334.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.47724 -0.64423 -0.01634  0.87861  1.39148
##
## Random effects:
##  Groups       Name                 Variance  Std.Dev.  Corr
##  Mouse_strain (Intercept)          7.172e-13 8.469e-07
##               HybridStatusoutbred  1.260e-12 1.123e-06 -1.00
##               HybridStatusparents  5.504e+00 2.346e+00 -0.64  0.64
##  Residual                          1.465e+01 3.827e+00
## Number of obs: 60, groups:  Mouse_strain, 12
##
## Fixed effects:
##             Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)  94.6748     0.6145 43.4600   154.1   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## convergence code: 0
## unable to evaluate scaled gradient
## Model failed to converge: degenerate  Hessian with 1 negative eigenvalues
```
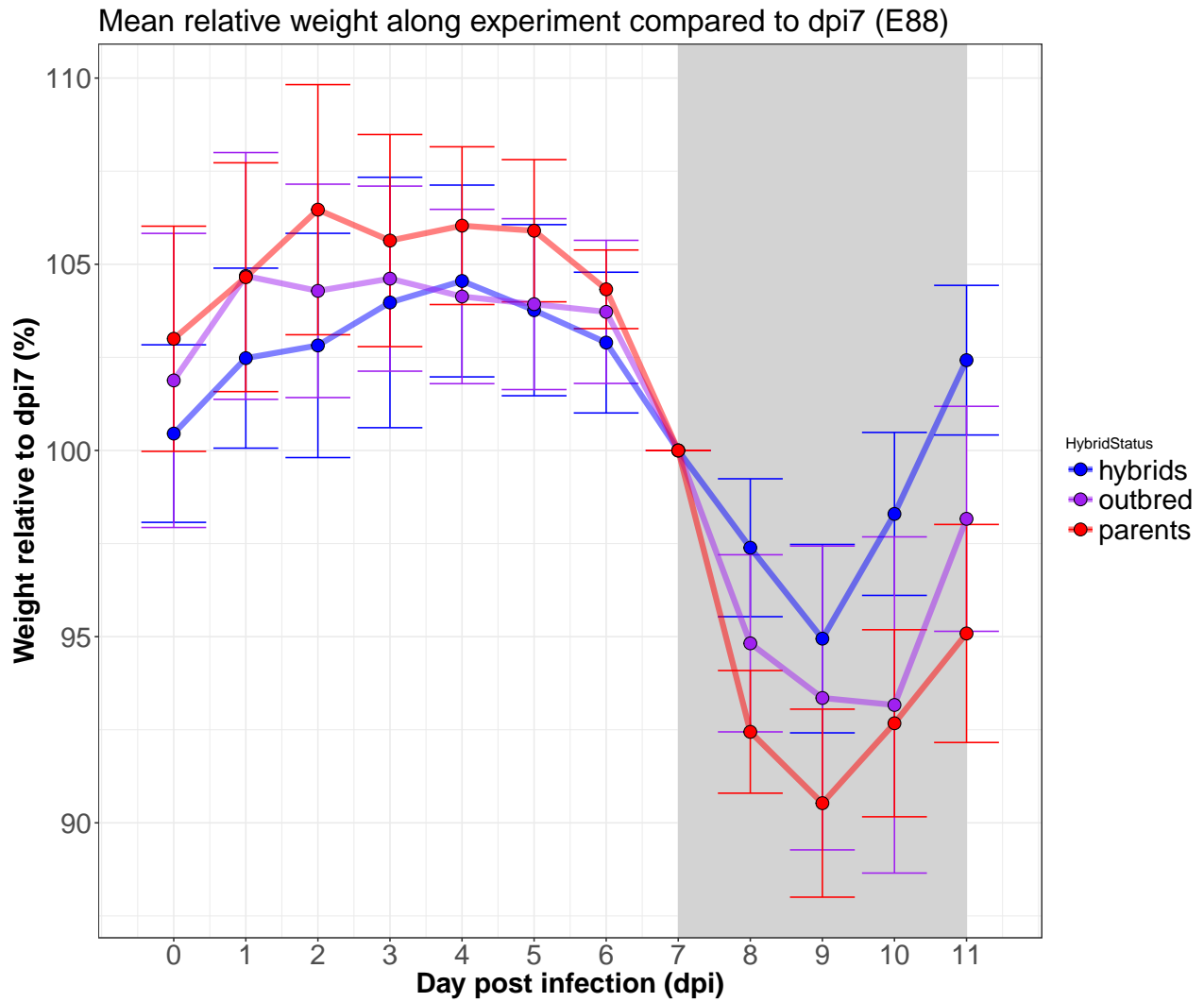
Eimeria falciformis

Weight along experiment per individual (E88)
yellow : oocysts detected in feces

Relative weight along experiment compared to dpi7 (E88)
yellow : oocysts detected in feces
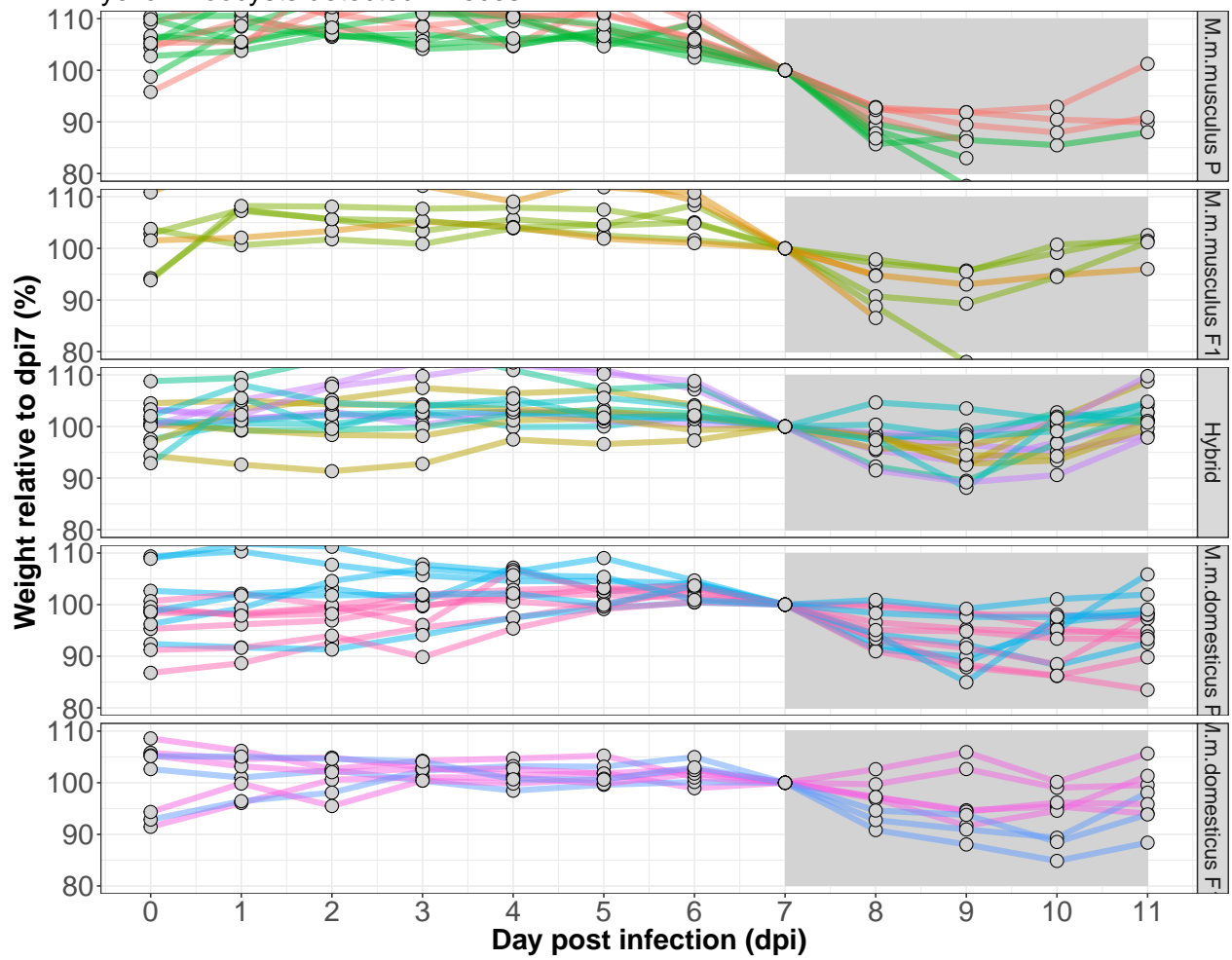
Mean relative weight along experiment compared to dpi7 (E88)

For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi7 to dpi11 (symptomatic period for E88 strain).

Maximum weigth loss during the symptomatic phase
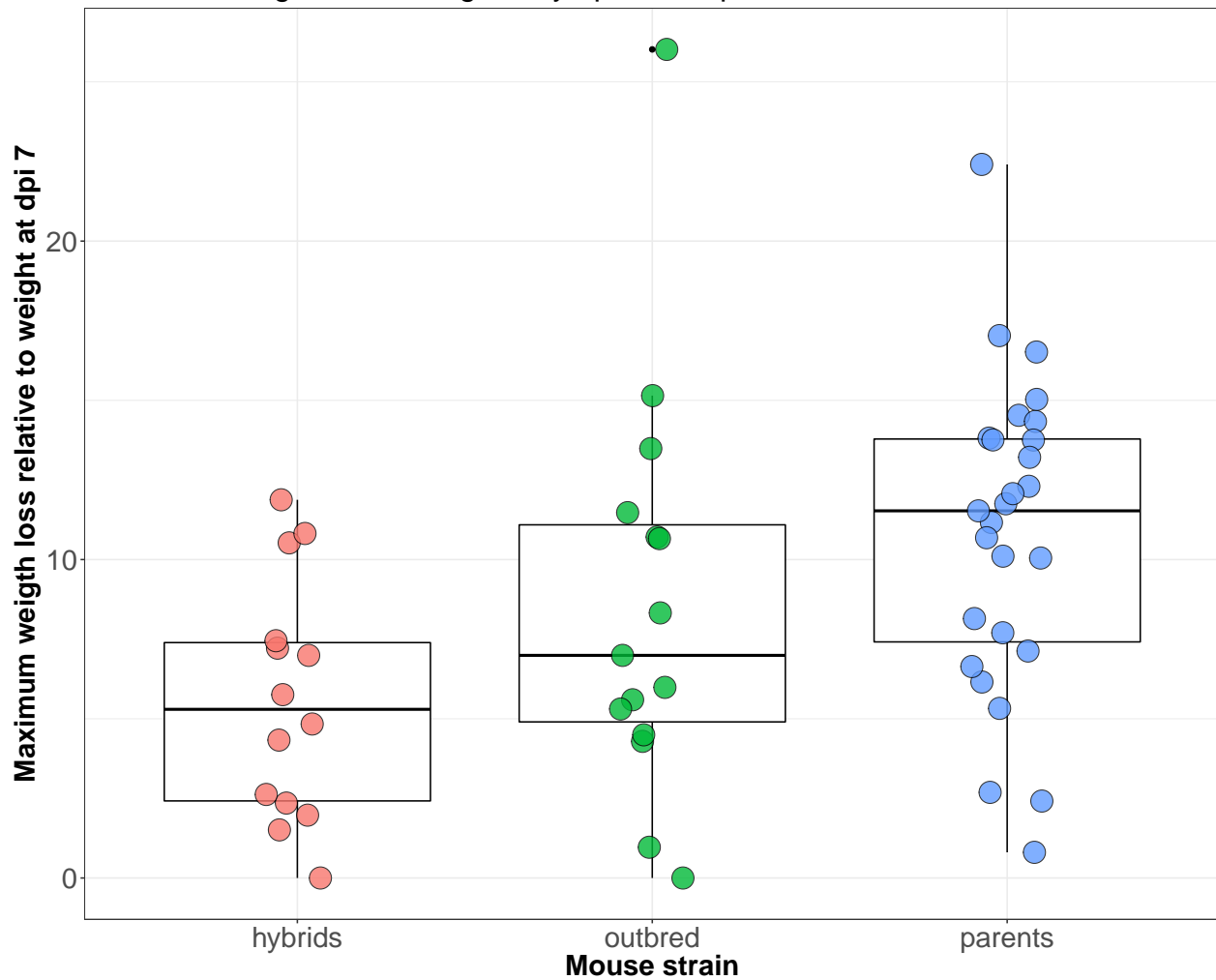

```
##
## Call:
## lm(formula = relativeWeight ~ HybridStatus, data = max.loss_005_E88)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -17.3894 -2.9743 -0.0367  3.3960  9.9730
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           94.410      1.369  68.976  < 2e-16 ***
## HybridStatusoutbred   -3.040      1.903  -1.597  0.11617
## HybridStatusparents   -5.189      1.687  -3.077  0.00331 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.121 on 53 degrees of freedom
## Multiple R-squared:  0.1524, Adjusted R-squared:  0.1204
## F-statistic: 4.763 on 2 and 53 DF,  p-value: 0.01252

## [1] "Along all experiment:"
```