

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

*Alice*

*09 October 2018*

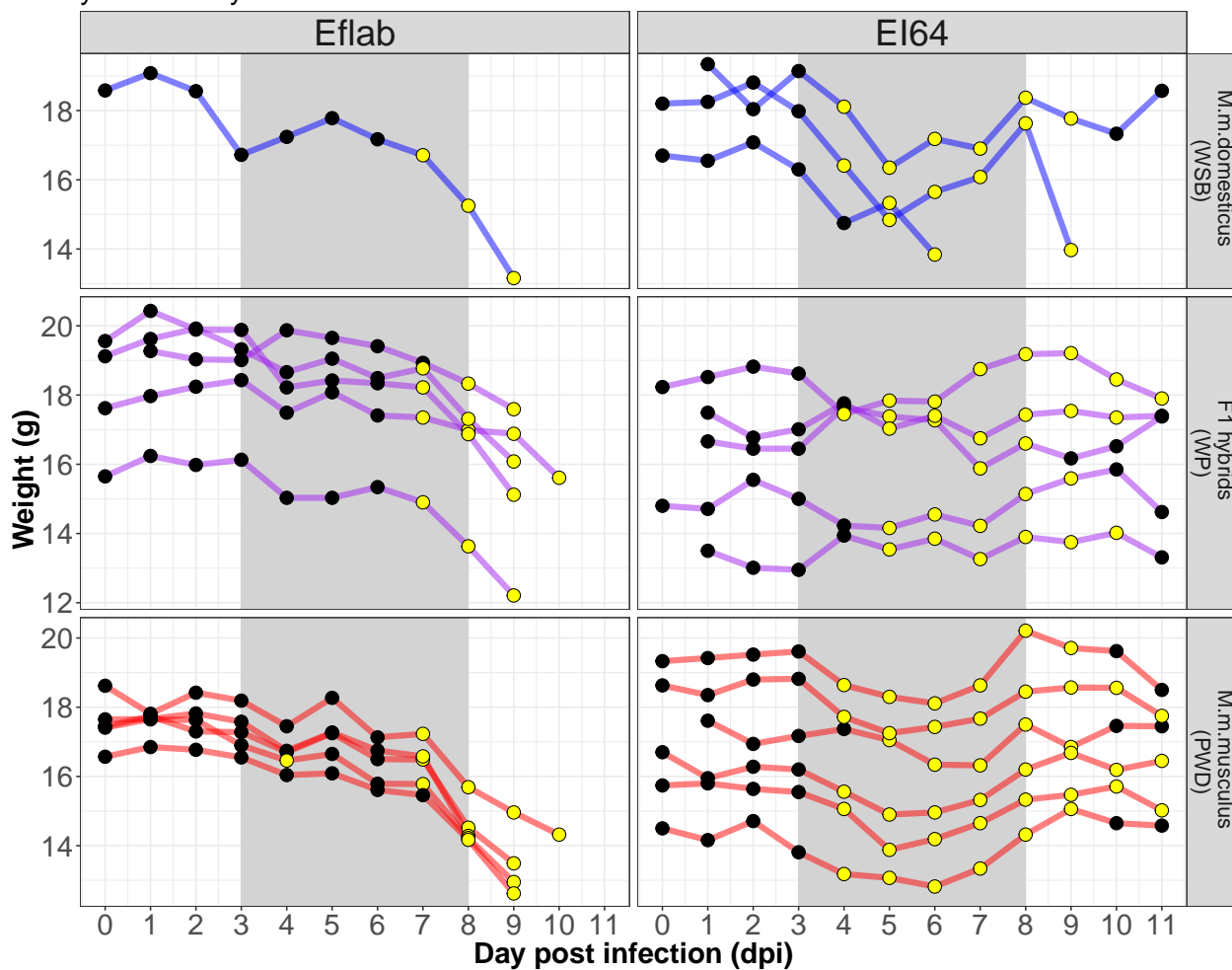
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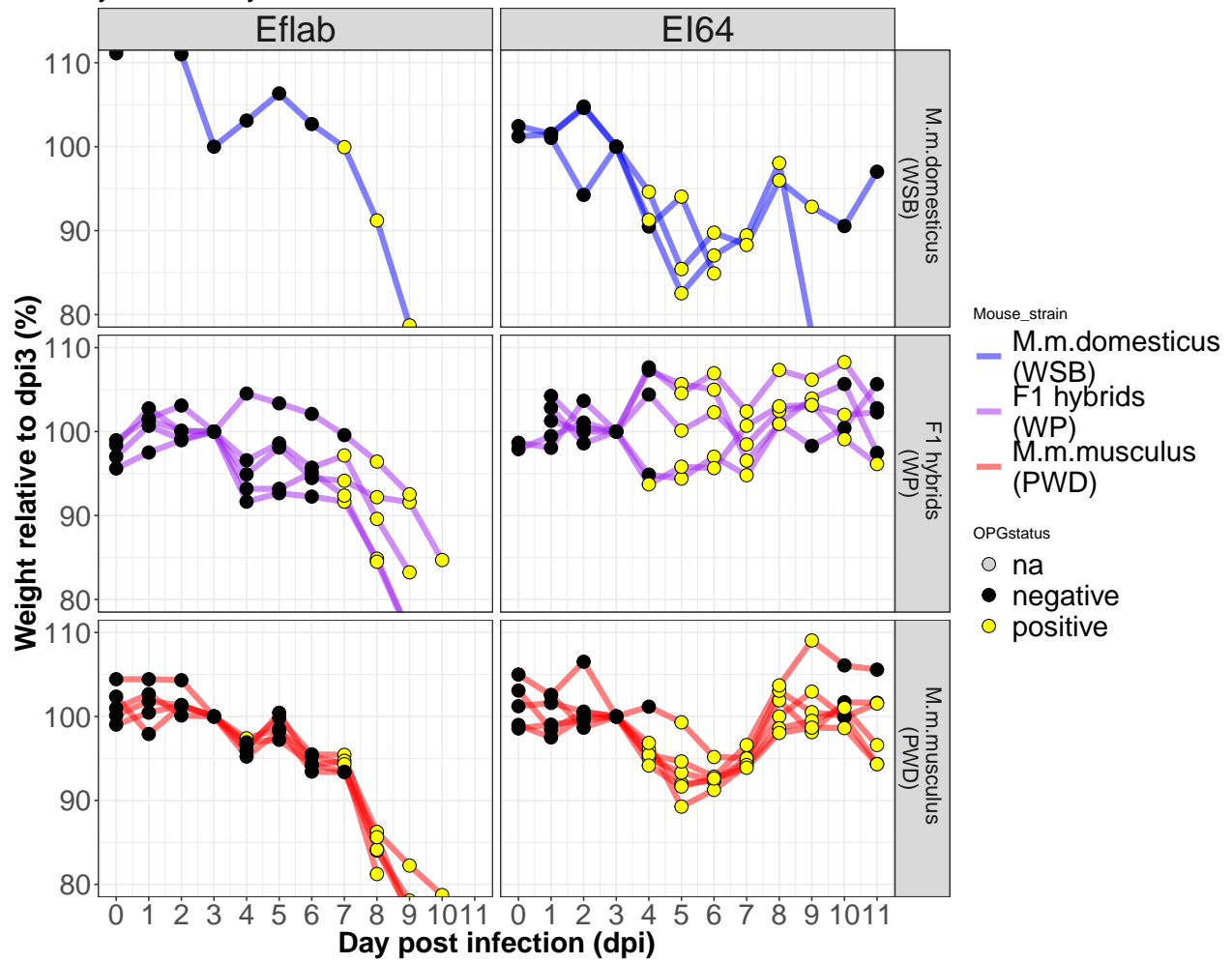
# Expe\_001, March 2017, Francisca's experiment. infection with E64 and Eflab

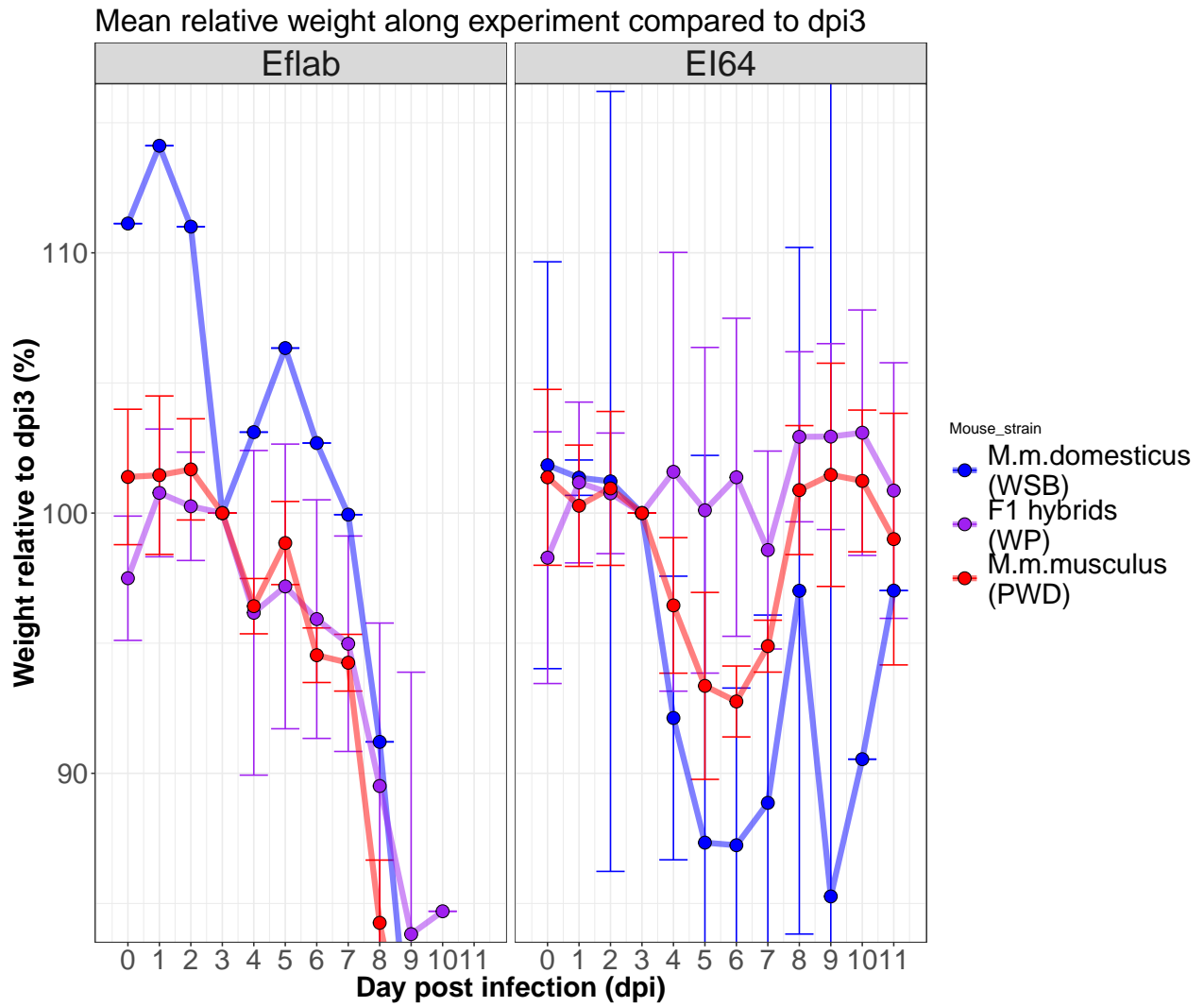
## 1. Weight loss

Weight along experiment per individual  
yellow : oocysts detected in feces

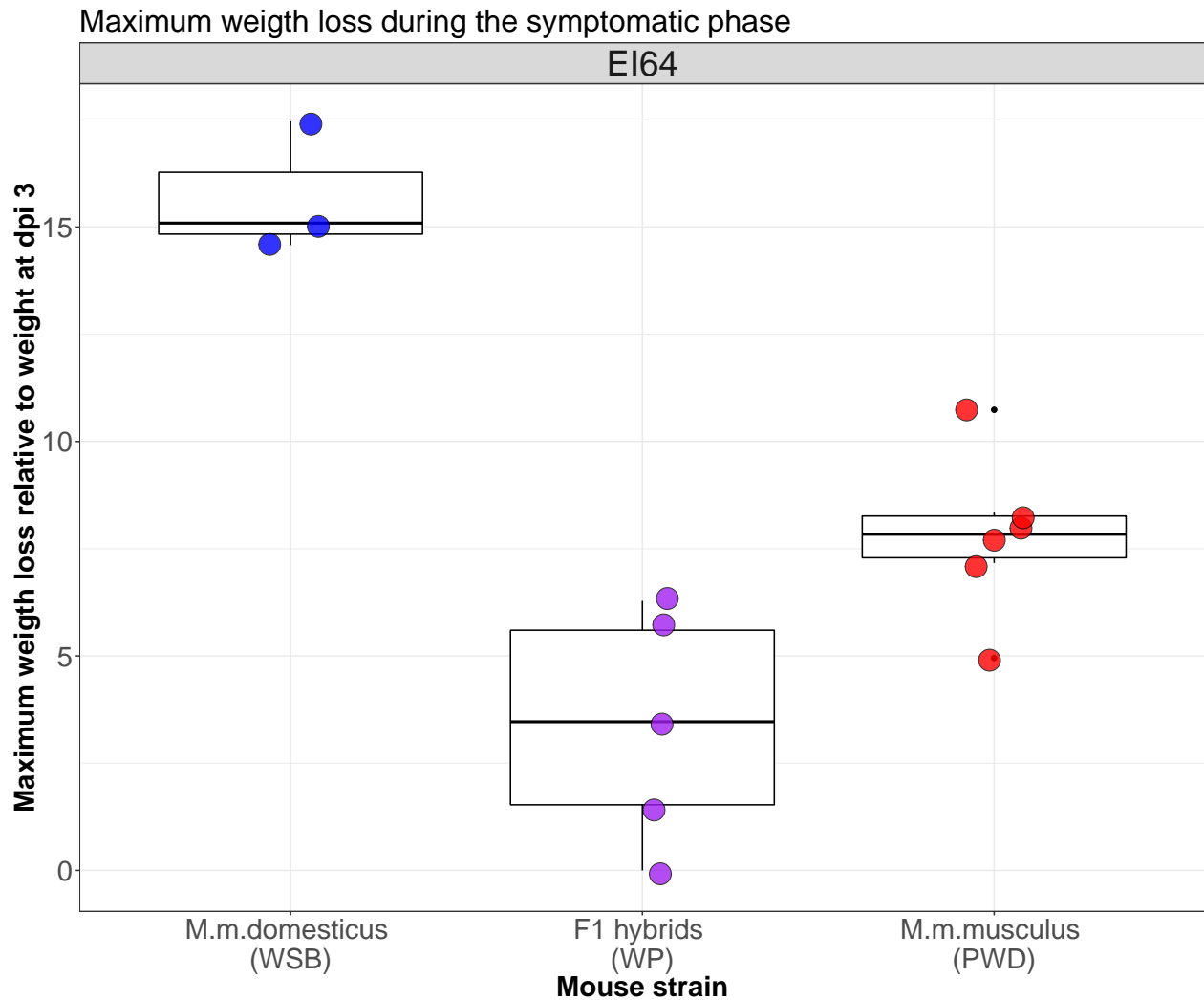


Relative weight along experiment compared to dpi3  
 yellow : oocysts detected in feces



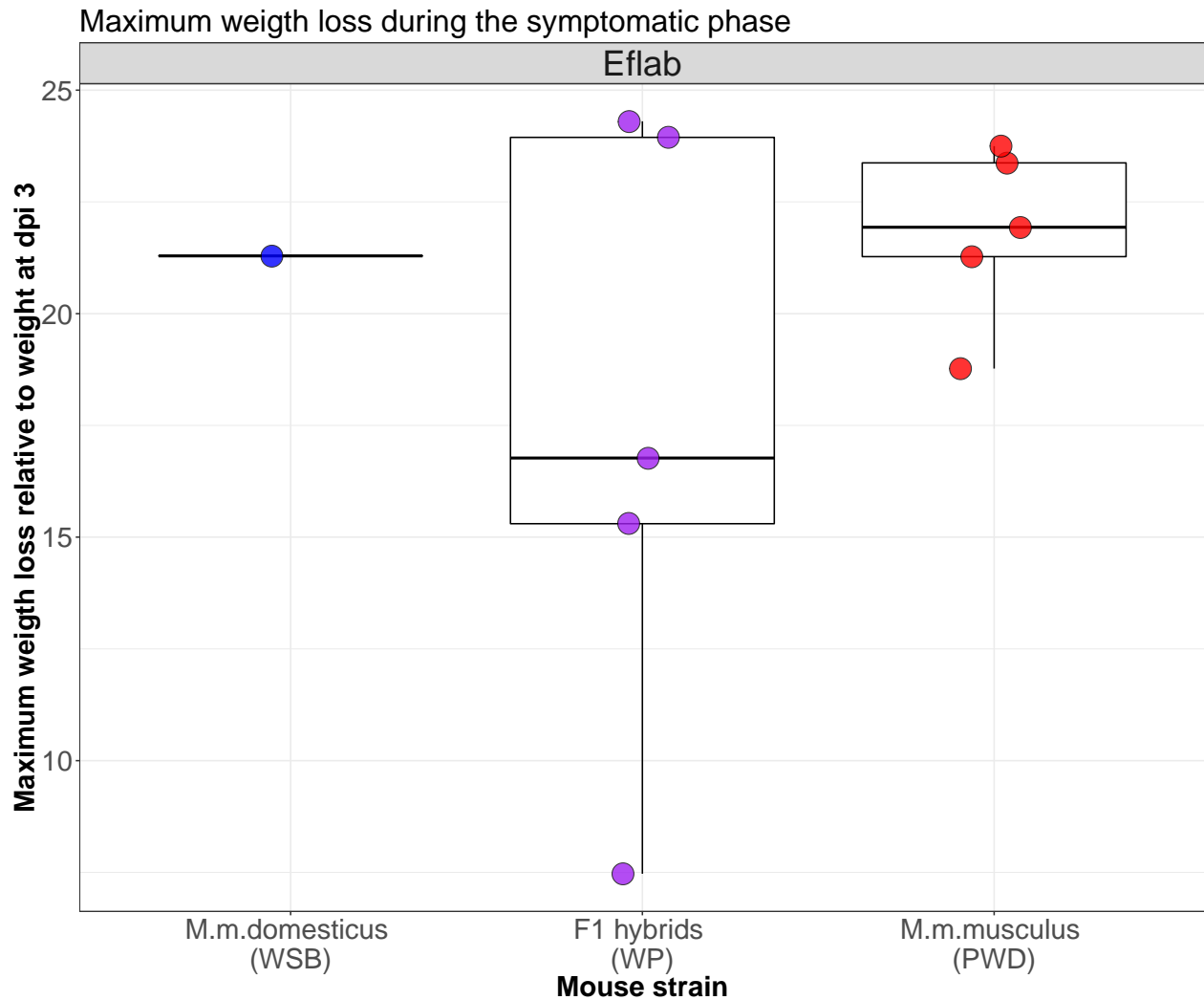


For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).



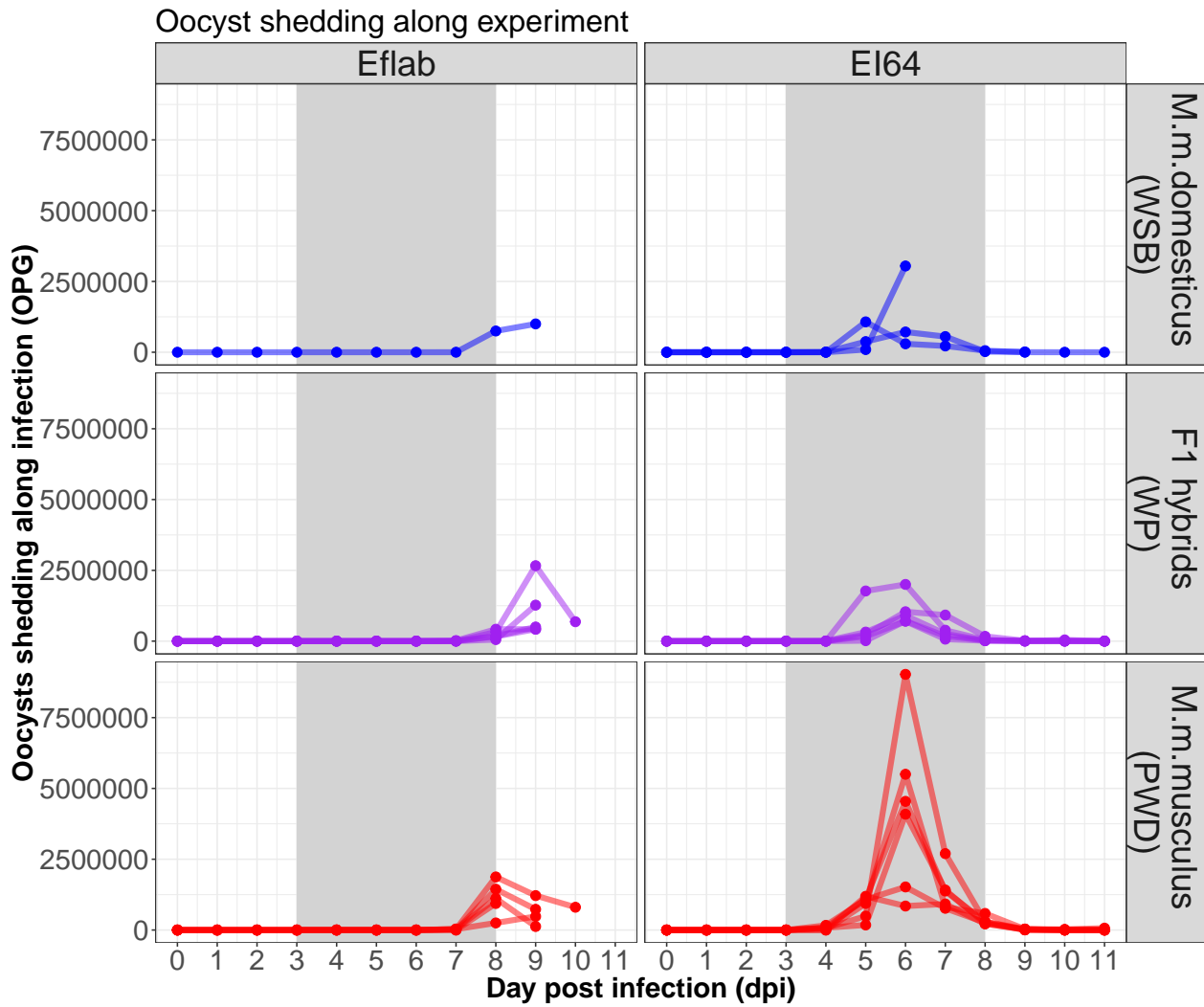
```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 10.141, df = 2, p-value = 0.006279
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_001_64$relativeWeight and max.loss_001_64$Mouse_strain
##
##           F1 hybrids \n(WP) M.m.domesticus \n(WSB)
## M.m.domesticus \n(WSB) 0.036 -
## M.m.musculus \n(PWD) 0.036 0.036
##
## P value adjustment method: BH
```

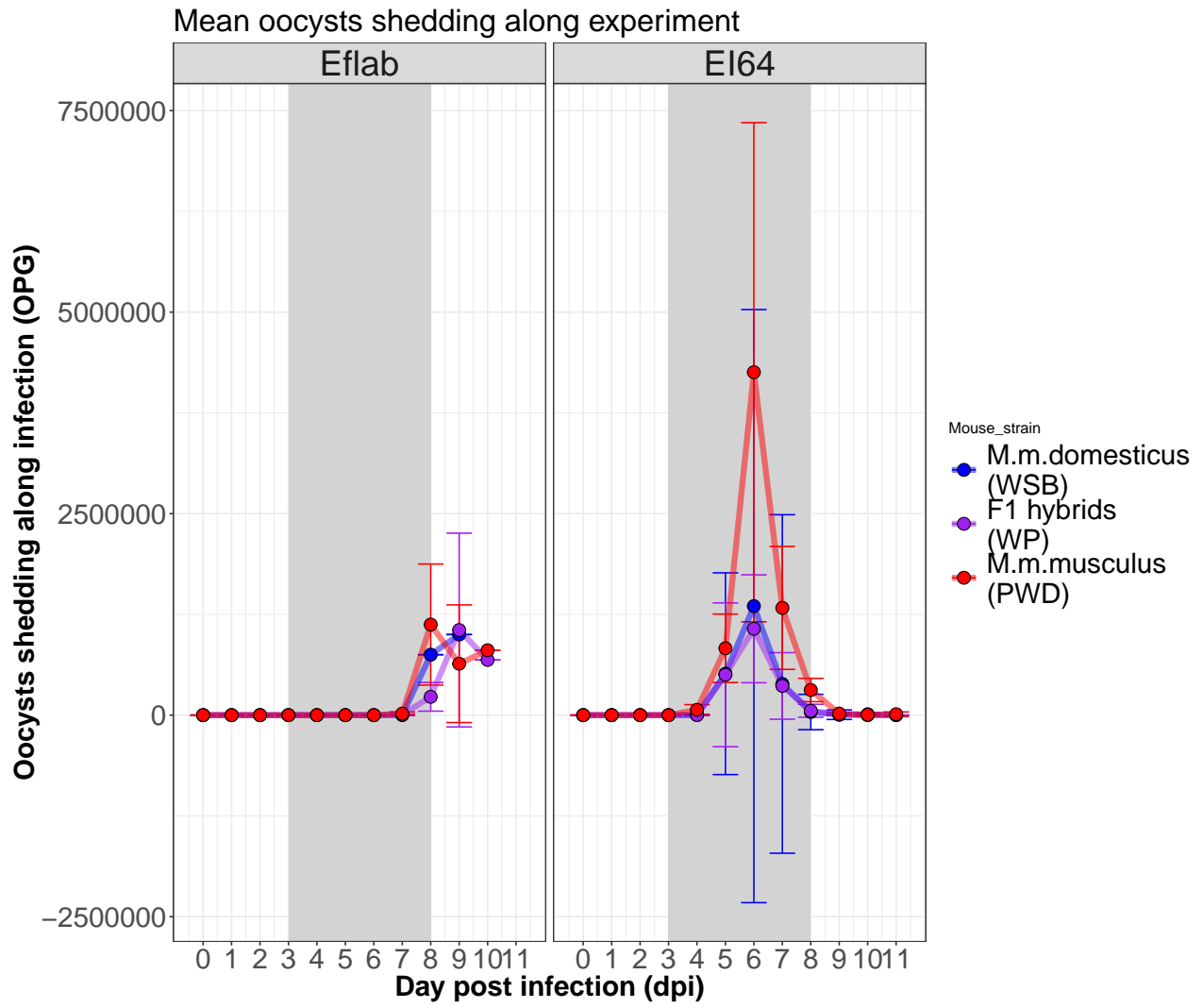
For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi7 to dpi11 (symptomatic period for E88 strain).



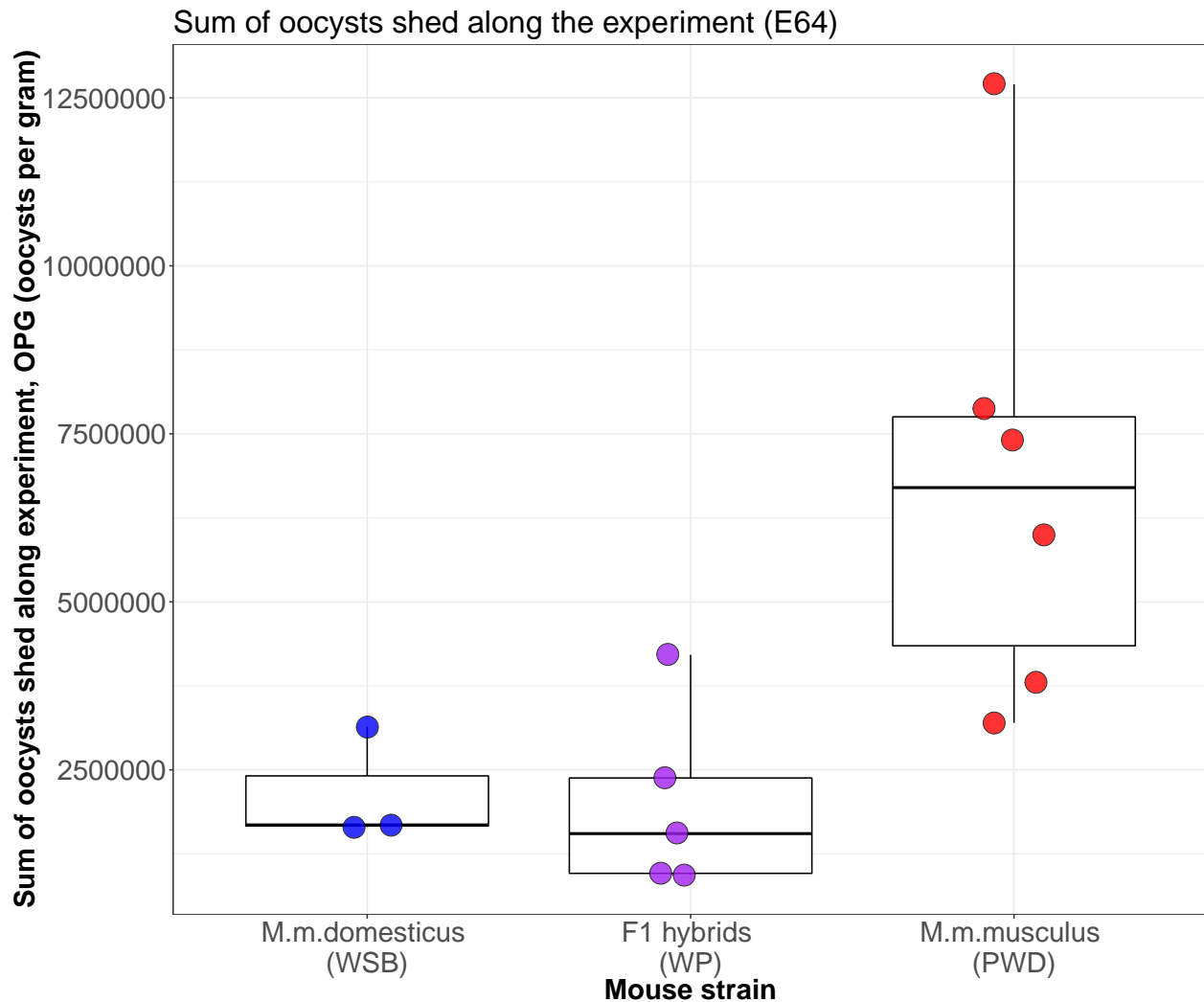
```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 0.32727, df = 2, p-value = 0.8491
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_001_88$relativeWeight and max.loss_001_88$Mouse_strain
##
##           F1 hybrids \n(WP) M.m.domesticus \n(WSB)
## M.m.domesticus \n(WSB) 1          -
## M.m.musculus \n(PWD)  1          1
##
## P value adjustment method: BH
```

## 2. Parasite shedding

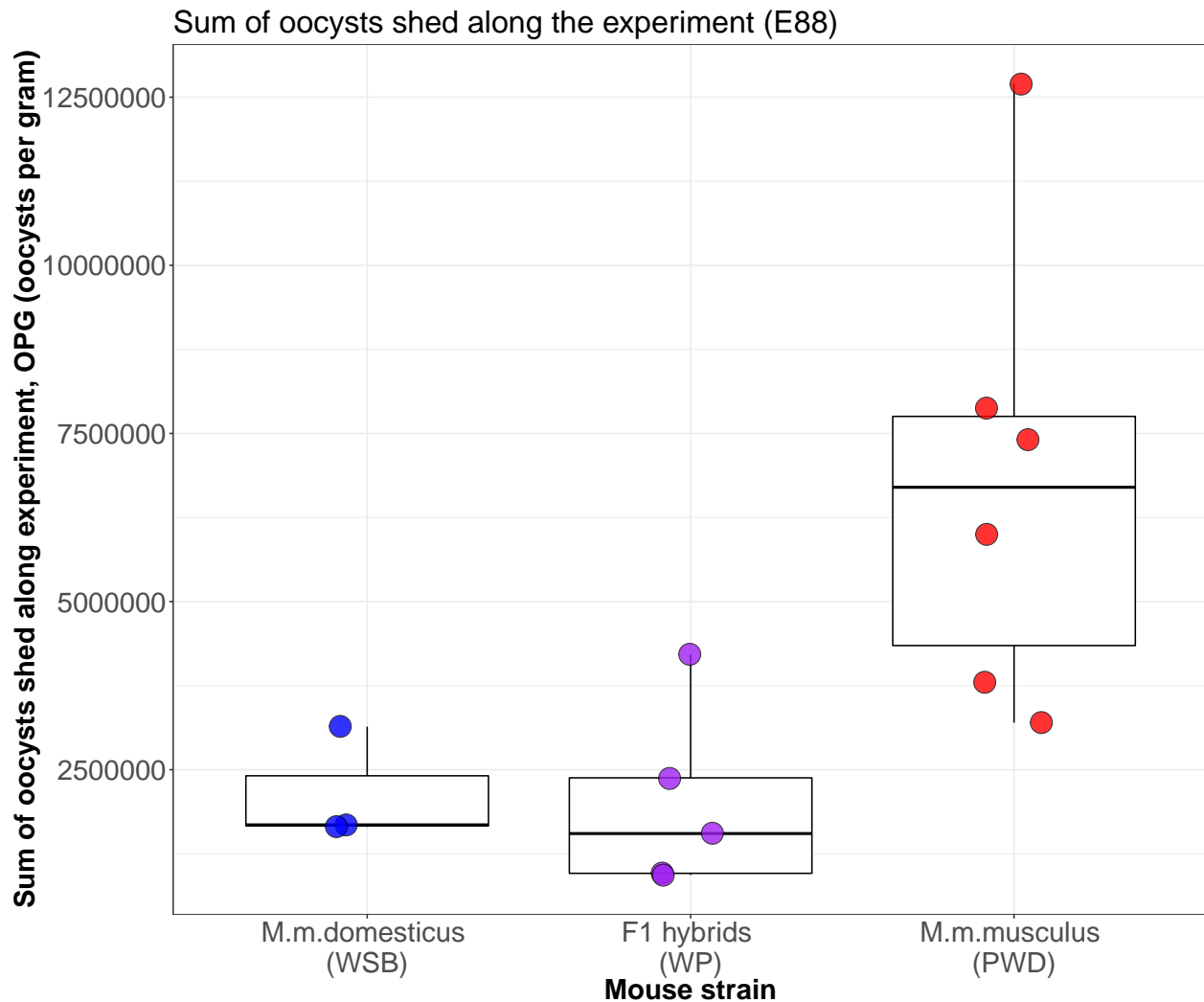








```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by Mouse_strain
## Kruskal-Wallis chi-squared = 8.16, df = 2, p-value = 0.01691
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_001_64$sum.oo and sum.oocysts_001_64$Mouse_strain
##
##           F1 hybrids \n(WP) M.m.domesticus \n(WSB)
## M.m.domesticus \n(WSB) 0.571 -
## M.m.musculus \n(PWD) 0.036 0.036
##
## P value adjustment method: BH
```



```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by Mouse_strain
## Kruskal-Wallis chi-squared = 8.16, df = 2, p-value = 0.01691
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_001_88$sum.oo and sum.oocysts_001_88$Mouse_strain
##
##           F1 hybrids \n(WP) M.m.domesticus \n(WSB)
## M.m.domesticus \n(WSB) 0.571 -
## M.m.musculus \n(PWD) 0.036 0.036
##
## P value adjustment method: BH
```

### 3. Comparison host/parasite proxy

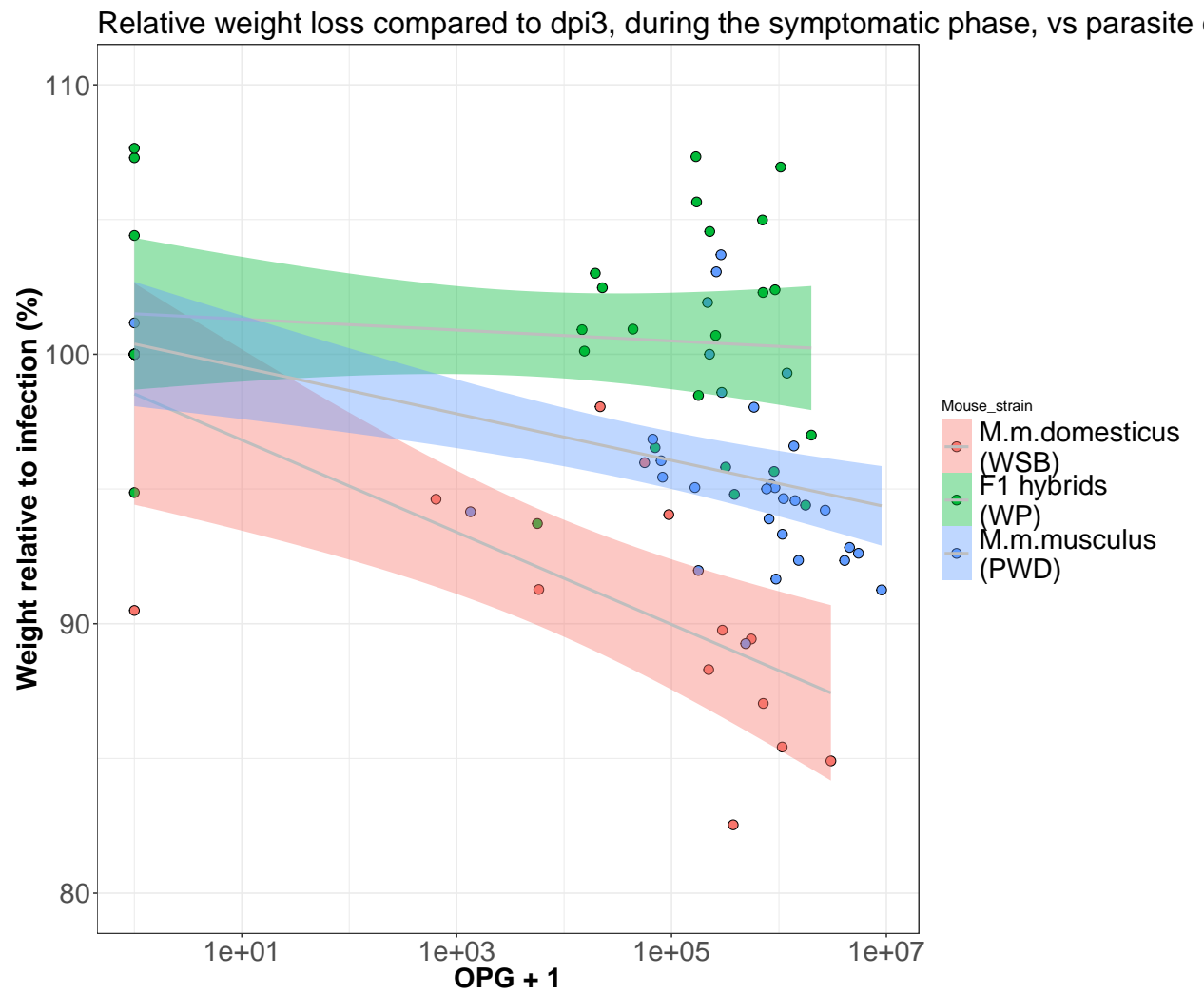


Figure 1: Weight as a function of OPG

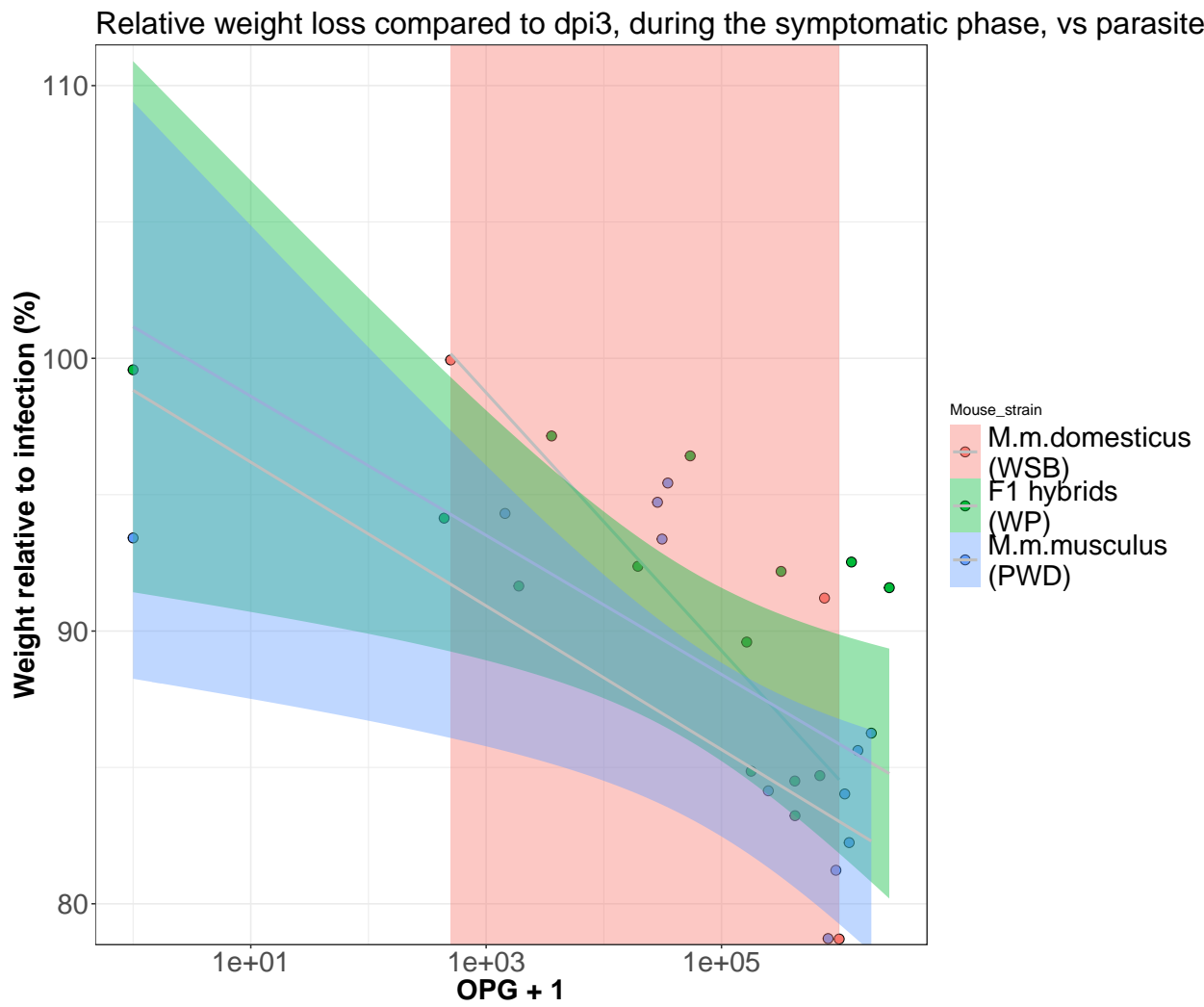
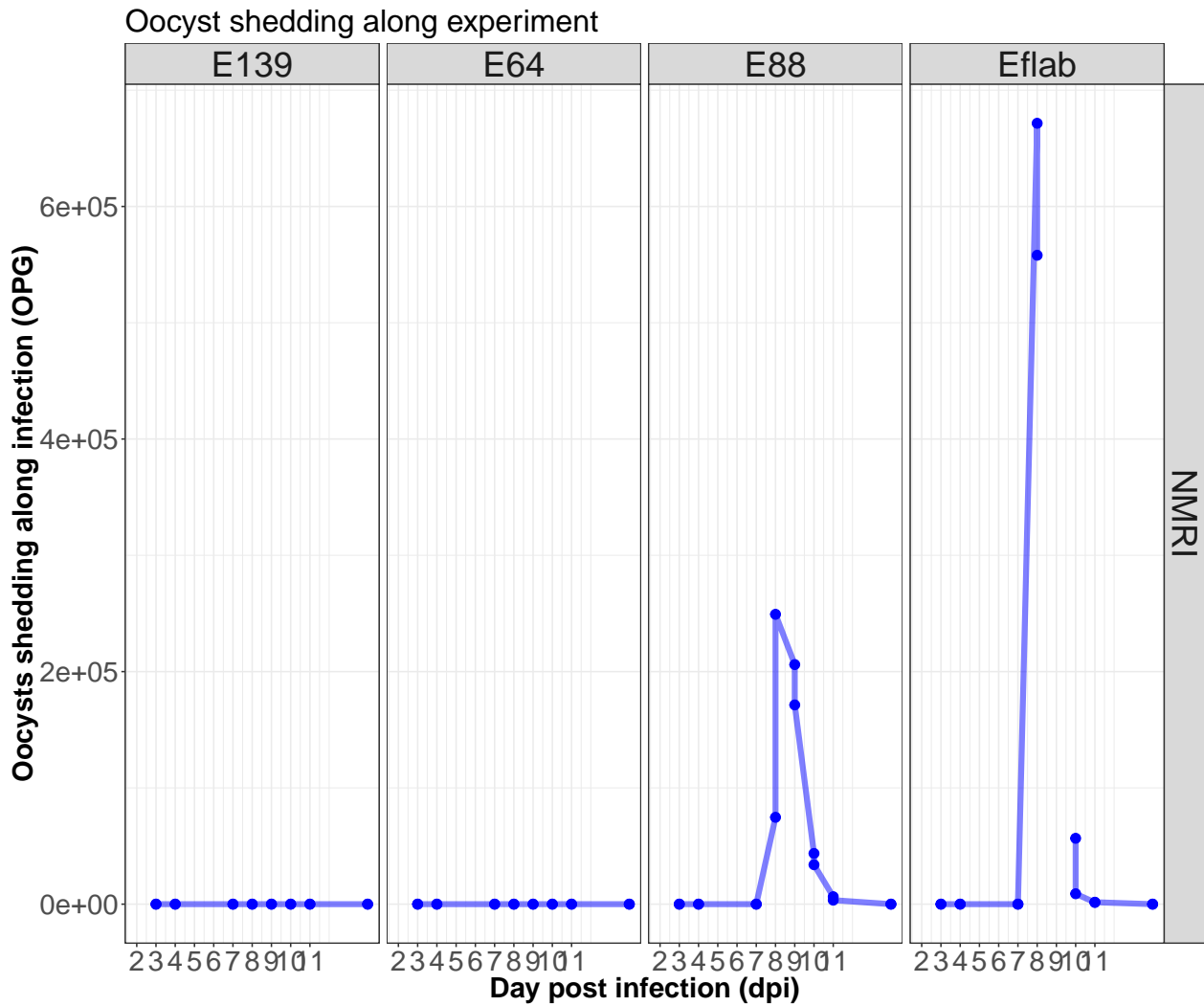


Figure 2: Weight as a function of OPG

Pass001: Nov 2017, passaging 4 isolates (some missing data)

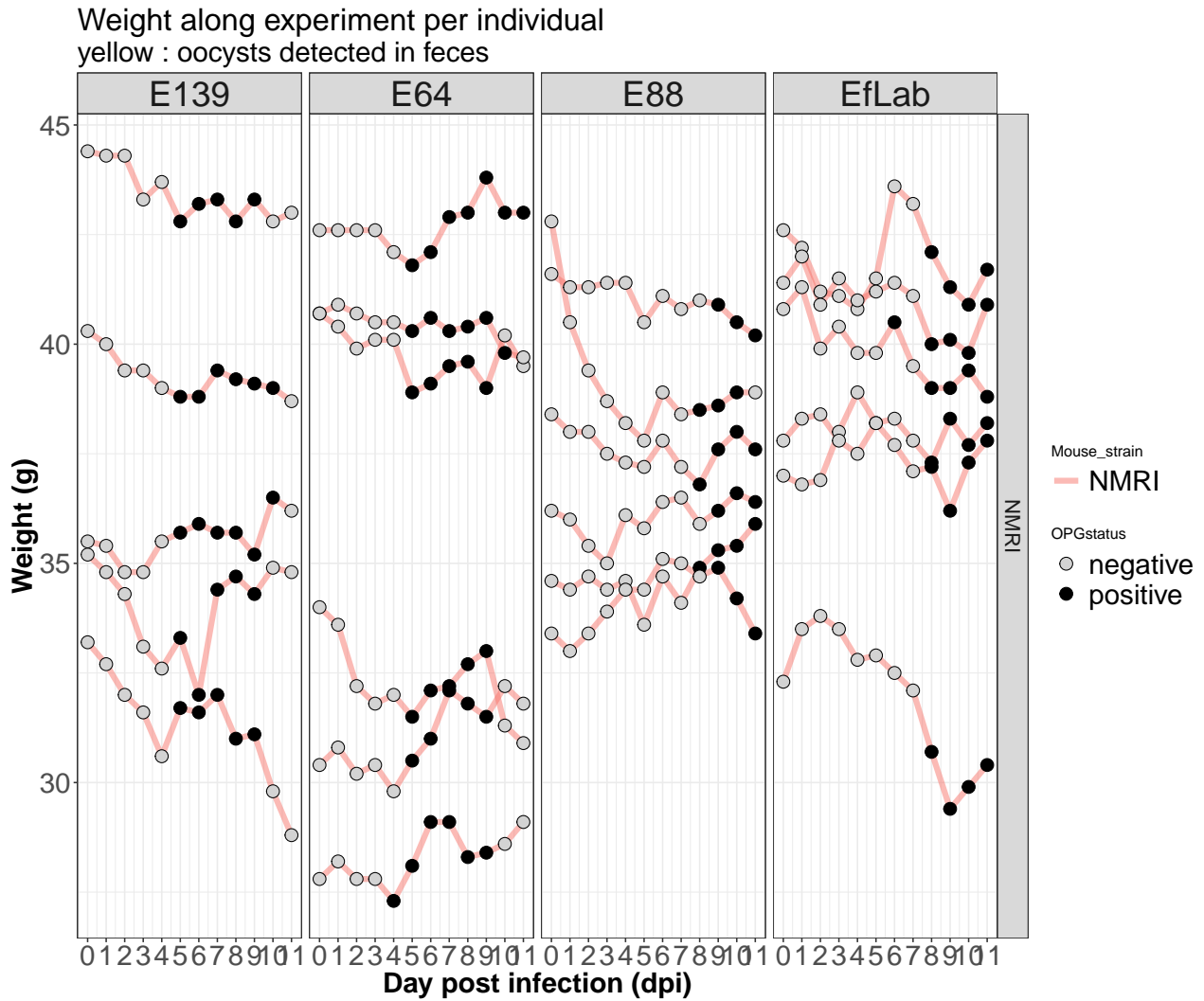
(Eflab, E88, E139, E64) in NMRI. 2 mice per cage. Only OPG recorded

Parasite shedding

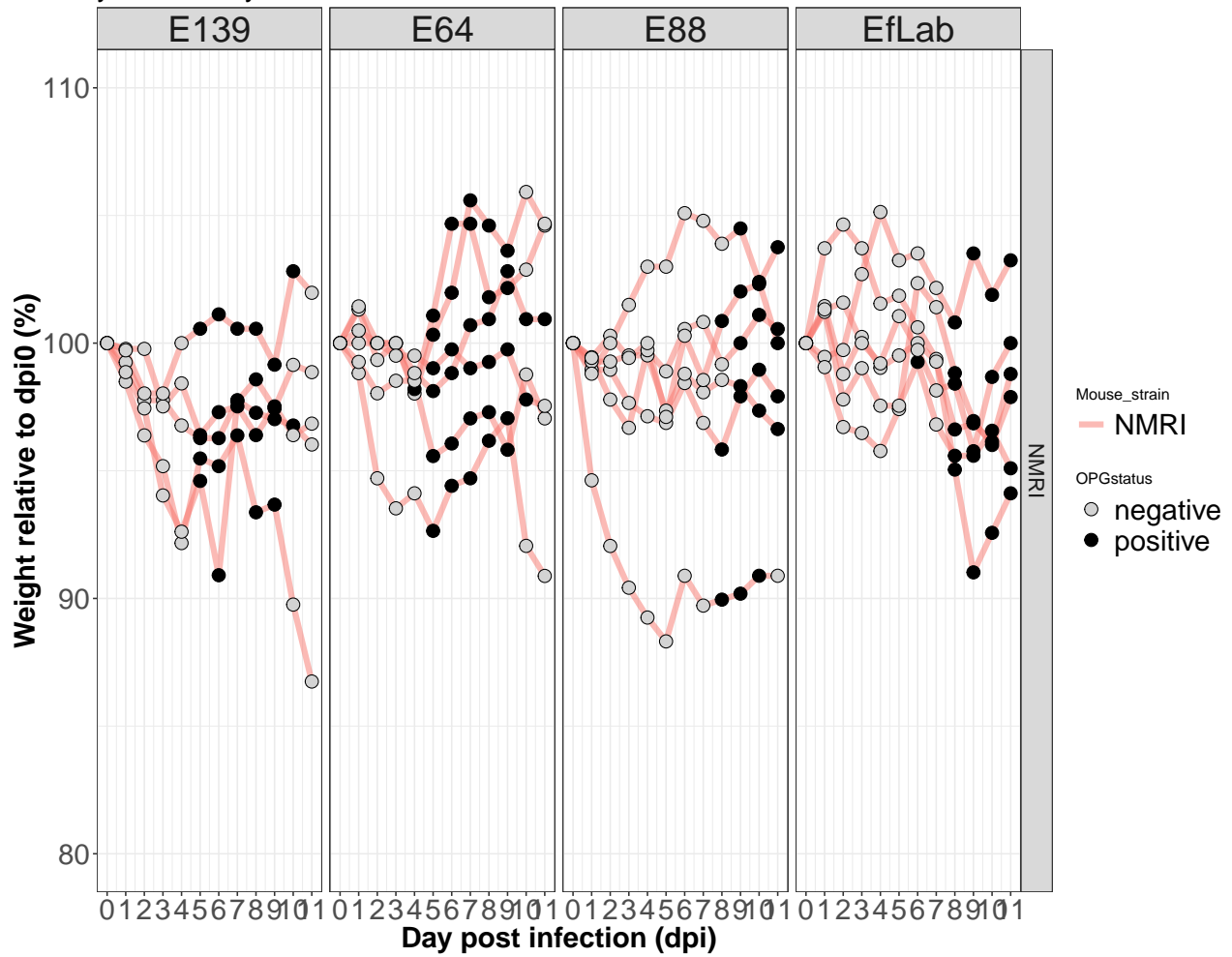


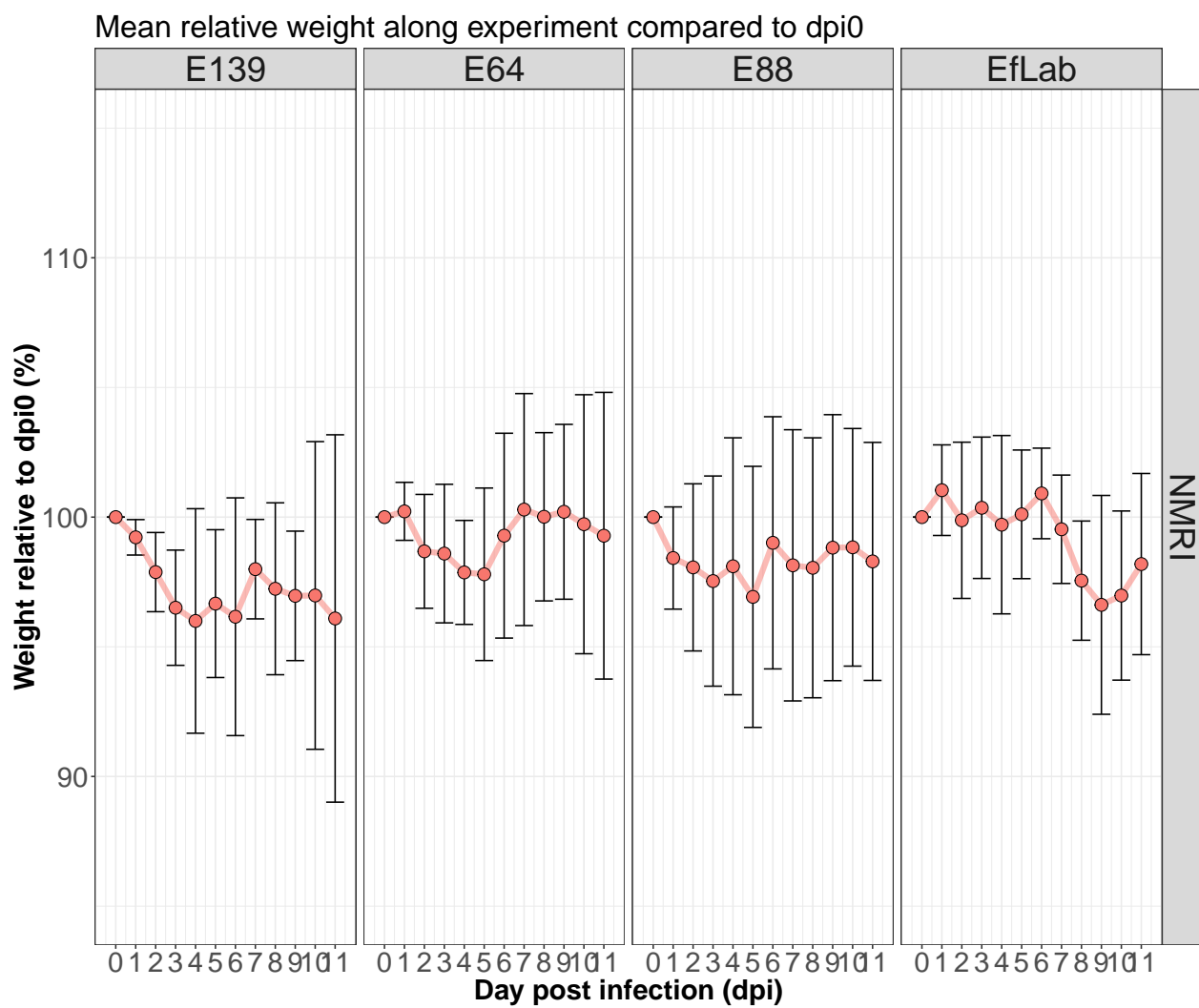
## Expe\_002: March 2018, NMRI mice infected with 4 *Eimeria* strains (Eflab, E88, E139, E64)

### 1. Weight loss



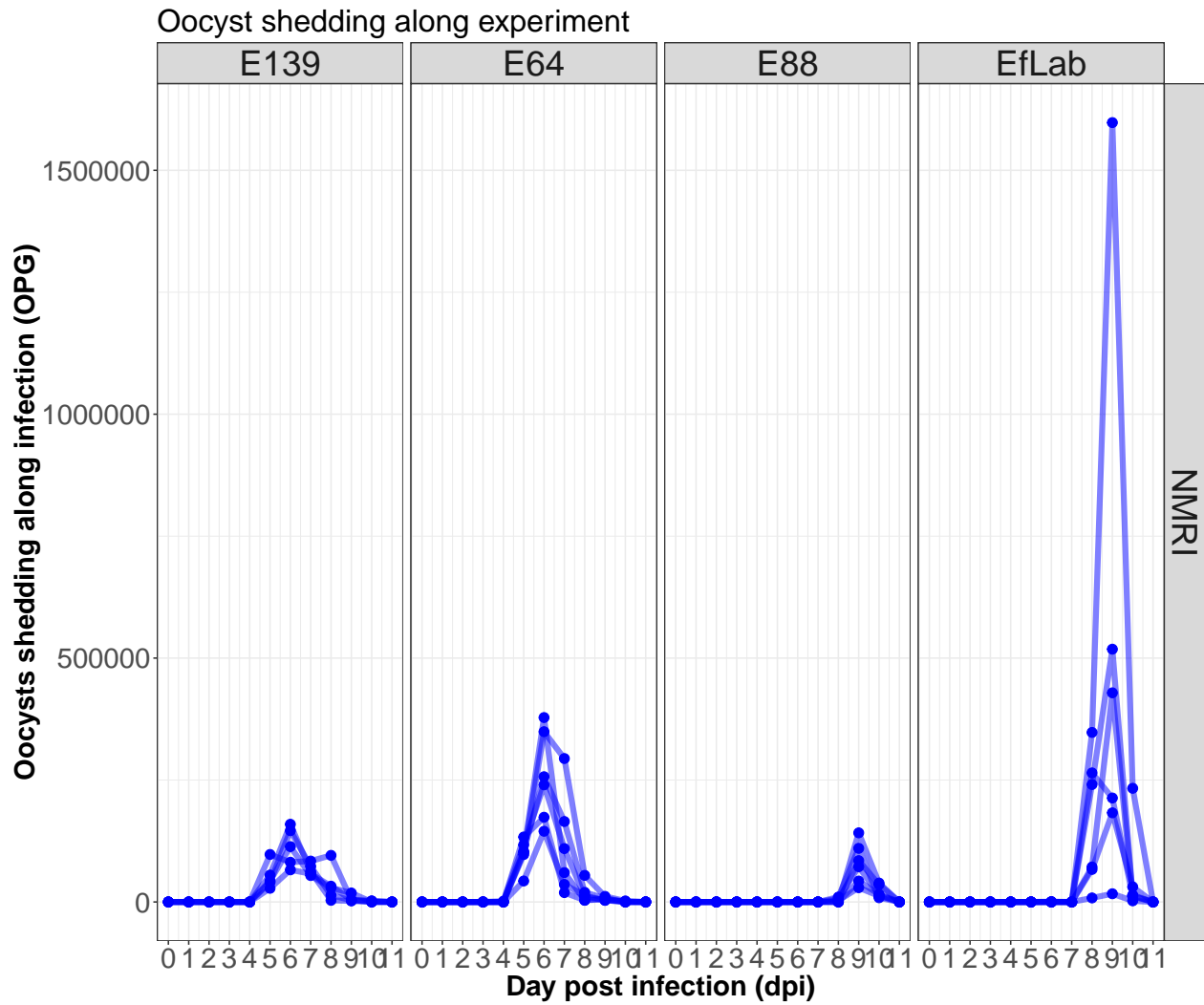
Relative weight along experiment compared to dpi0  
 yellow : oocysts detected in feces



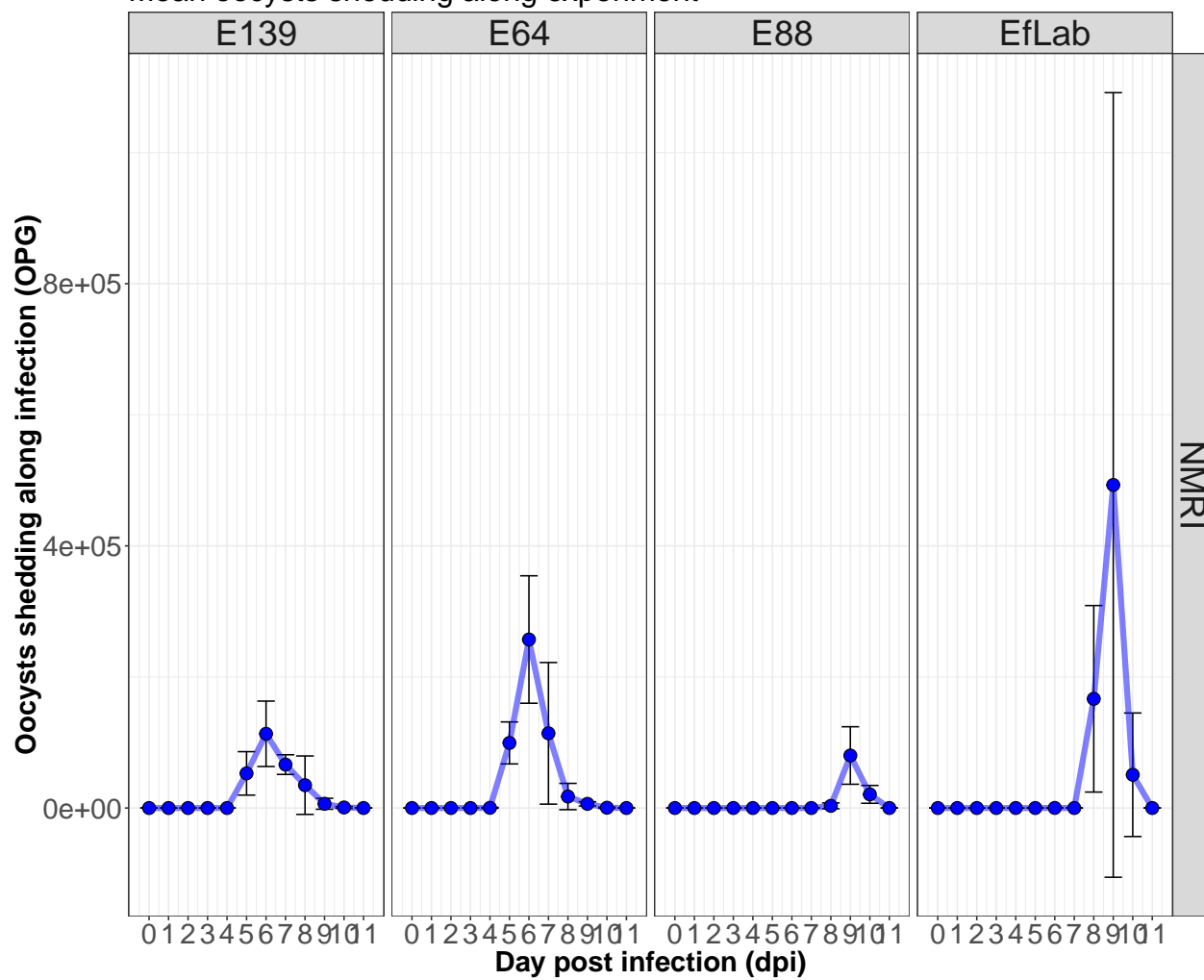




## 2. Parasite shedding



Mean oocysts shedding along experiment



### 3. Comparison host/parasite proxy

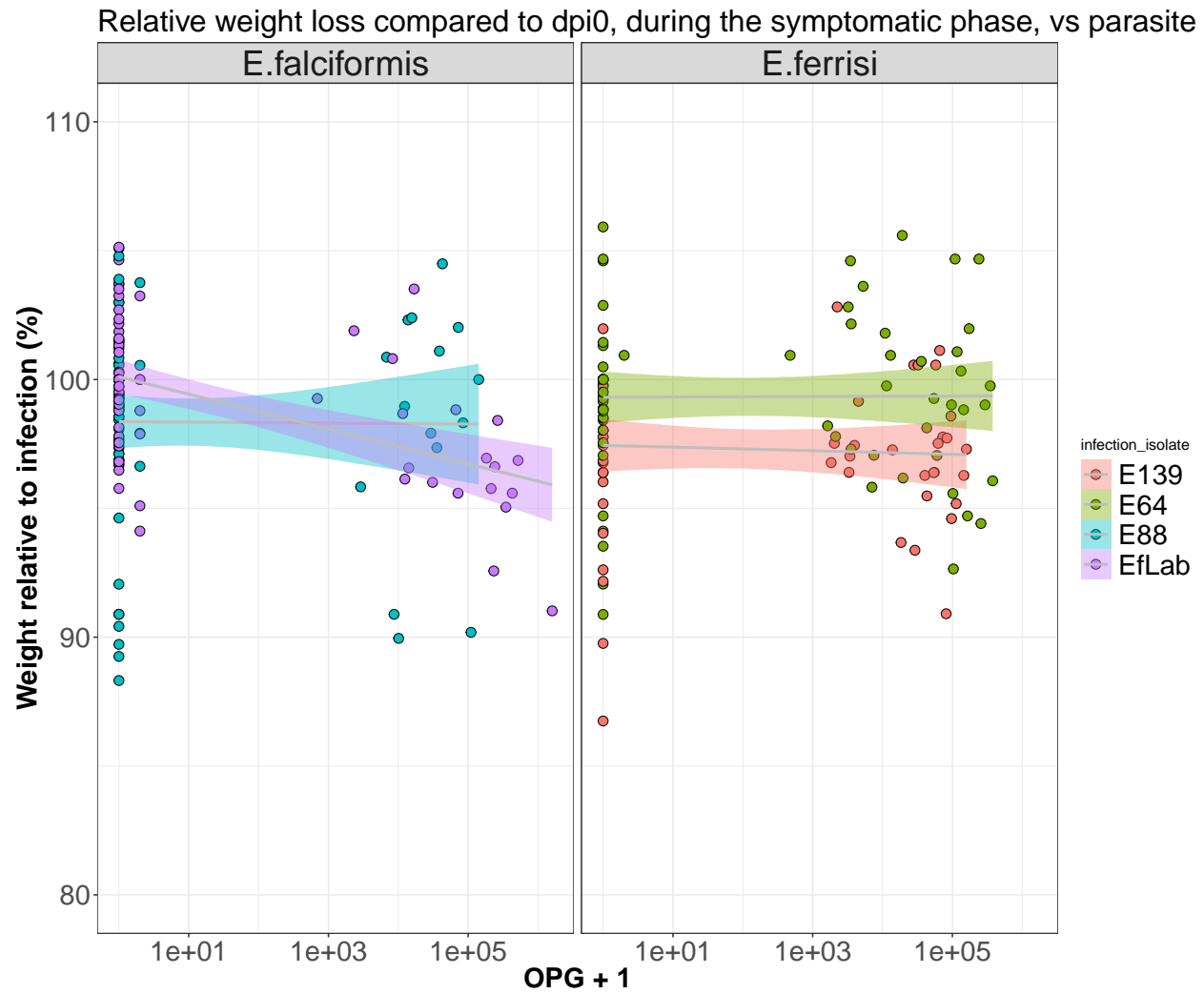
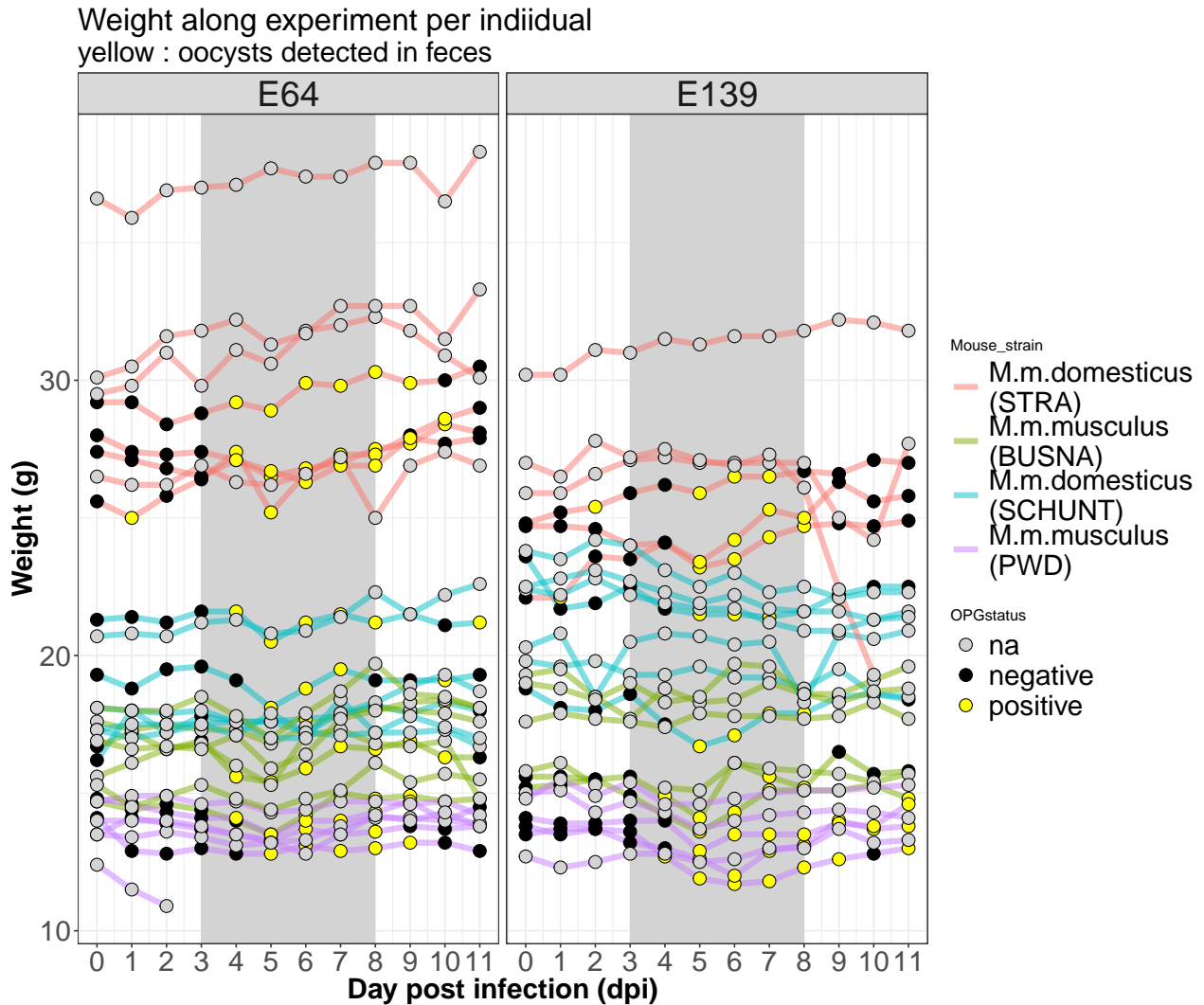


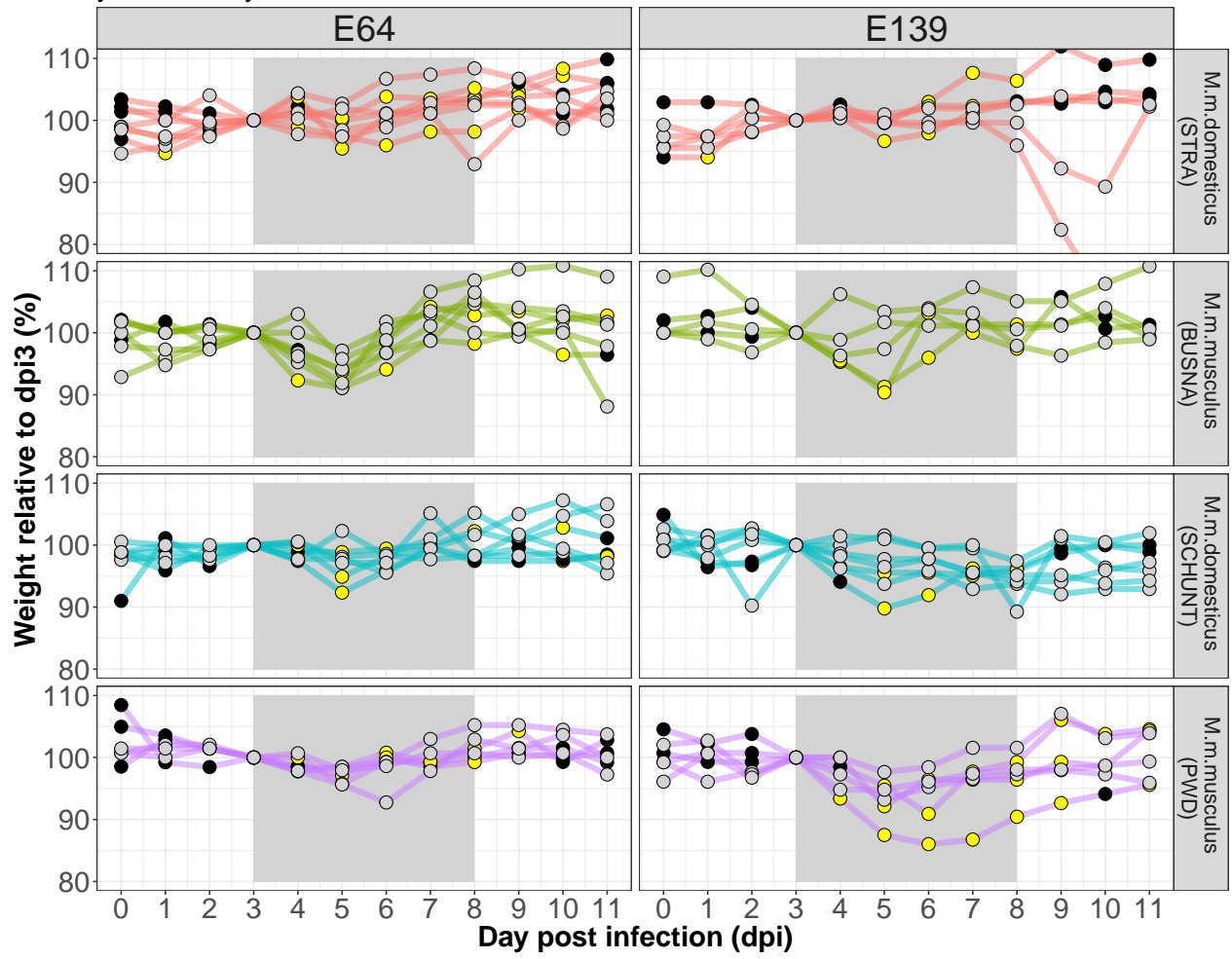
Figure 3: Weight as a function of OPG

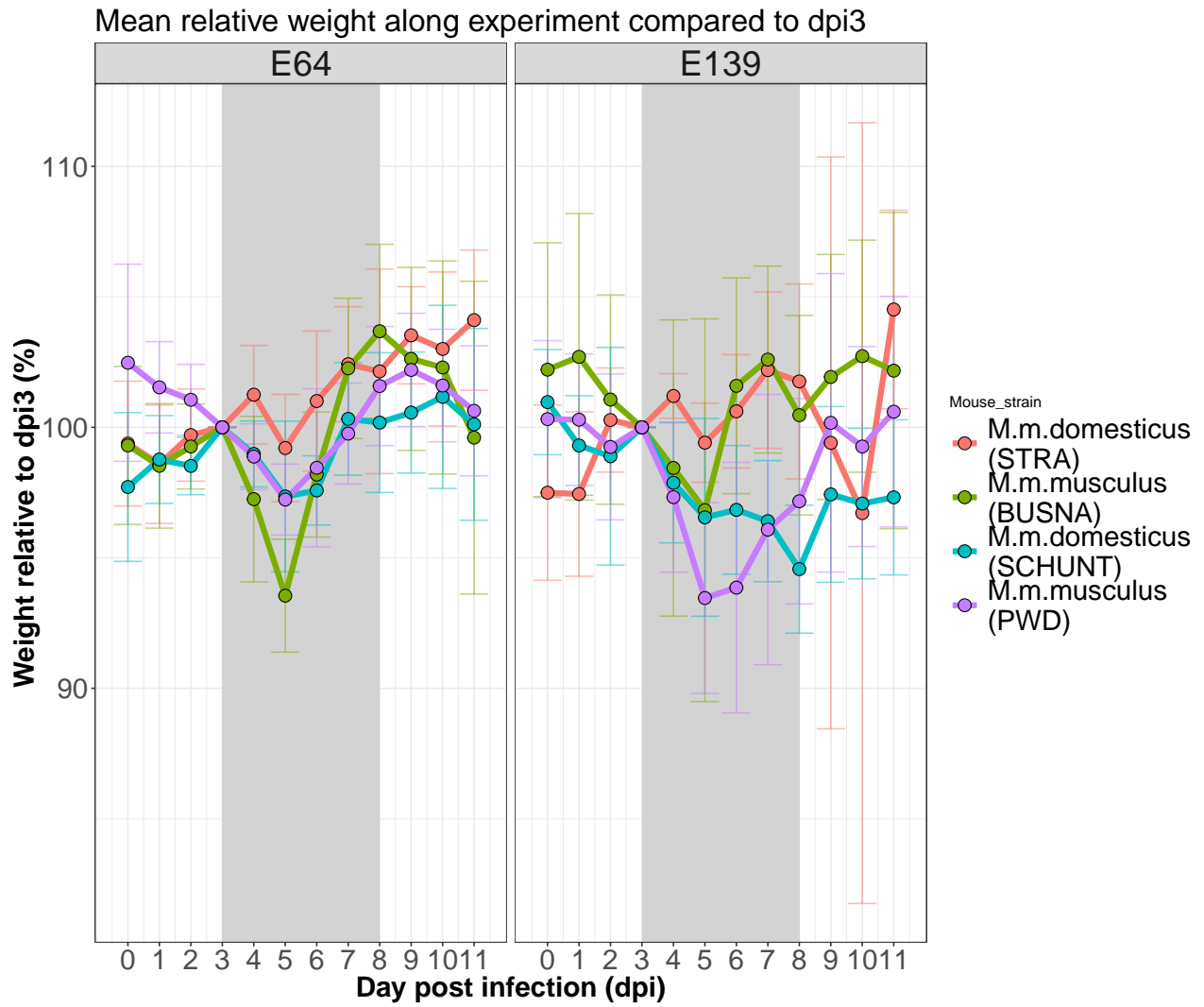
Expe\_003 & Expe\_004, April-May 2018, first batch Parental strains (F0) BUSNA, STRA, SCHUNT, PWD, infection with Eferrisi (E64 and E139) [2 batches]

## 1. Weight loss

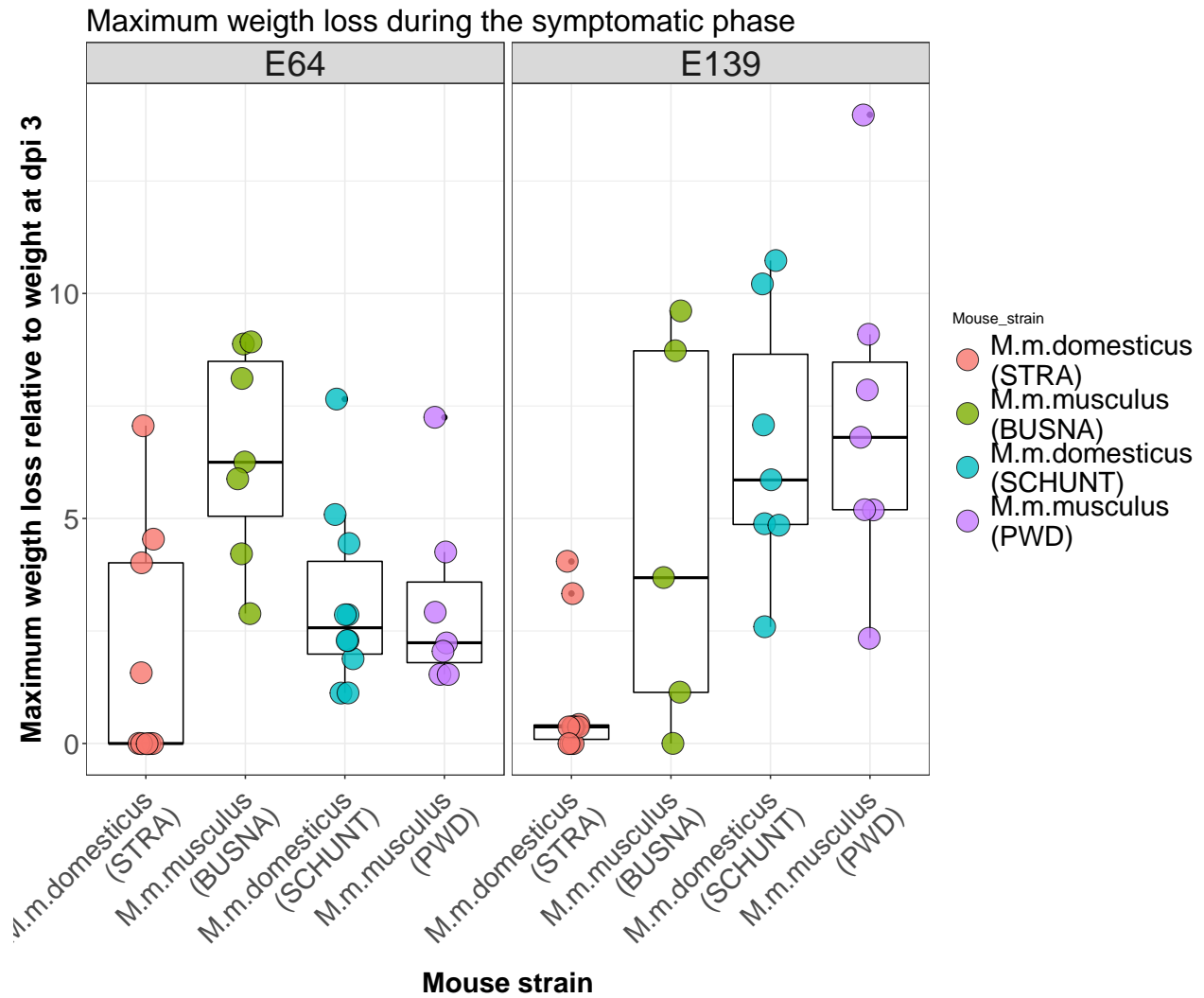


Relative weight along experiment compared to dpi3  
 yellow : oocysts detected in feces



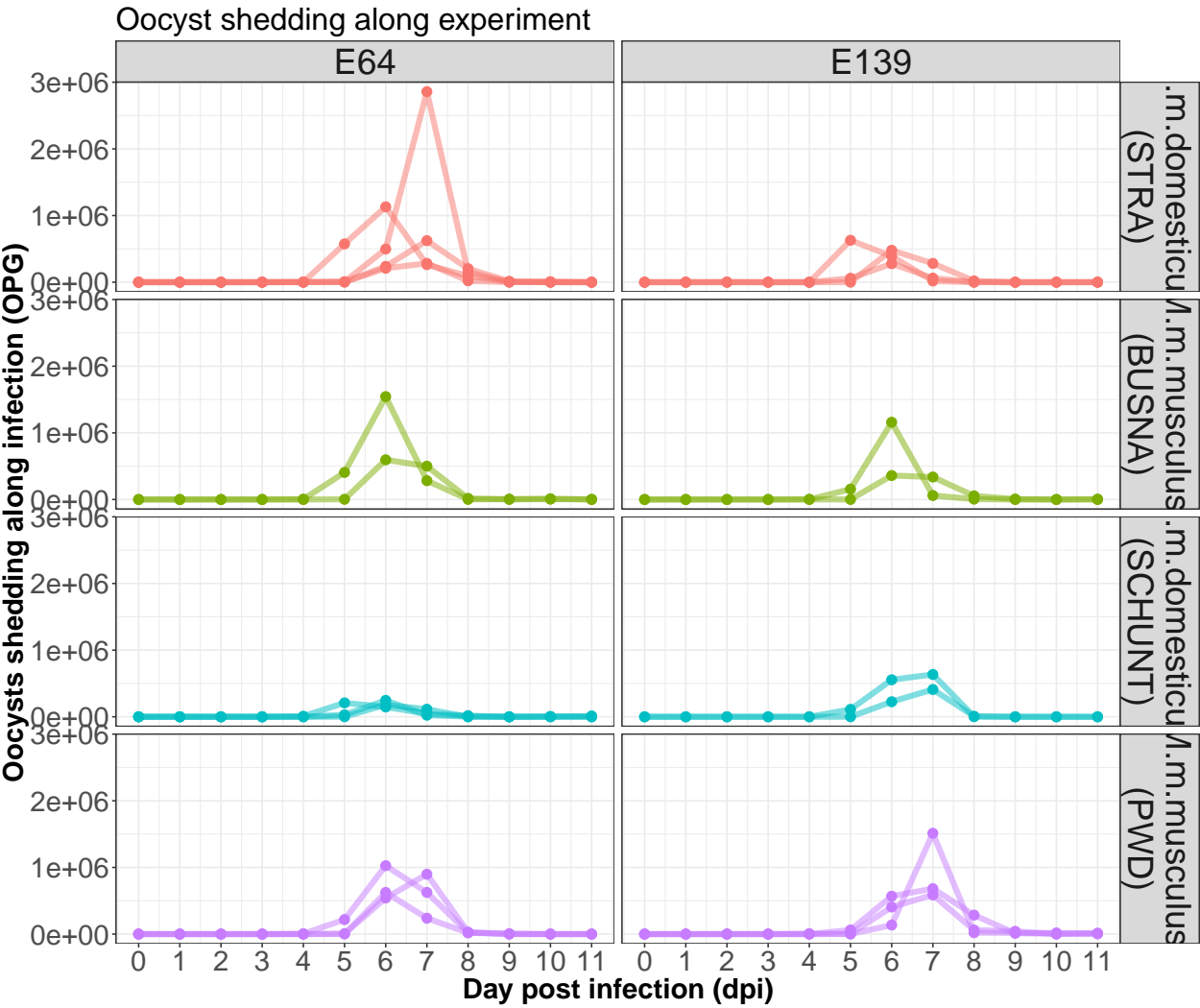


For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).



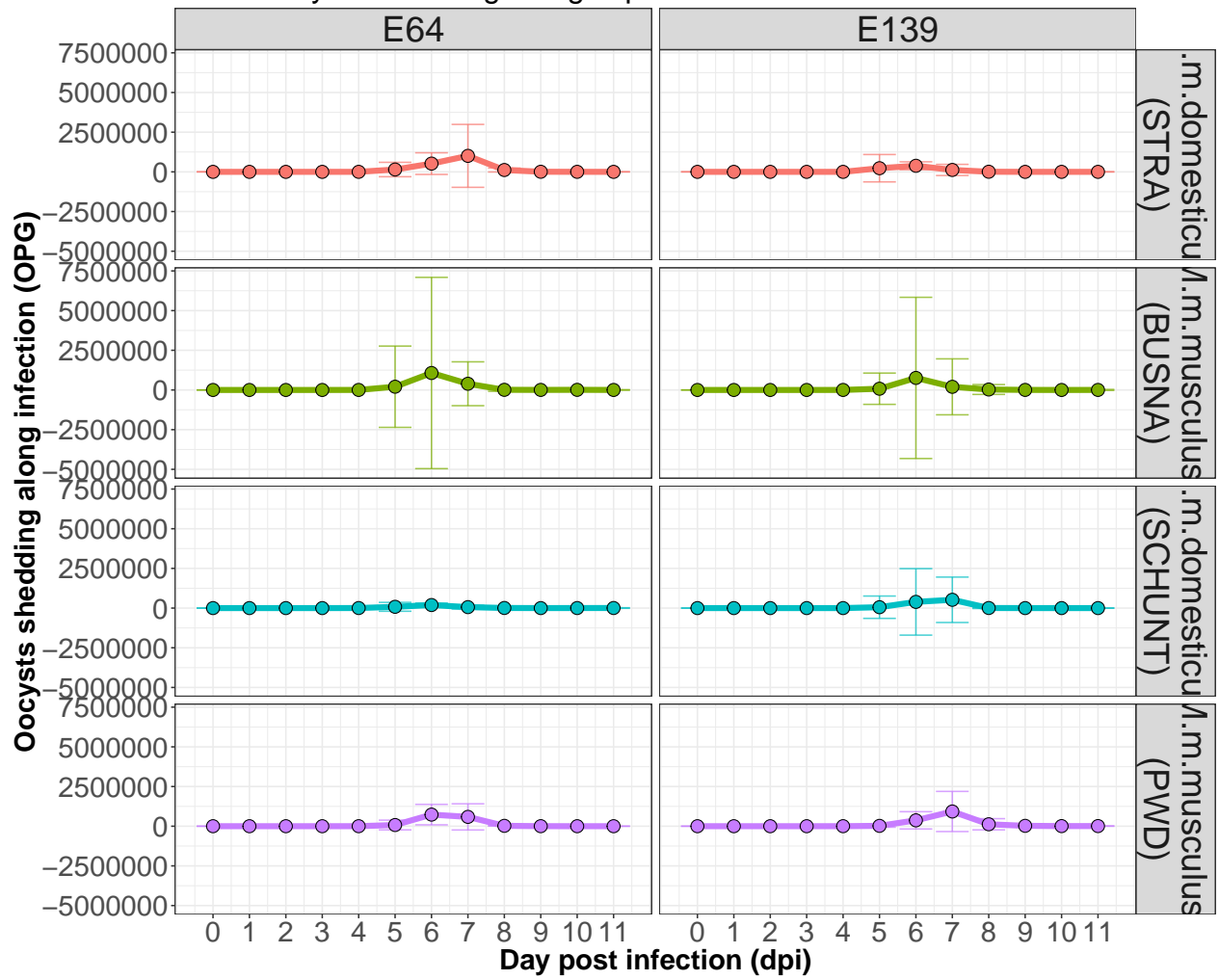
```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 20.177, df = 3, p-value = 0.000156
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_003_4$relativeWeight and max.loss_003_4$Mouse_strain
##
##           M.m.domesticus \n(STRA) M.m.musculus \n(BUSNA)
## M.m.musculus \n(BUSNA)      0.0022                -
## M.m.domesticus \n(SCHUNT) 0.0014                0.4167
## M.m.musculus \n(PWD)      0.0014                0.6649
##           M.m.domesticus \n(SCHUNT)
## M.m.musculus \n(BUSNA)      -
## M.m.domesticus \n(SCHUNT) -
## M.m.musculus \n(PWD)      0.7060
##
## P value adjustment method: BH
```

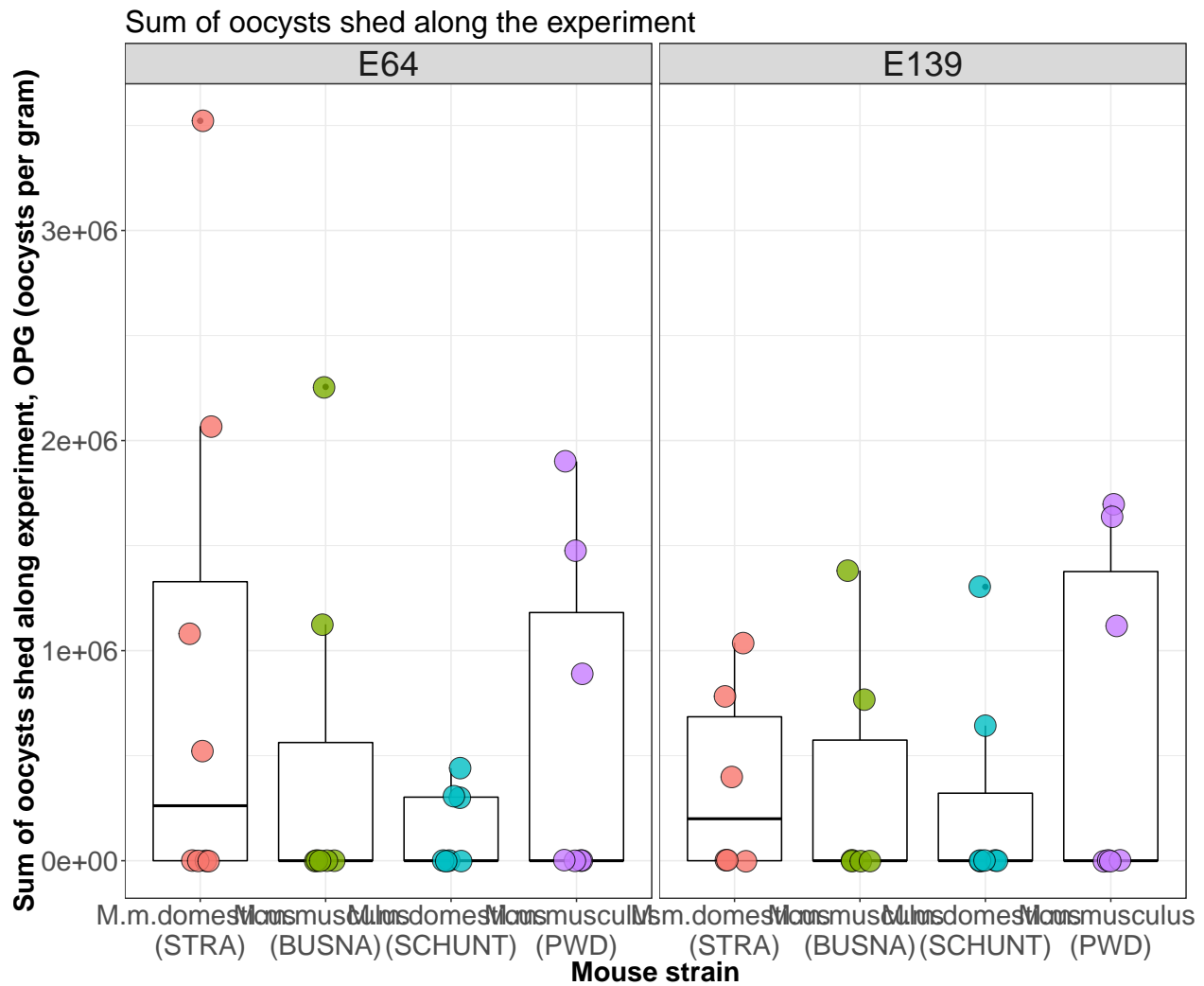
2. Parasite shedding





Mean oocysts shedding along experiment





```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by Mouse_strain
## Kruskal-Wallis chi-squared = 1.8585, df = 3, p-value = 0.6023
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_003_4$sum.oo and sum.oocysts_003_4$Mouse_strain
##
##           M.m.domesticus \n(STRA) M.m.musculus \n(BUSNA)
## M.m.musculus \n(BUSNA)      0.73                -
## M.m.domesticus \n(SCHUNT) 0.73                1.00
## M.m.musculus \n(PWD)      1.00                0.73
##           M.m.domesticus \n(SCHUNT)
## M.m.musculus \n(BUSNA)      -
## M.m.domesticus \n(SCHUNT) -
## M.m.musculus \n(PWD)      0.73
##
## P value adjustment method: BH
```

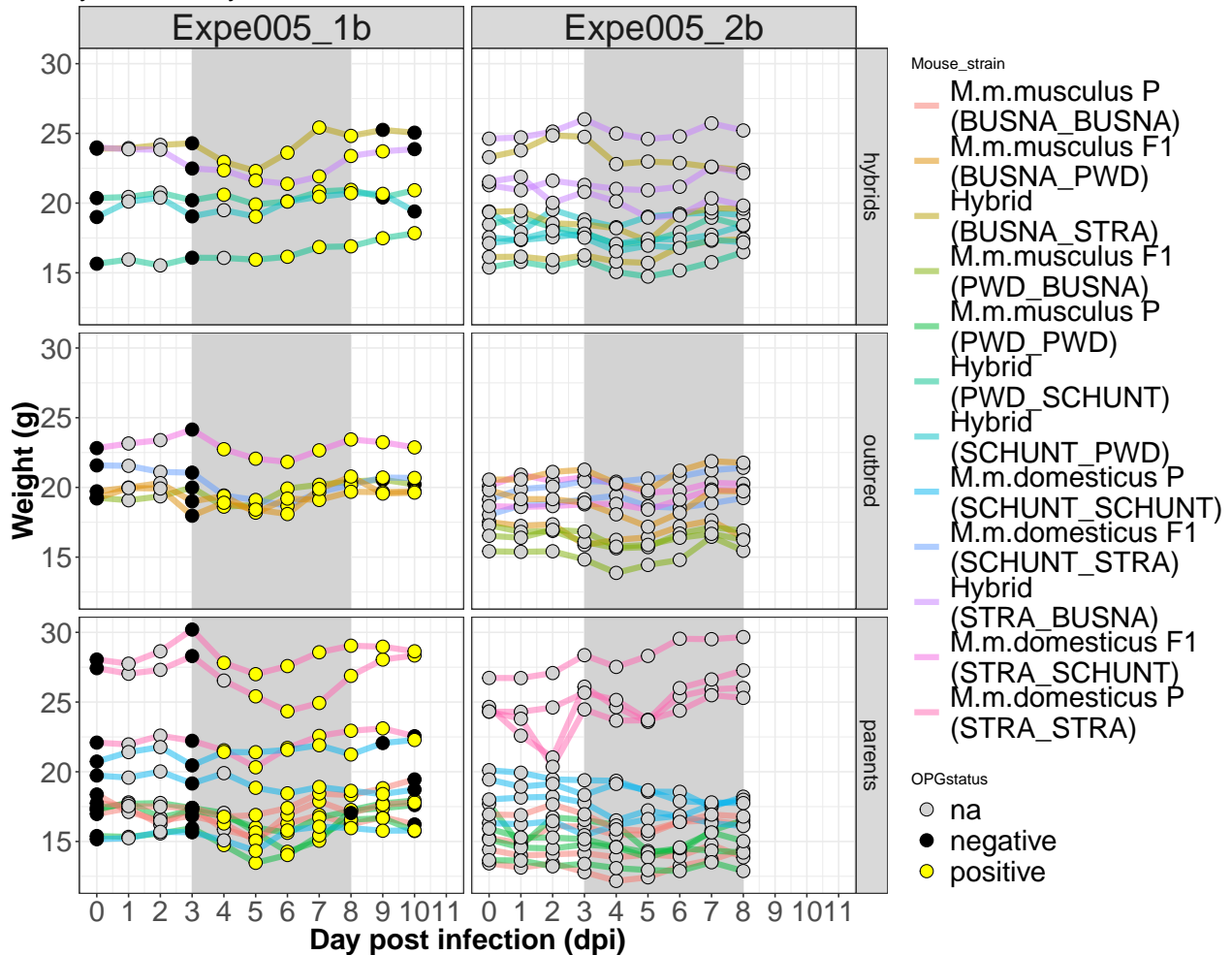
Expe\_005, July 2018, FULL experiment (parents, intra specific and inter species hybrids) BUSNA, STRA, SCHUNT, PWD, infection with *Eimeria ferrisi* and *Efalciiformis* (E64 and E88)

1. Weight loss

*Eimeria ferrisi*

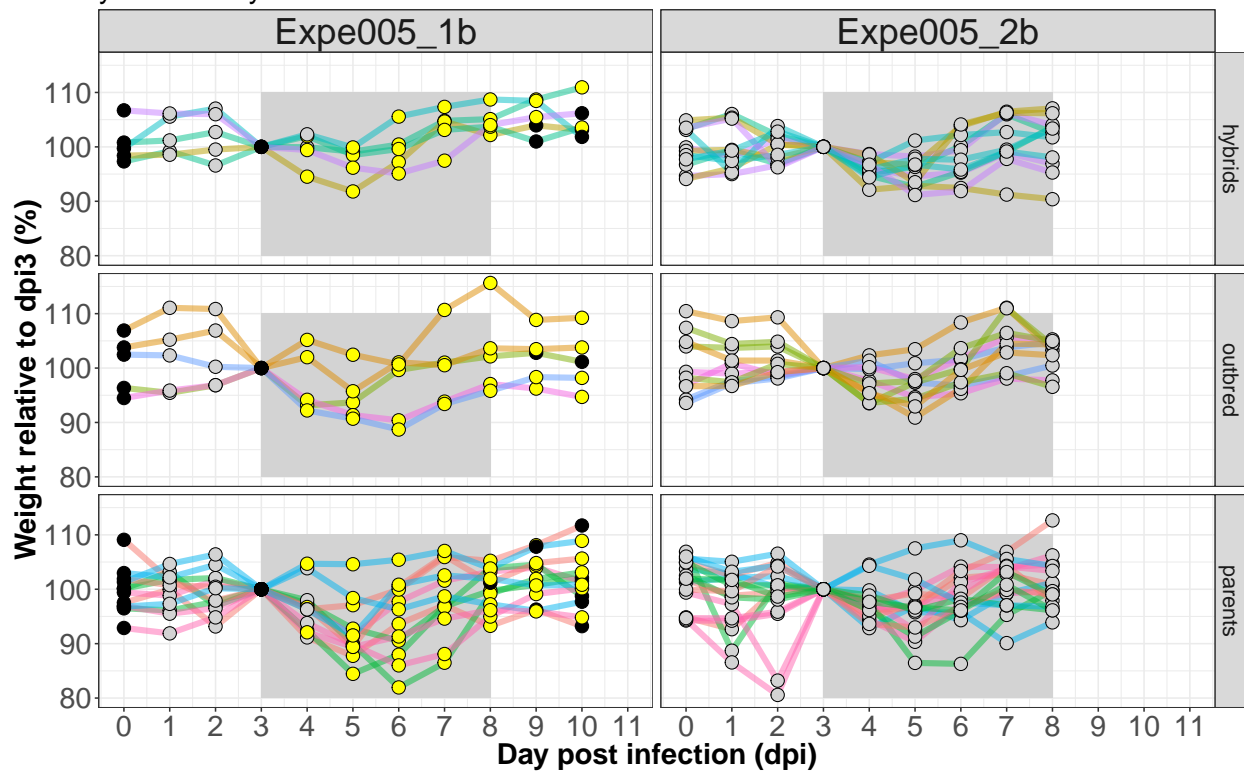
Weight along experiment per individual (E64)

yellow : oocysts detected in feces



Relative weight along experiment compared to dpi3 (E64)

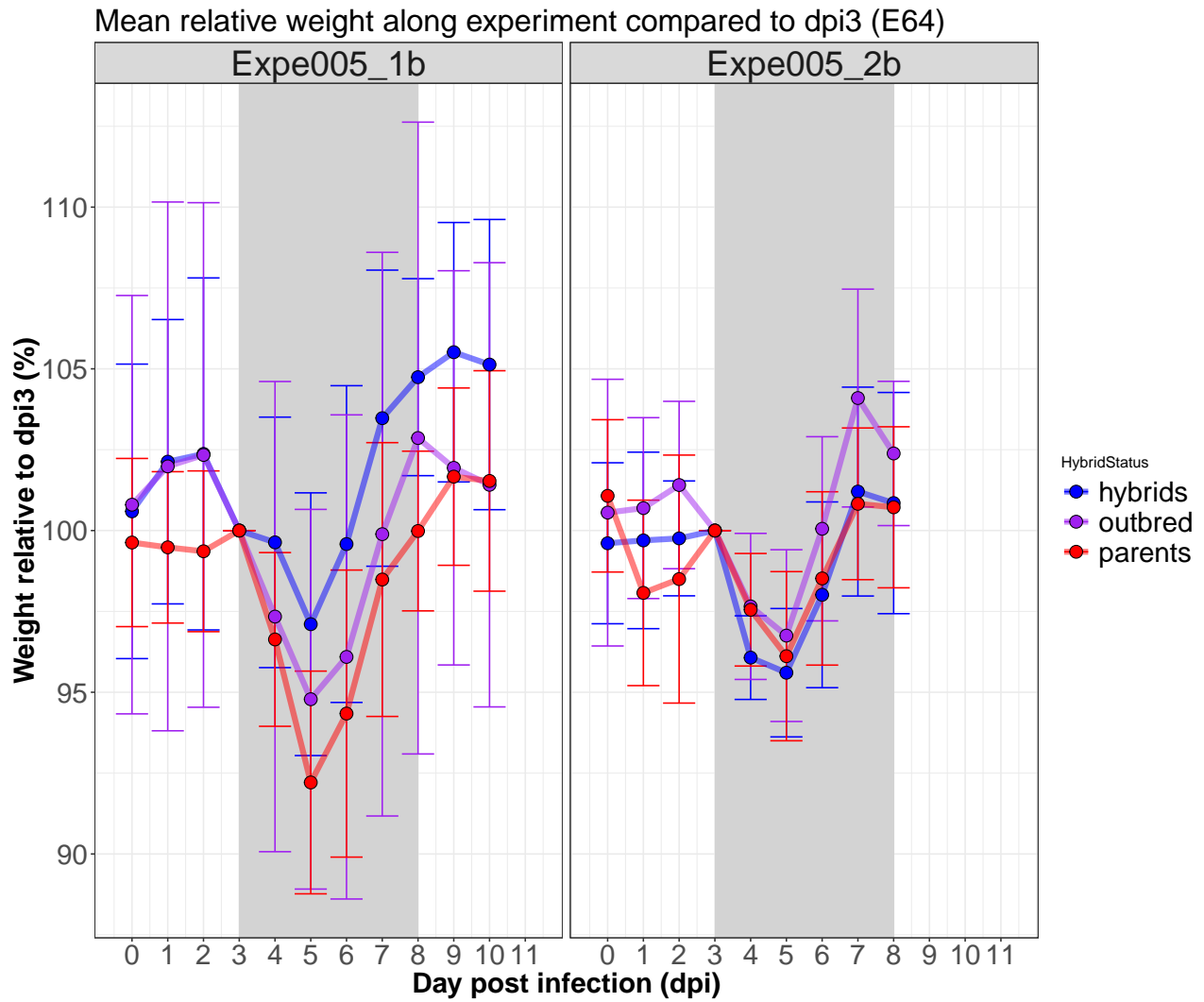
yellow : oocysts detected in feces



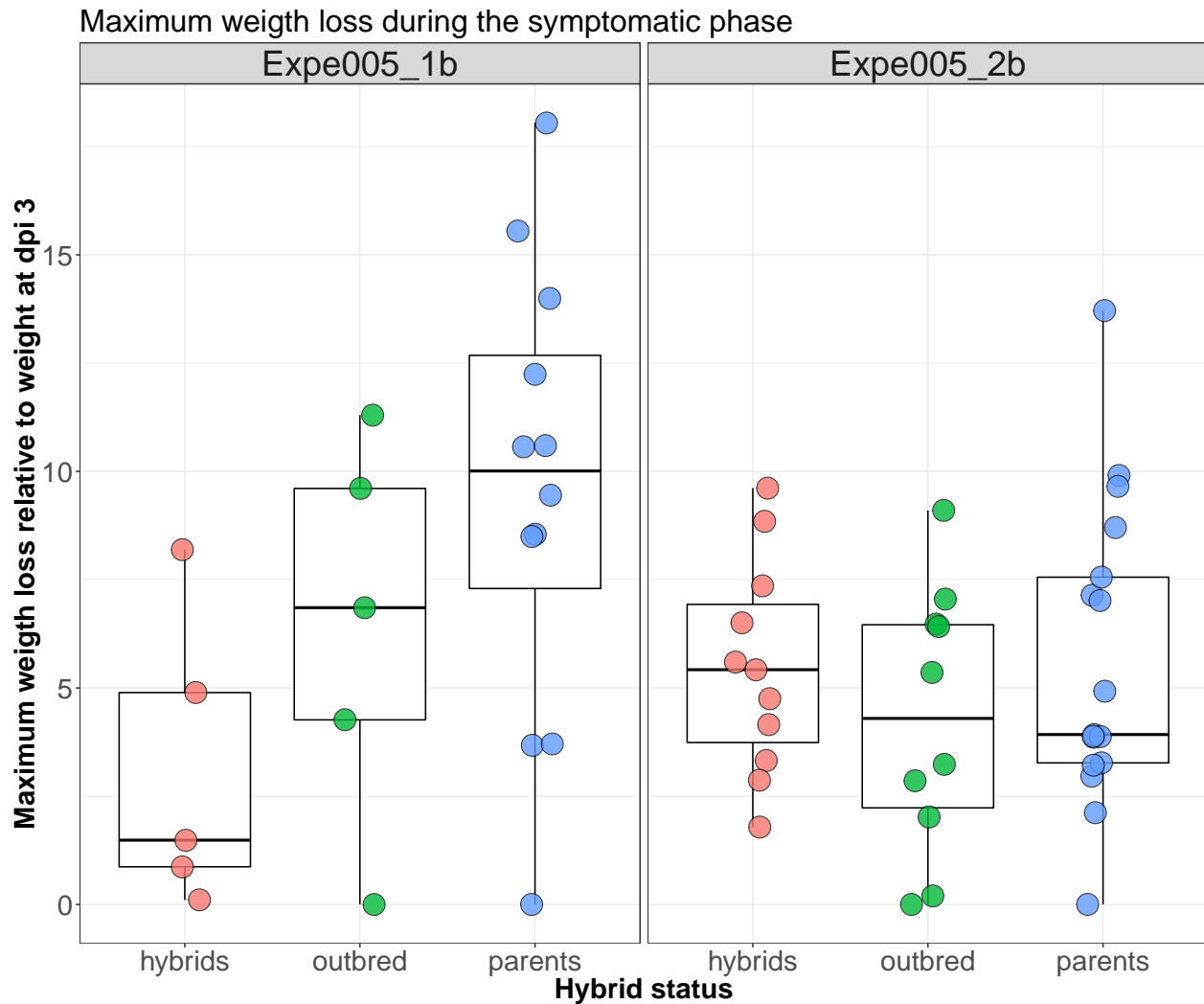
gative ● positive

Mouse\_strain

|                              |                             |                                  |
|------------------------------|-----------------------------|----------------------------------|
| M.m.musculus P (BUSNA_BUSNA) | M.m.musculus F1 (PWD_BUSNA) | Hybrid (SCHUNT_PWD)              |
| M.m.musculus F1 (BUSNA_PWD)  | M.m.musculus P (PWD_PWD)    | M.m.domesticus P (SCHUNT_SCHUNT) |
| Hybrid (BUSNA_STRA)          | Hybrid (PWD_SCHUNT)         | M.m.domesticus F1 (SCHUNT_STRA)  |



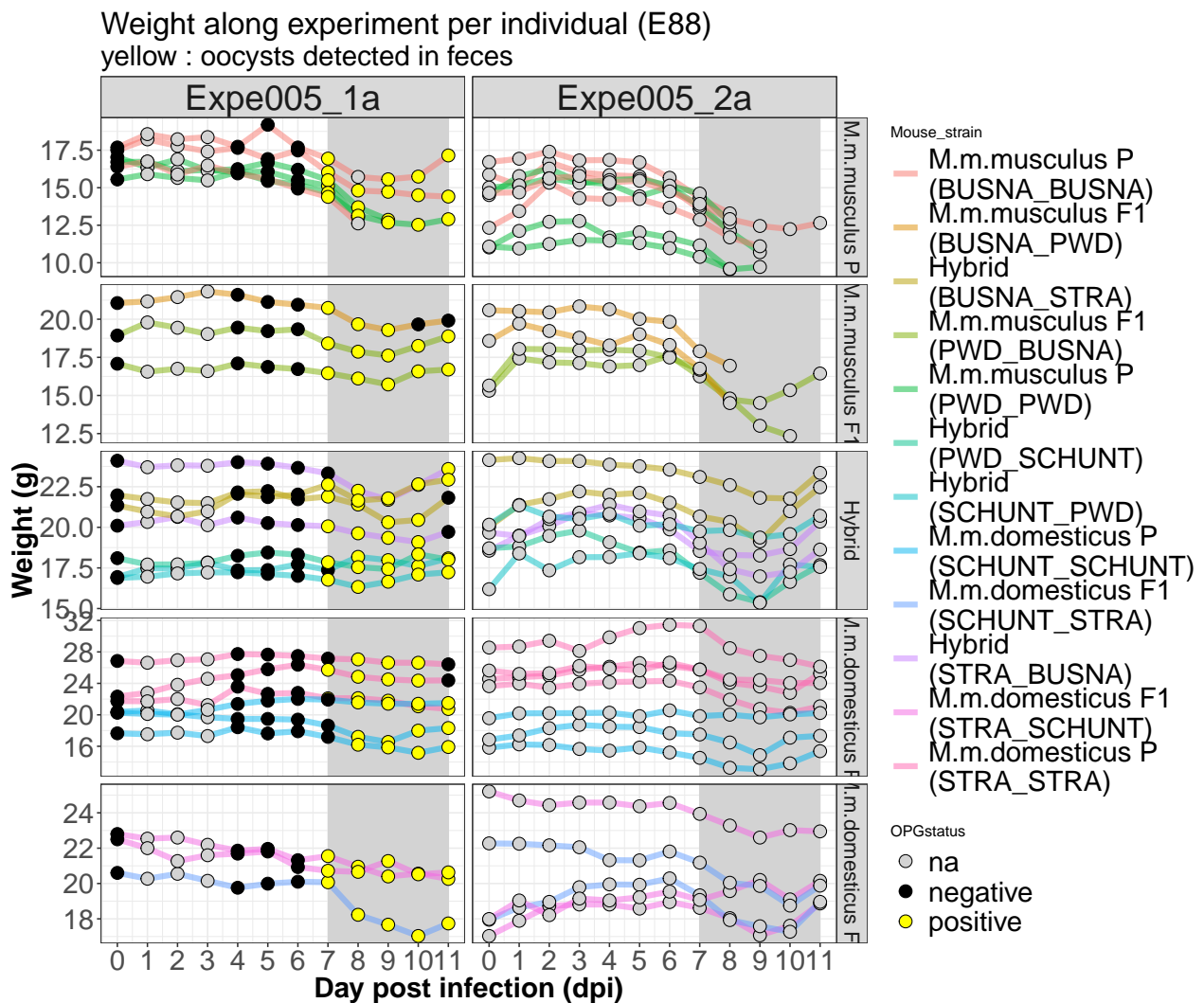
For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).



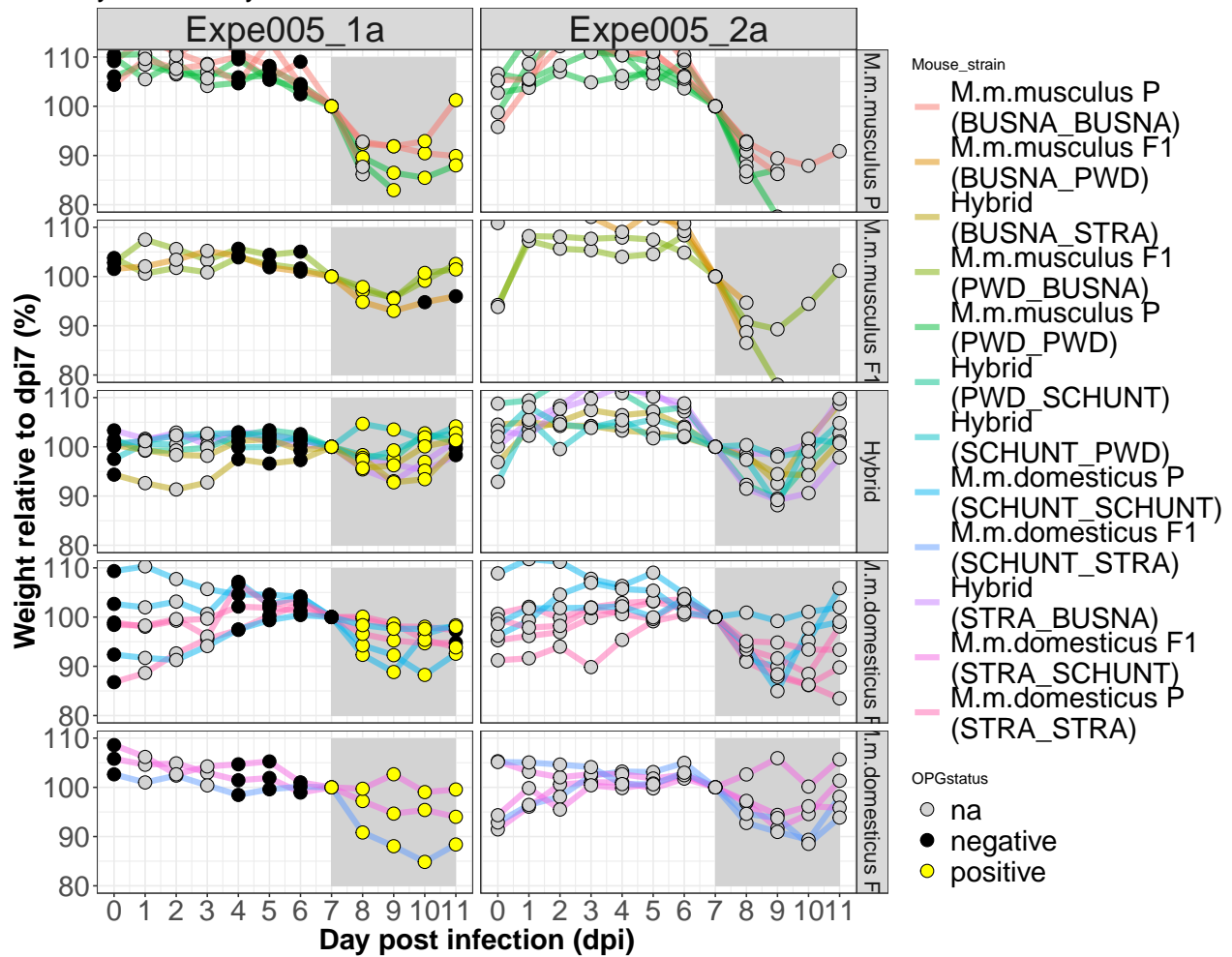
```
## [1] "first batch"
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 5.0441, df = 2, p-value = 0.0803
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E64B1$relativeWeight and maxloss_E64B1$HybridStatus
##
##      hybrids outbred
## outbred 0.42      -
## parents 0.08      0.42
##
## P value adjustment method: BH
## [1] "second batch"
##
## Kruskal-Wallis rank sum test
```

```
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 1.3931, df = 2, p-value = 0.4983
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E64B2$relativeWeight and maxloss_E64B2$HybridStatus
##
## hybrids outbred
## outbred 0.52 -
## parents 0.93 0.52
##
## P value adjustment method: BH
```

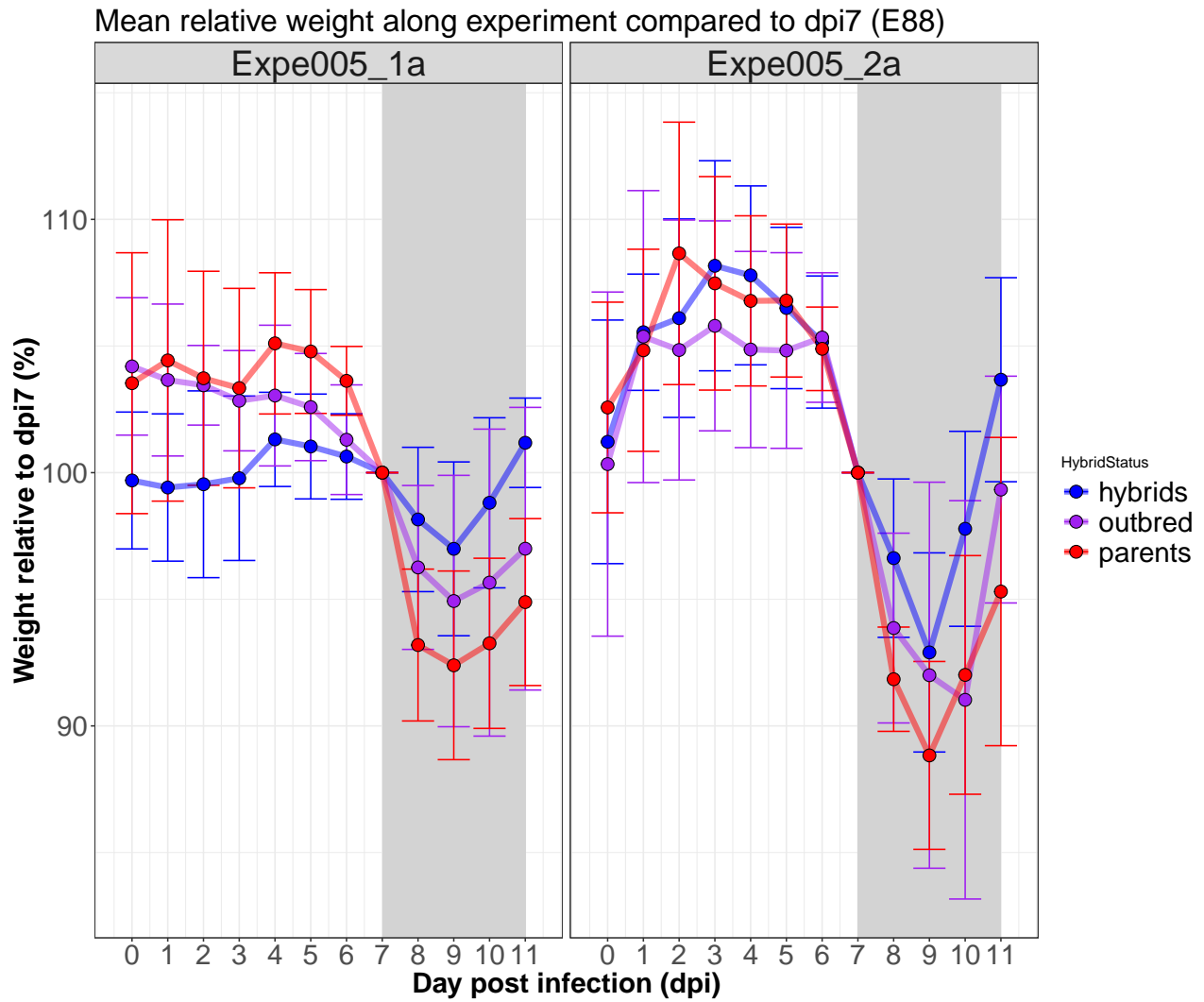
### Eimeria falciformis



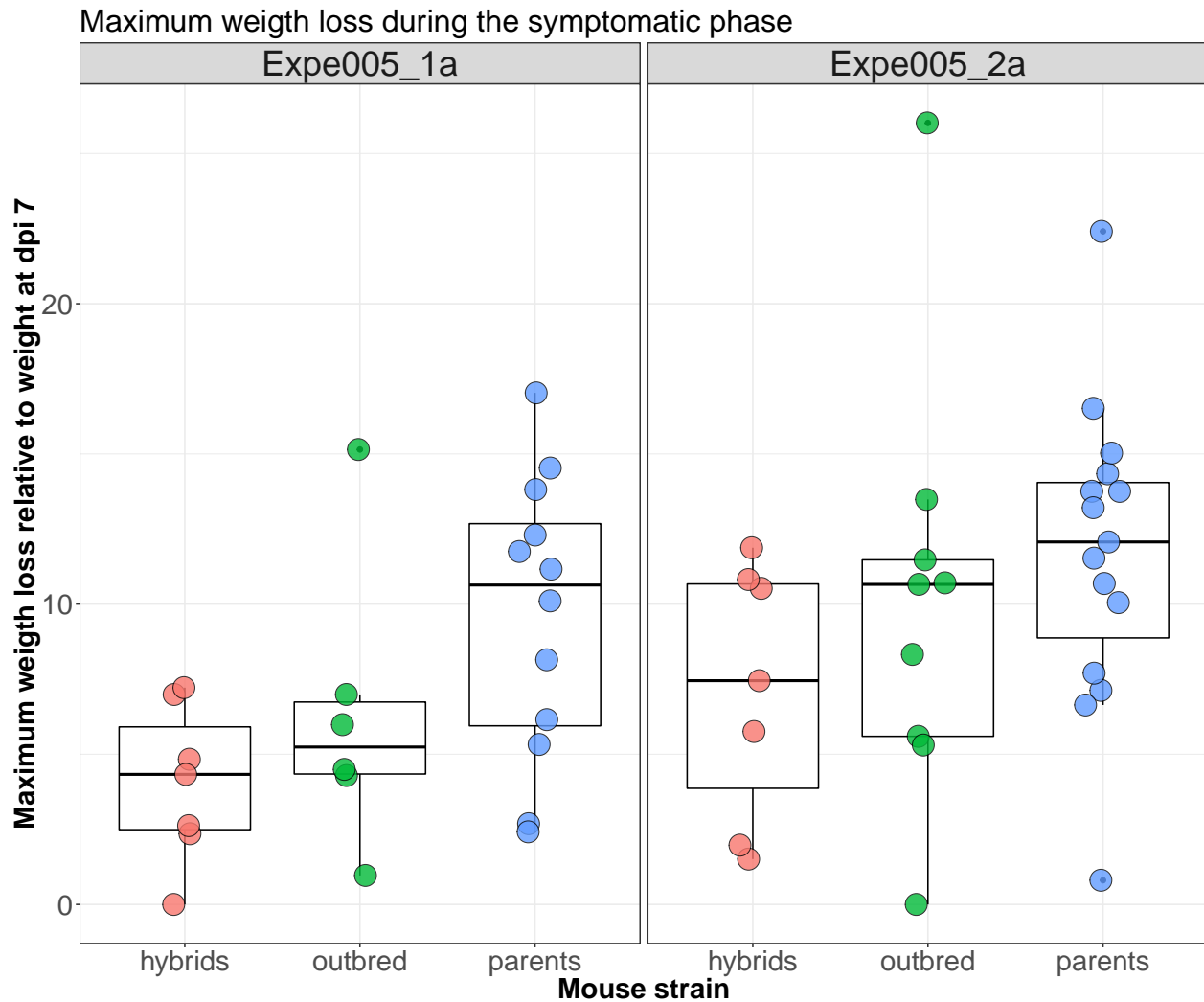
Relative weight along experiment compared to dpi7 (E88)  
yellow : oocysts detected in feces







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).

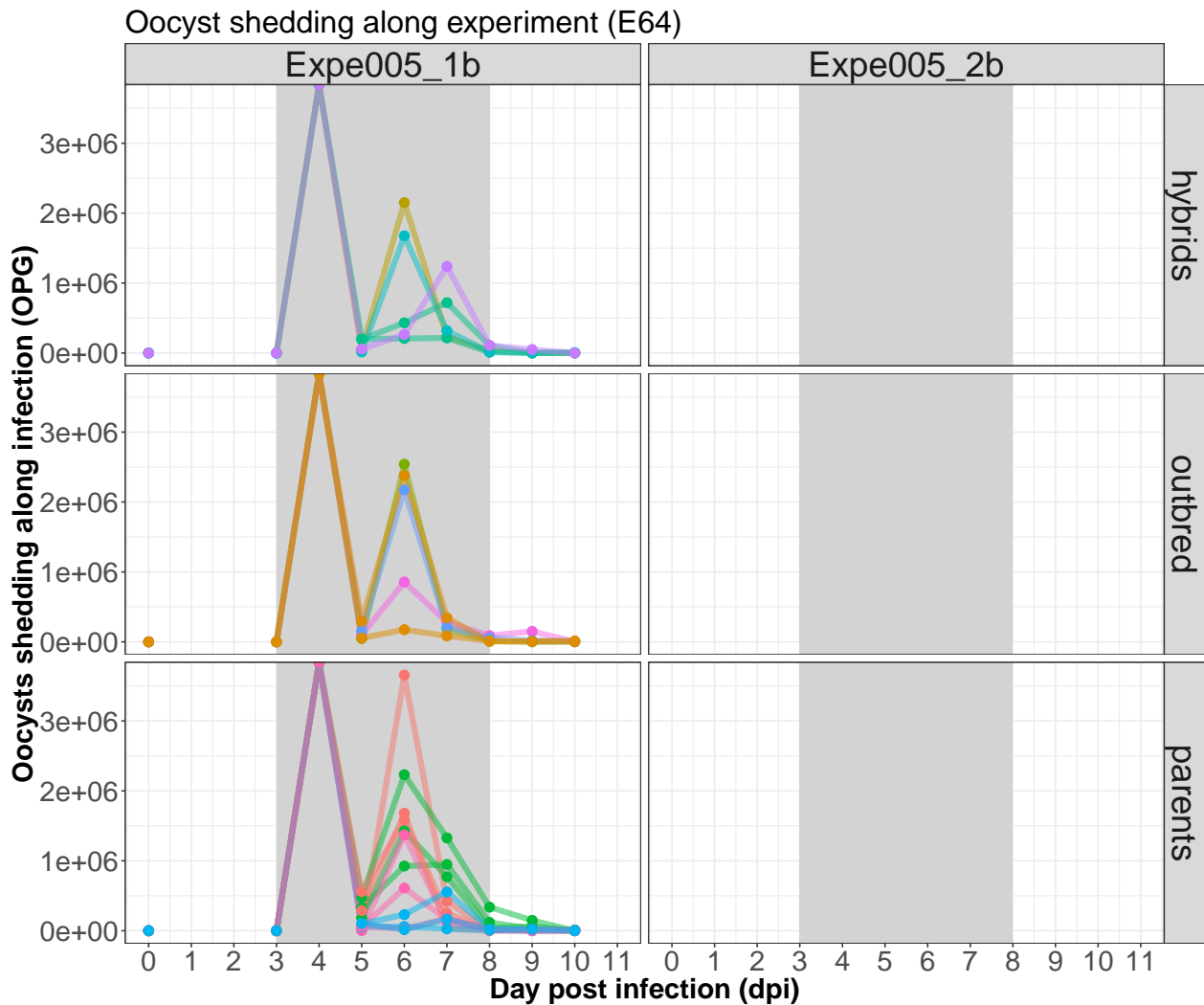


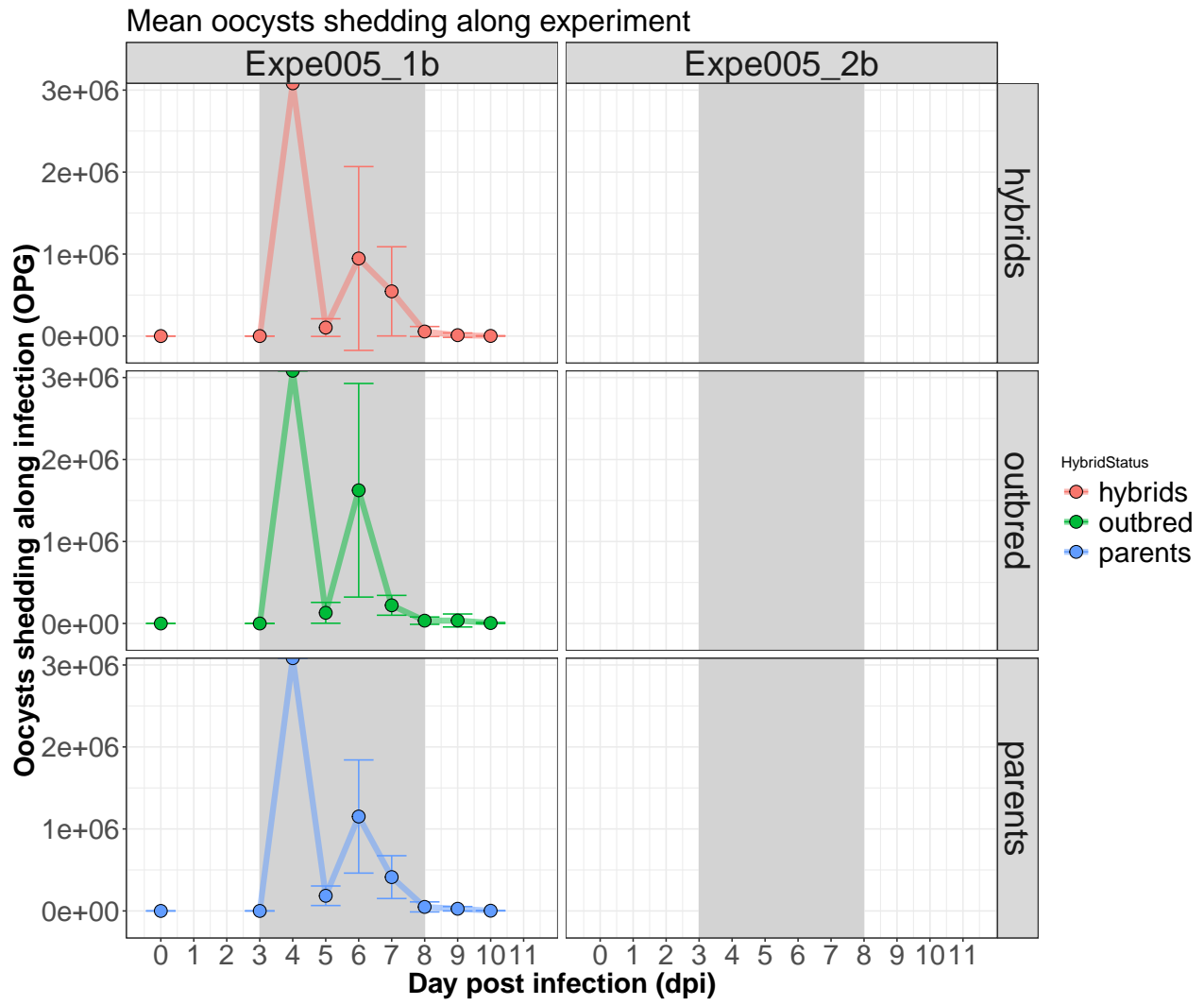
```
## [1] "first batch"

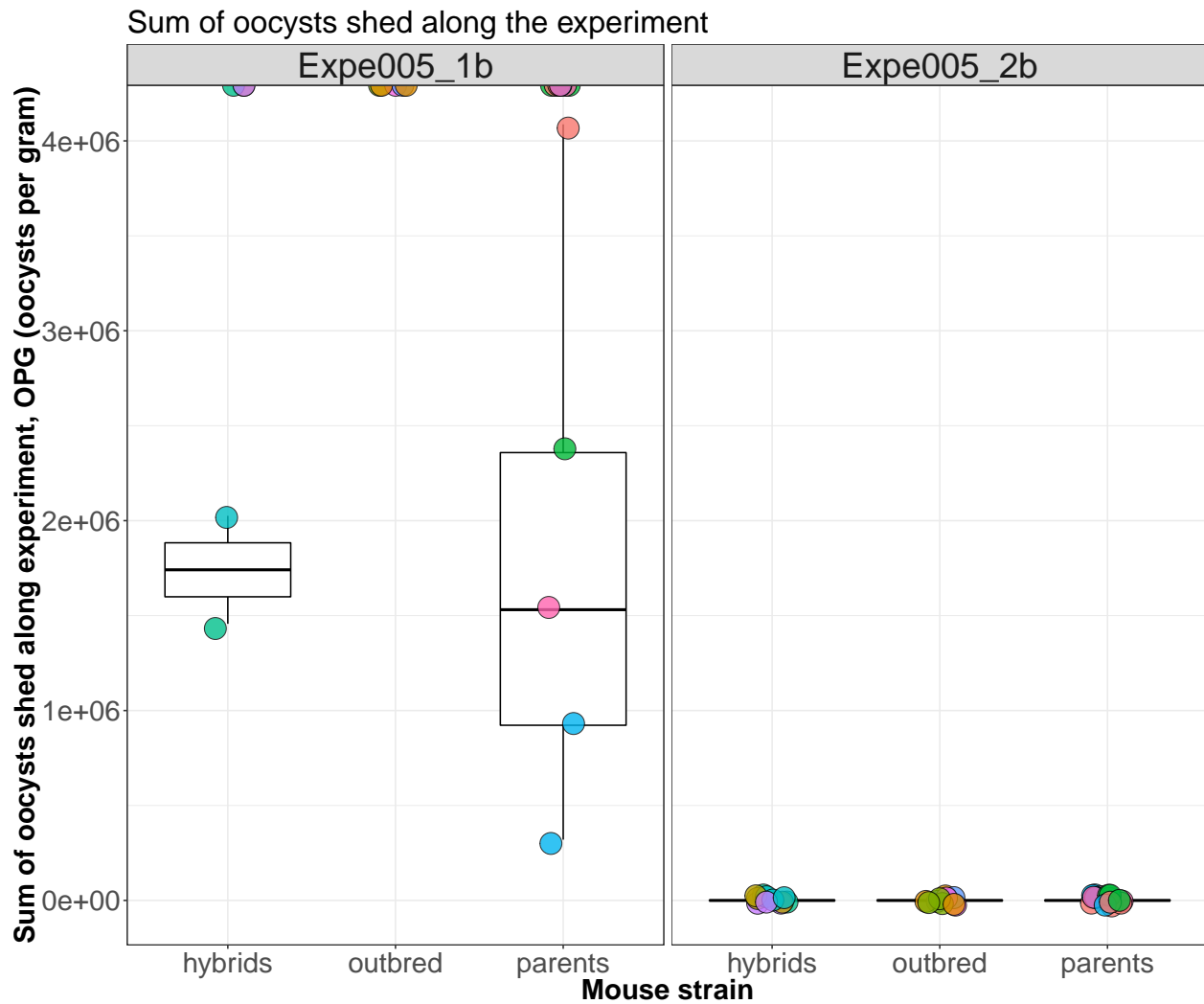
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 6.1426, df = 2, p-value = 0.04636
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E88B1$relativeWeight and maxloss_E88B1$HybridStatus
##
##      hybrids outbred
## outbred 0.534    -
## parents 0.039    0.319
##
## P value adjustment method: BH
## [1] "second batch"
##
## Kruskal-Wallis rank sum test
```

```
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 4.3167, df = 2, p-value = 0.1155
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E88B2$relativeWeight and maxloss_E88B2$HybridStatus
##
## hybrids outbred
## outbred 0.54 -
## parents 0.14 0.36
##
## P value adjustment method: BH
```

## 2. Parasite shedding

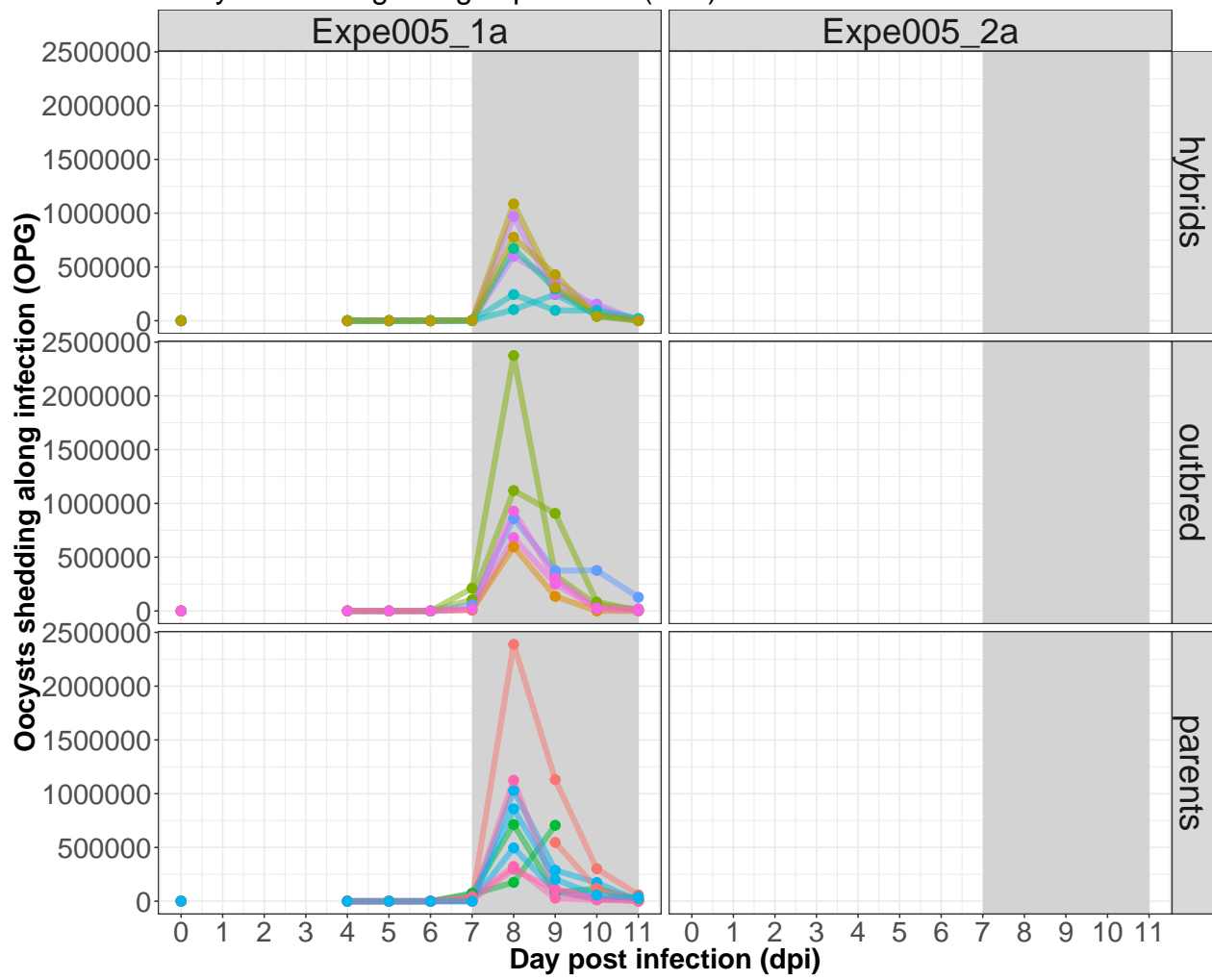


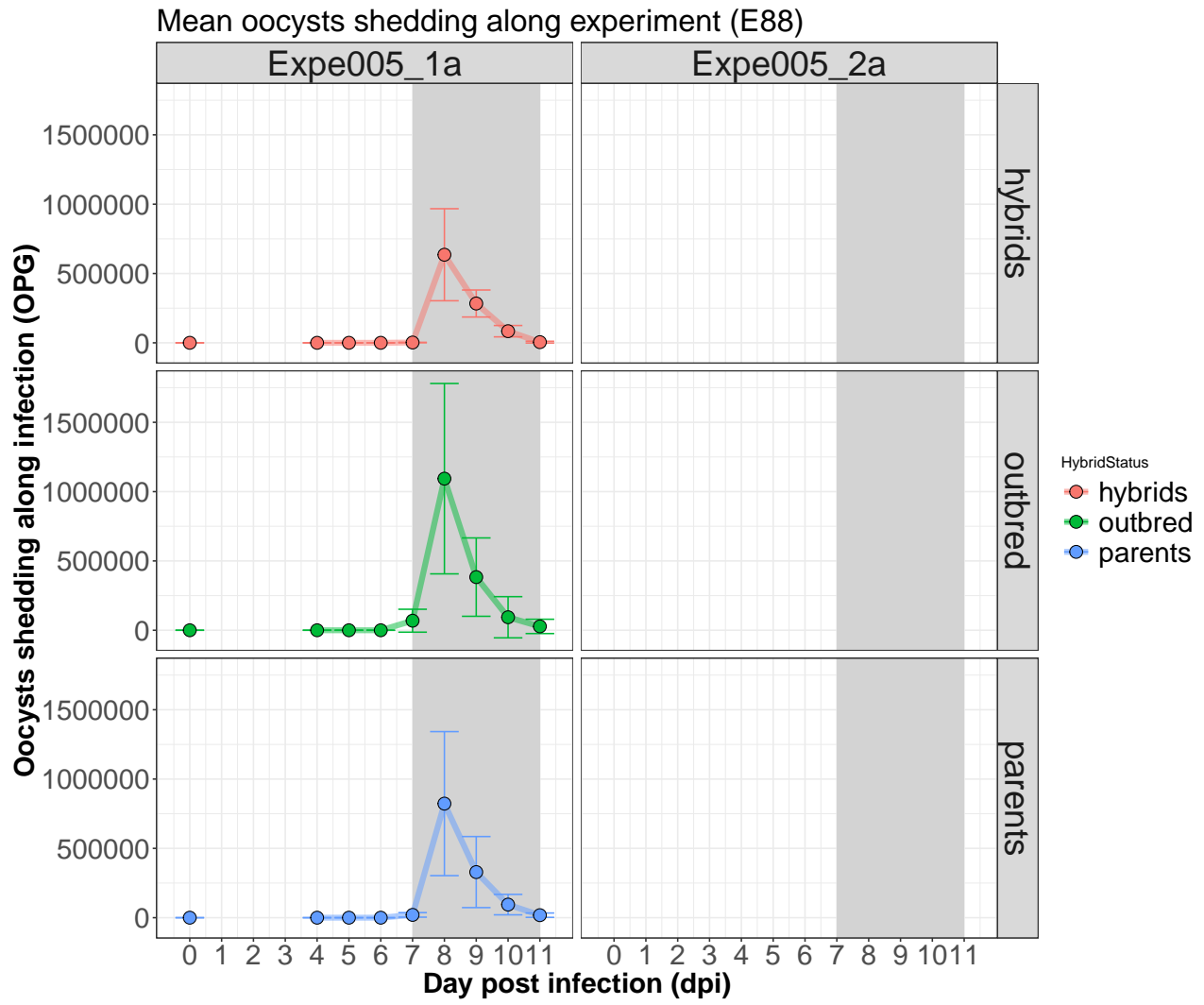


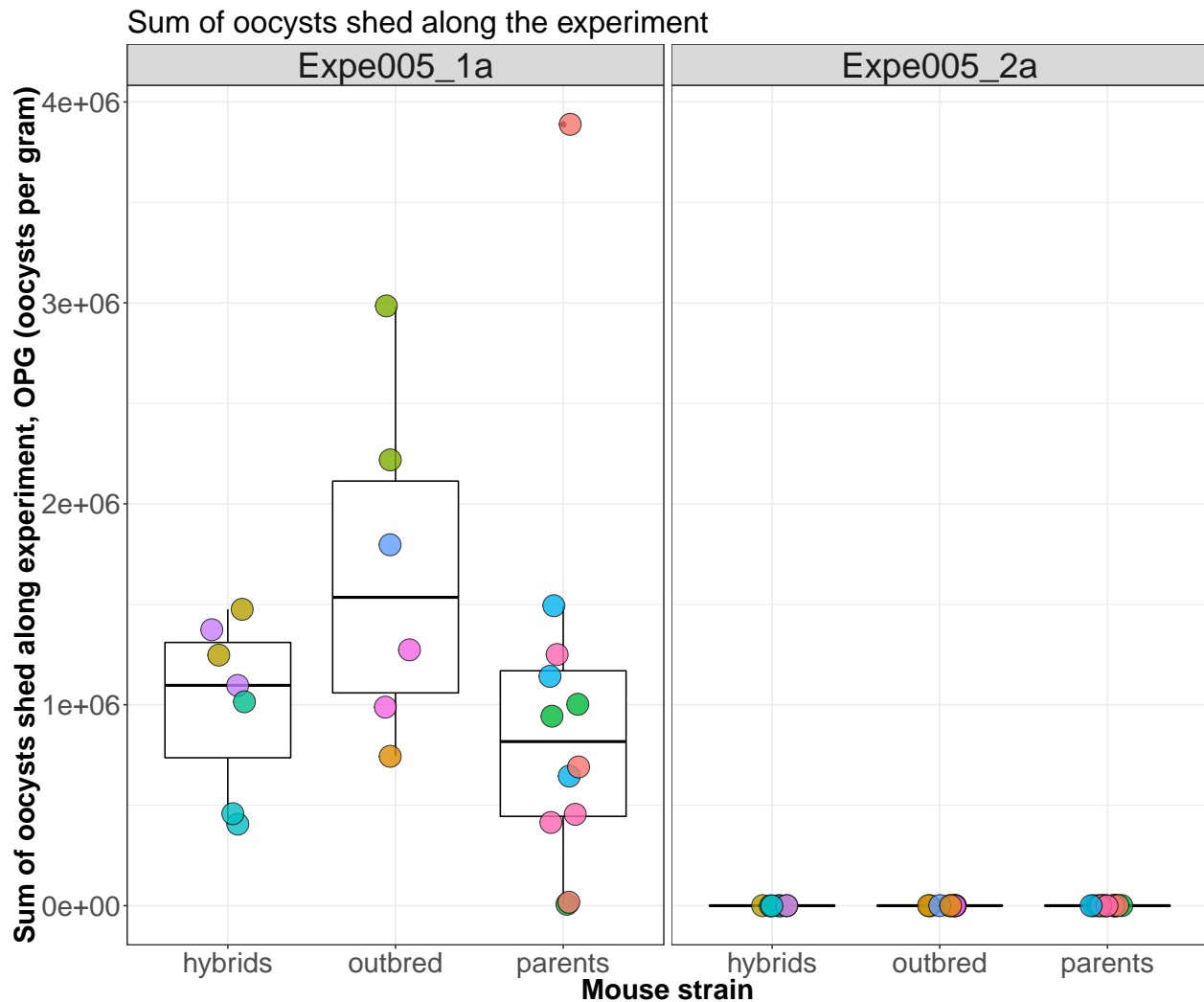


```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by HybridStatus
## Kruskal-Wallis chi-squared = 0.49187, df = 2, p-value = 0.782
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_005_64$sum.oo and sum.oocysts_005_64$HybridStatus
##
##      hybrids outbred
## outbred 0.34      -
## parents 0.58      0.32
##
## P value adjustment method: BH
Eimeria falciformis
```

Oocyst shedding along experiment (E88)







```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by HybridStatus
## Kruskal-Wallis chi-squared = 0.32579, df = 2, p-value = 0.8497
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_005_88$sum.oo and sum.oocysts_005_88$HybridStatus
##
##      hybrids outbred
## outbred 0.96      -
## parents 0.96      0.96
##
## P value adjustment method: BH
```

Ideas:

- Add variable for each 4 parents and test the linear relationships for each of these variables set to 0 (copy of DNA), 1 (copy of DNA) (2 we can remove as we want outbred vs hybrids) + another variable HybridStatus : hybrid or outbred. + mixed effect (1|EH\_ID, 1|Expe)



- Depend on the angle, but could be really interesting to quantify this for each mouse strain (outbreeding effect + hybrid effect) and show that it is highly strain specific. The focus on the article could be on that.
- Internal collaborators: Alice Balard, Vivian Mittné, Francisca Böhning, Emanuel Heitlinger
- External collaborators: Stuart J. Baird, Jaroslav Piálek, Ludovít Ďureje, Joëlle Göüy de Bellocq, Milos Macholán.
- Acknowledgements: Victor Jarquin, Jenny Jost, Deborah Dymke, Lubomír Bednář, Parnika Mukherjee, Julia Murata, Clément Vollet, Tabea Roth von Szepesbela, Yasmin Schickel, Gordon Mählis