

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

Alice

30 November 2018

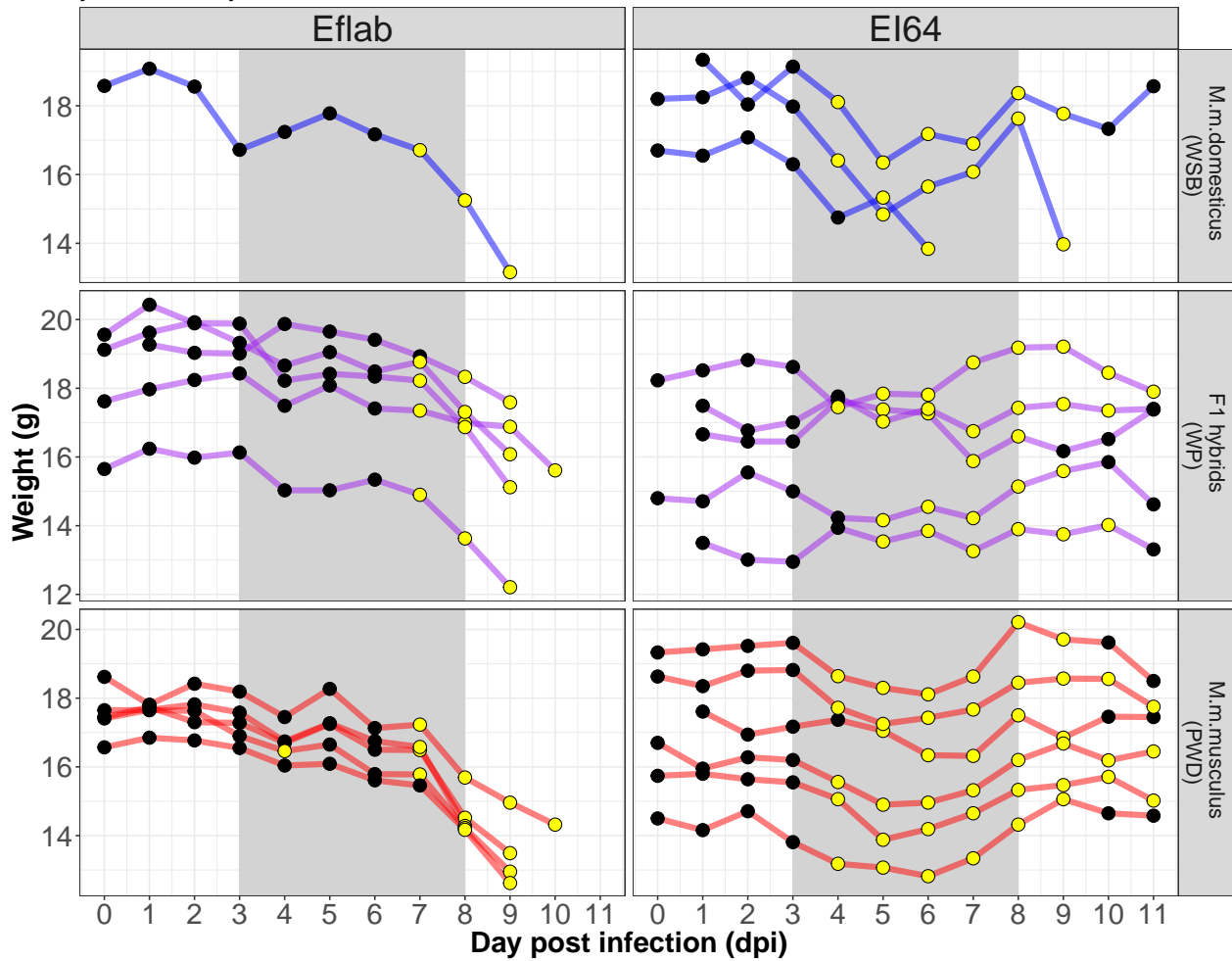
Contents

Expe_001, March 2017, Francisca's experiment. infection with E64 and Eflab	1
1. Weight loss	1
2. Parasite shedding	6
3. Comparison host/parasite proxy	10
Pass001: Nov 2017, passaging 4 isolates (some missing data)	12
(Eflab, E88, E139, E64) in NMRI. 2 mice per cage. Only OPG recorded	12
Parasite shedding	12
Expe_002: March 2018, NMRI mice infected with 4 <i>Eimeria</i> strains (Eflab, E88, E139, E64)	13
1. Weight loss	13
2. Parasite shedding	16
3. Comparison host/parasite proxy	18
Expe_003 & Expe_004, April-May 2018, first batch Parental strains (F0) BUSNA, STRA, SCHUNT, PWD, infection with Eferrisi (E64 and E139) [2 batches]	19
1. Weight loss	19
2. Parasite shedding	23
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)	26
1. Weight loss	26
<i>Eimeria ferrisi</i>	26
<i>Eimeria falciformis</i>	30
2. Parasite shedding	34

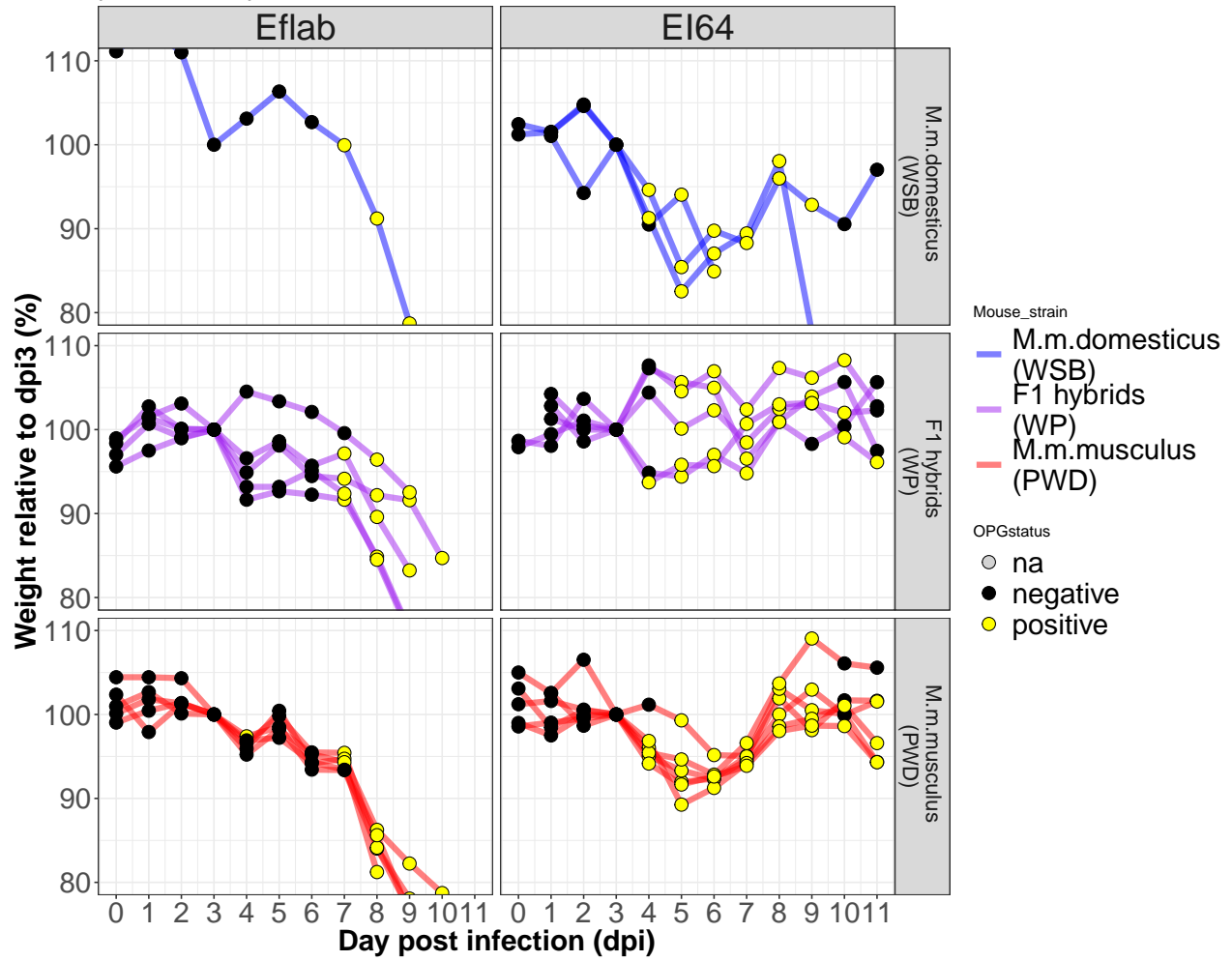
Expe_001, March 2017, Francisca's experiment. infection with E64 and Eflab

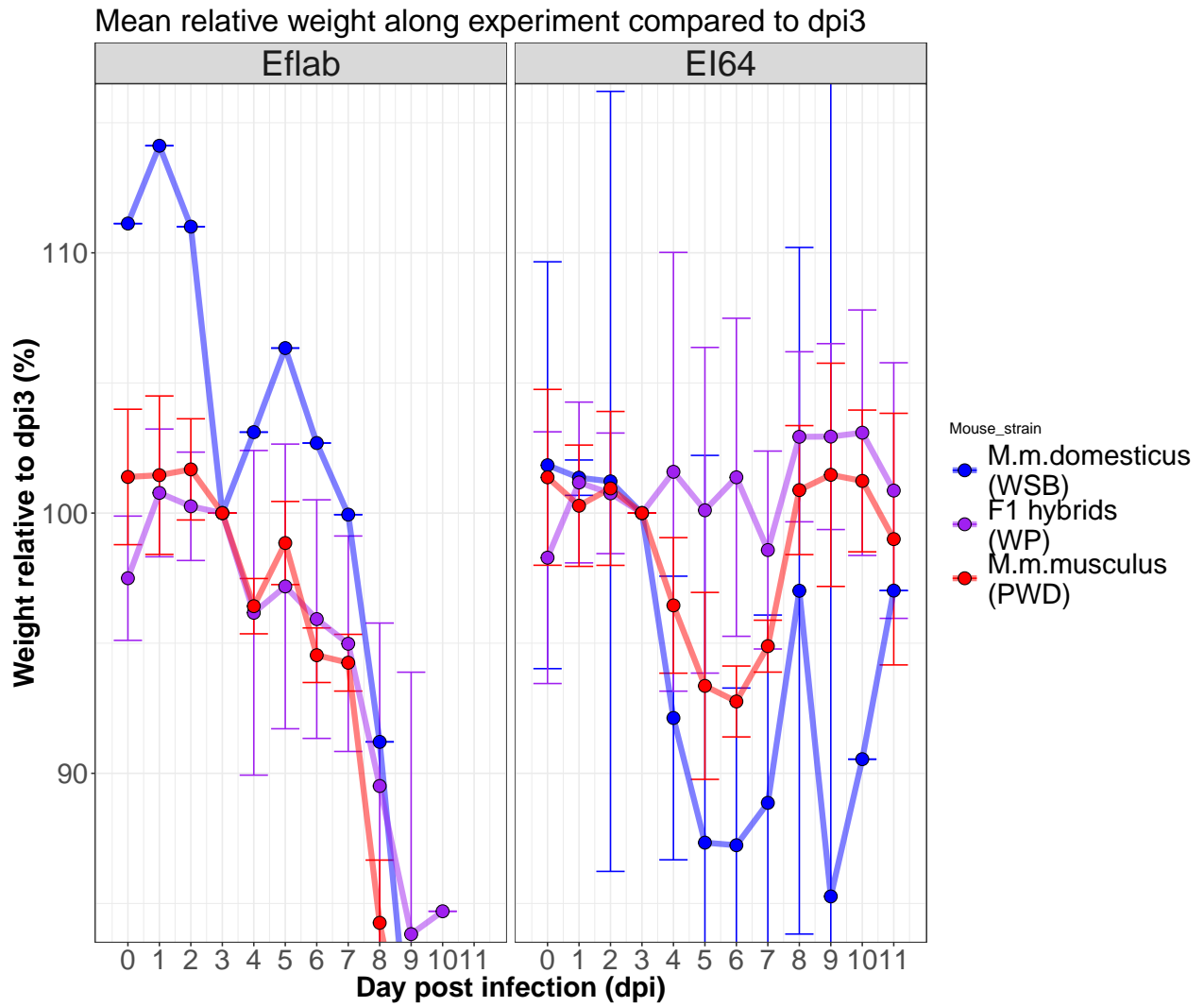
1. Weight loss

Weight along experiment per individual
yellow : oocysts detected in feces

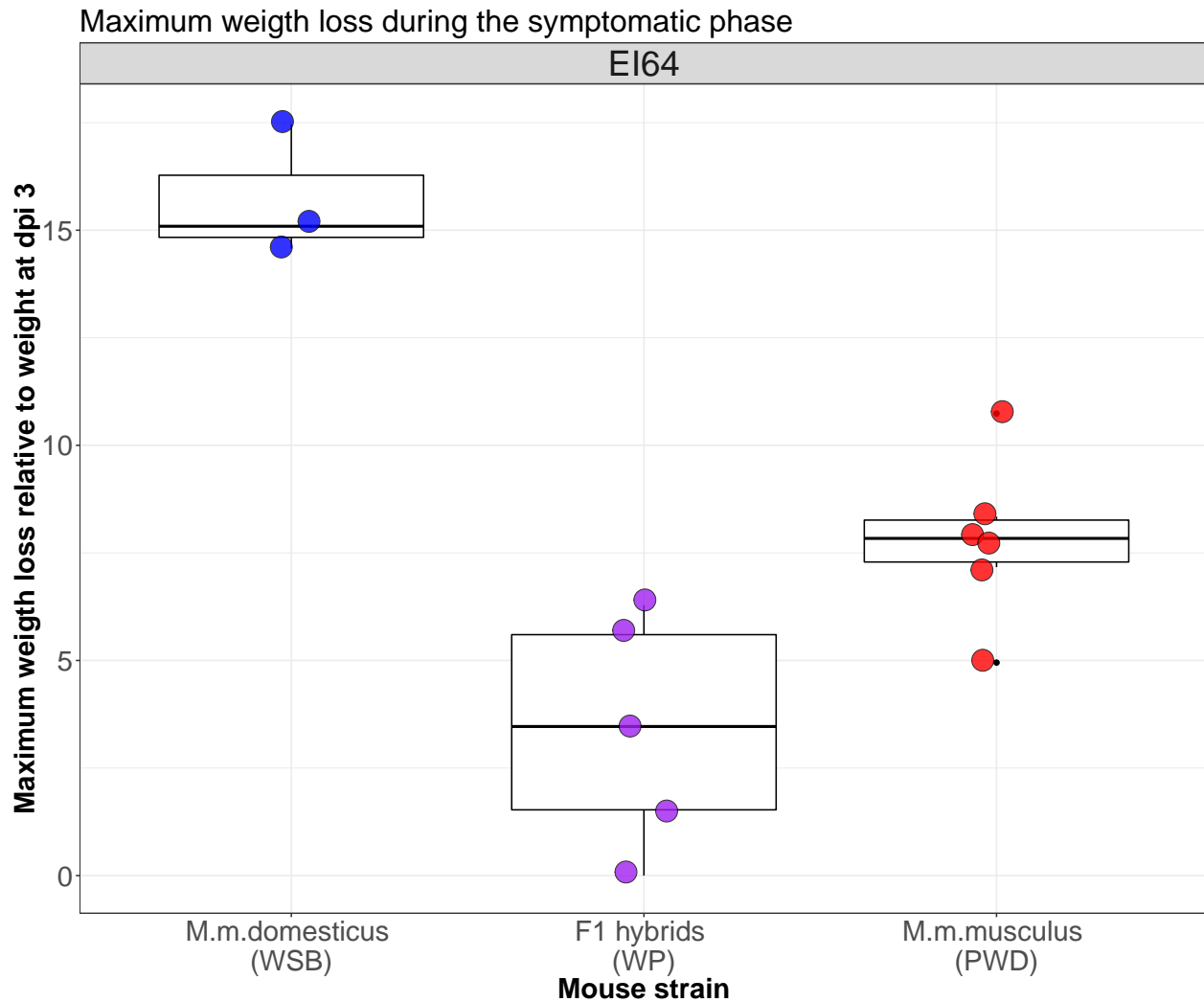


Relative weight along experiment compared to dpi3
 yellow : oocysts detected in feces



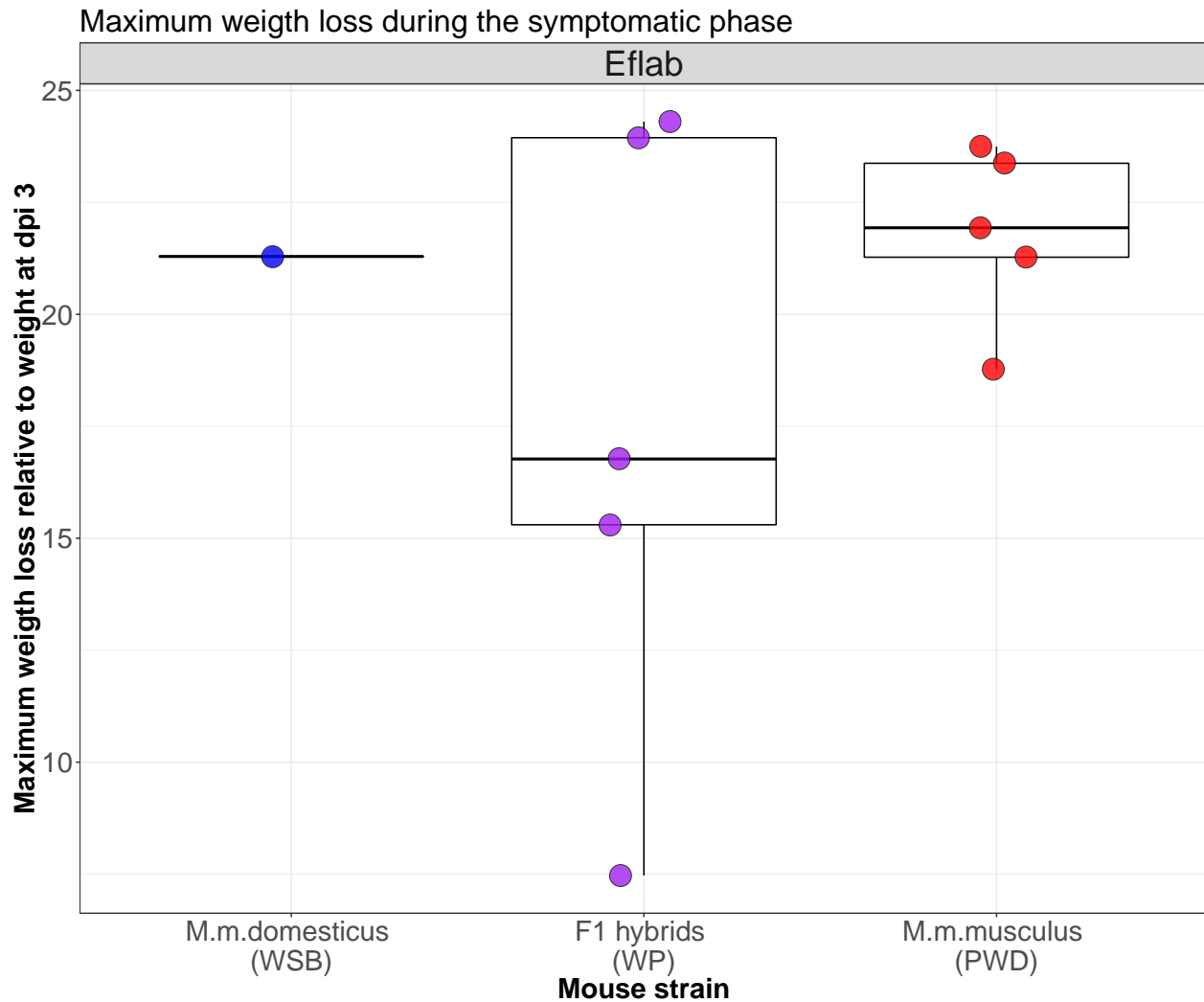


For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).



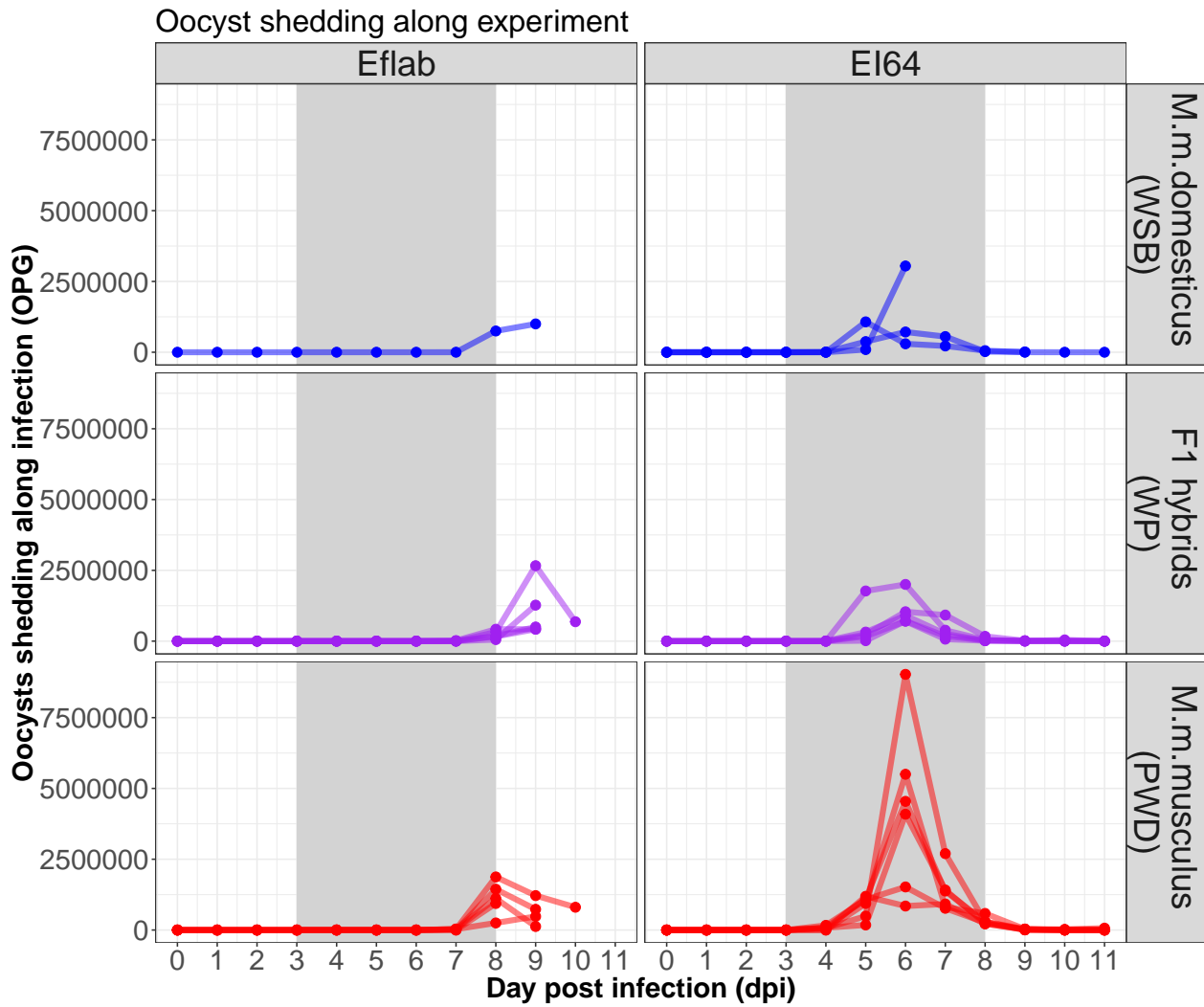
```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 10.141, df = 2, p-value = 0.006279
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_001_64$relativeWeight and max.loss_001_64$Mouse_strain
##
##           F1 hybrids \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
```

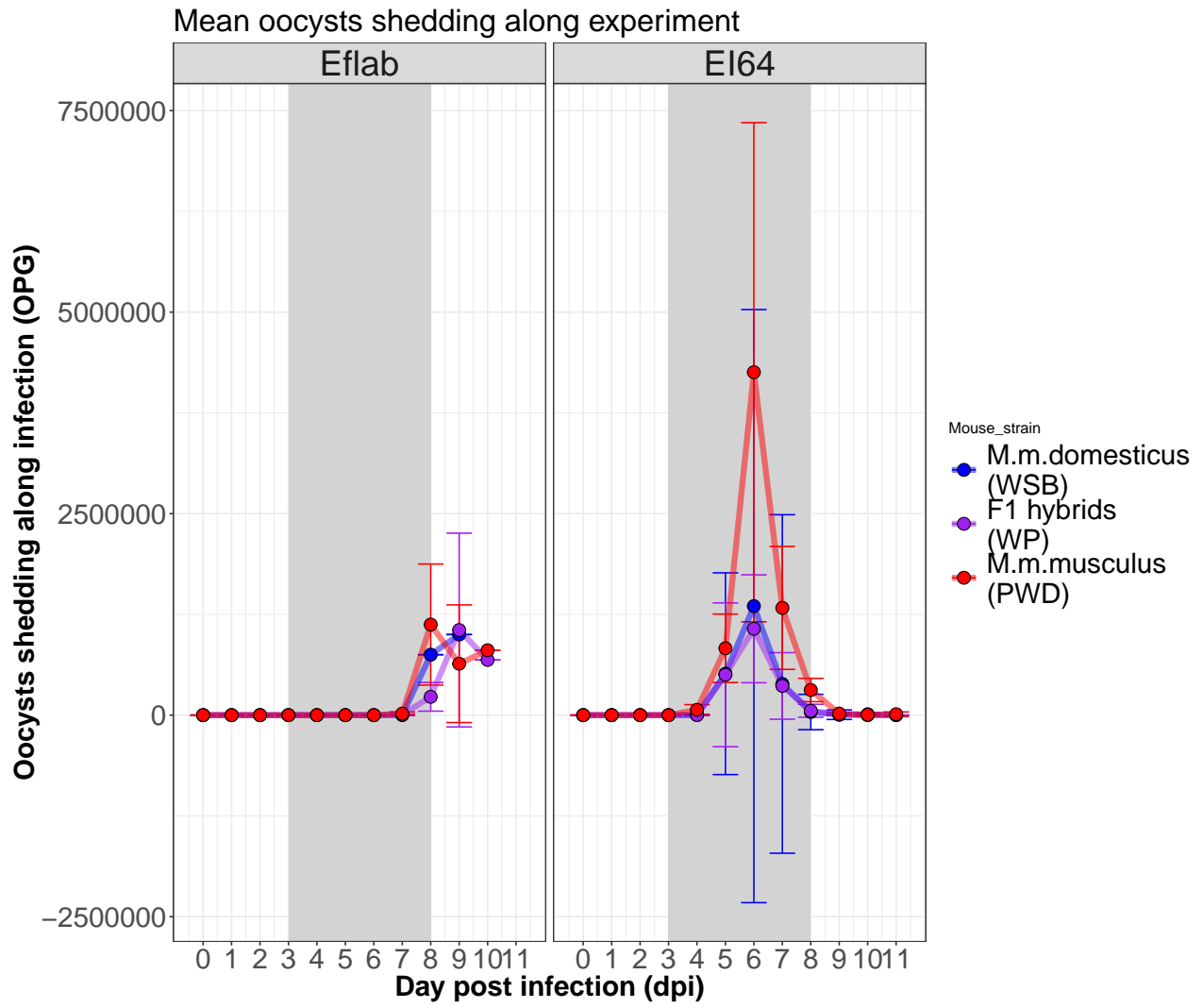
For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi7 to dpi11 (symptomatic period for E88 strain).

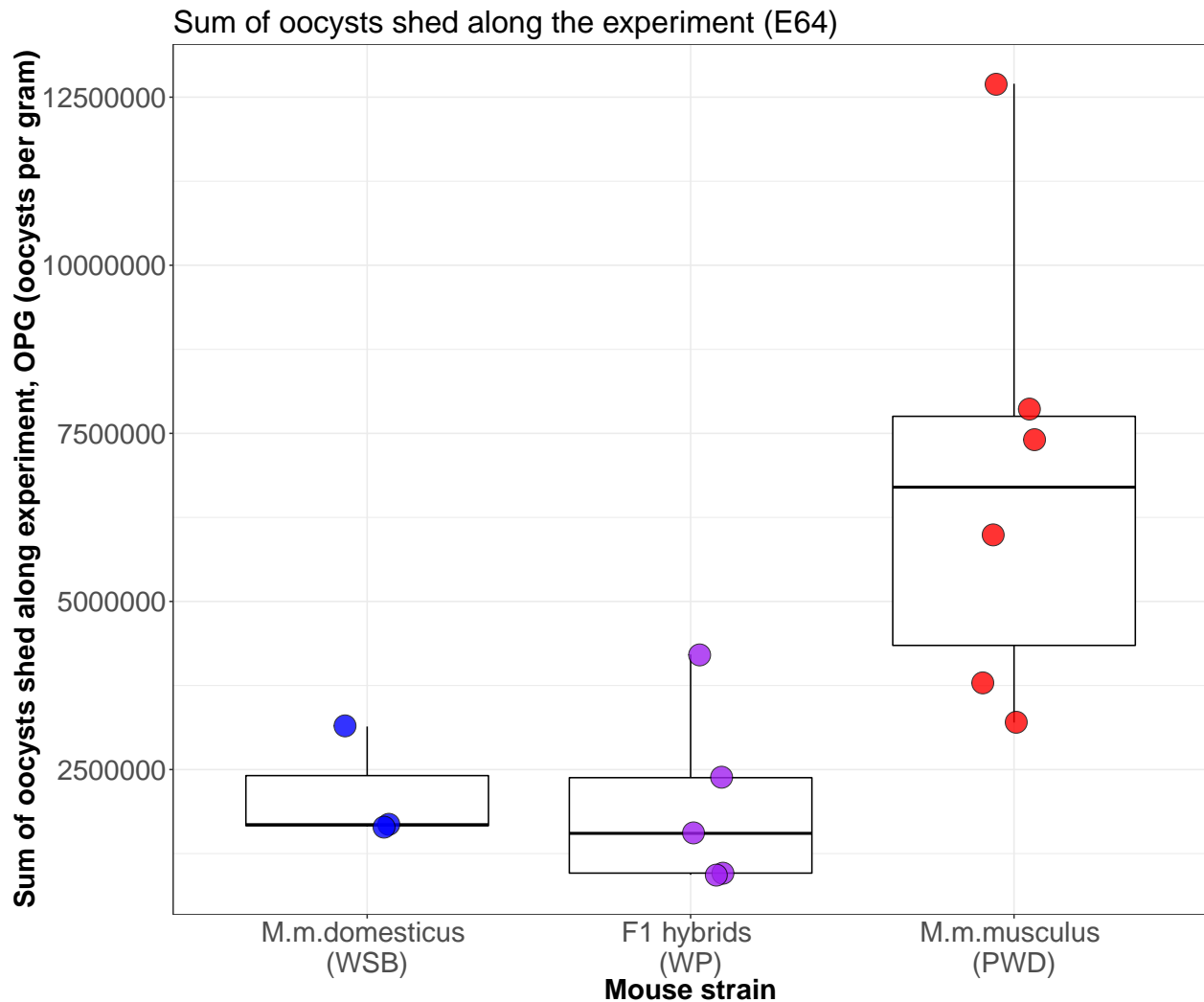


```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 0.32727, df = 2, p-value = 0.8491
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_001_88$relativeWeight and max.loss_001_88$Mouse_strain
##
##           F1 hybrids \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
```

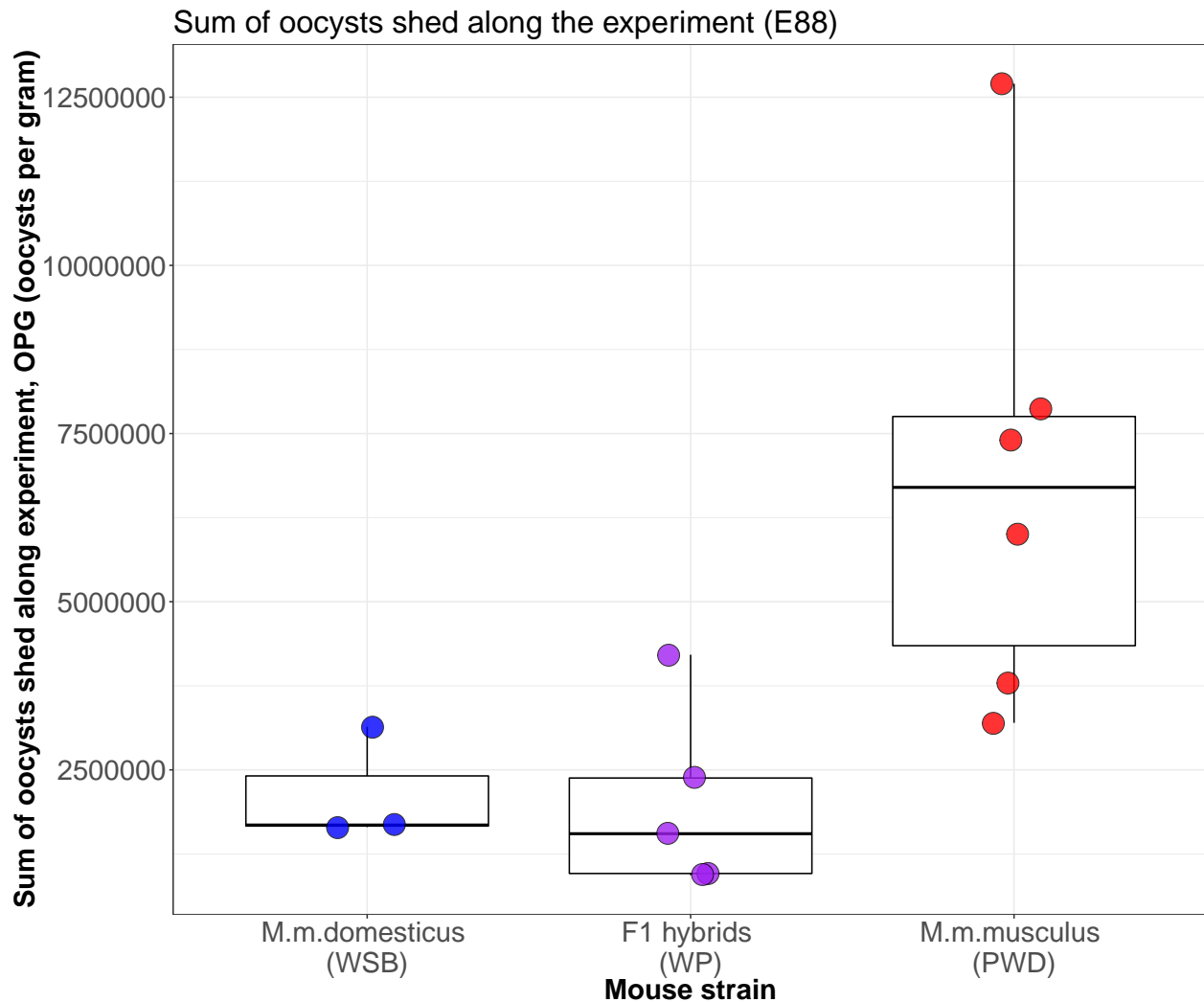
2. Parasite shedding







```
##
## 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

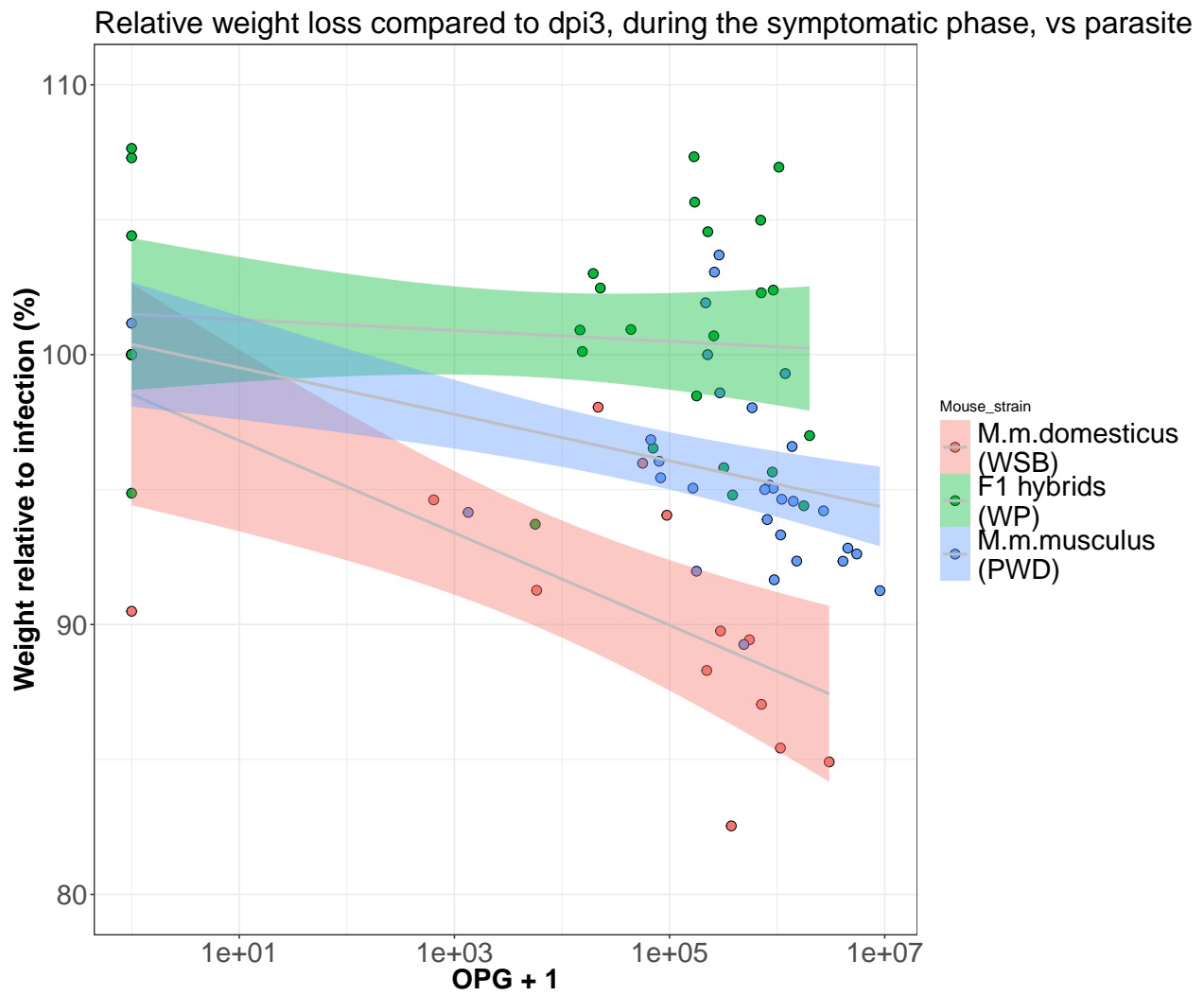


Figure 1: Weight as a function of OPG

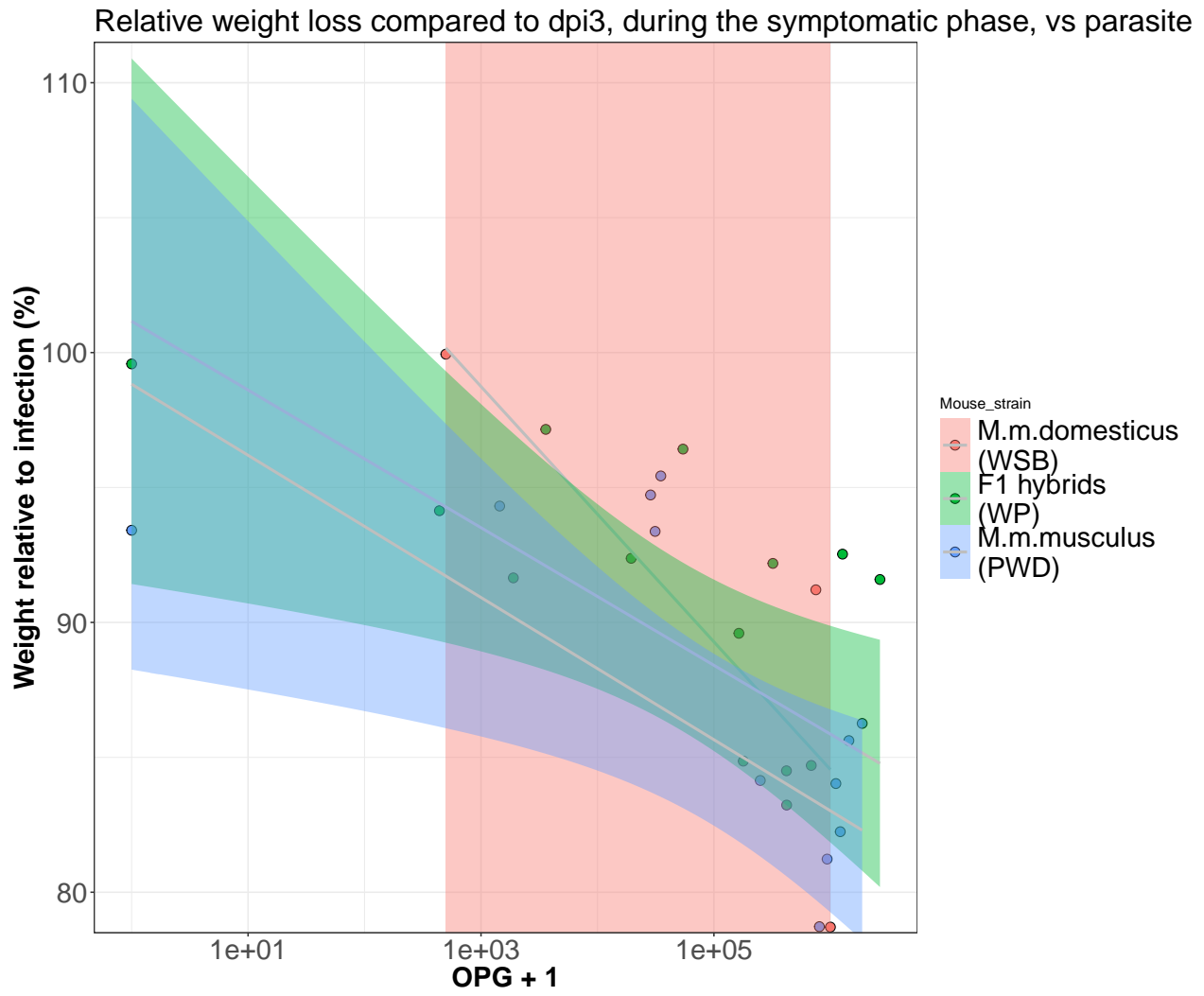
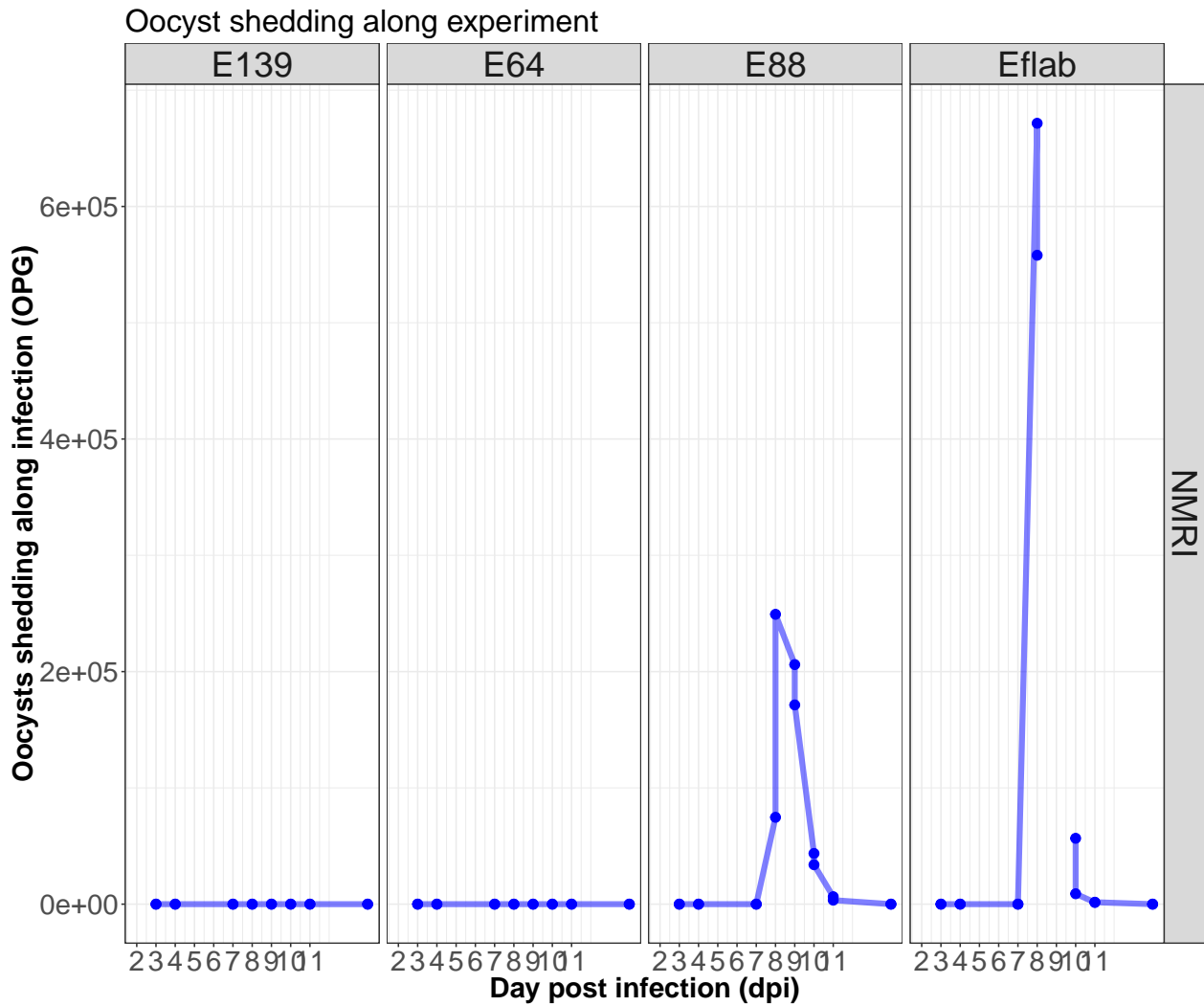


Figure 2: Weight as a function of OPG

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

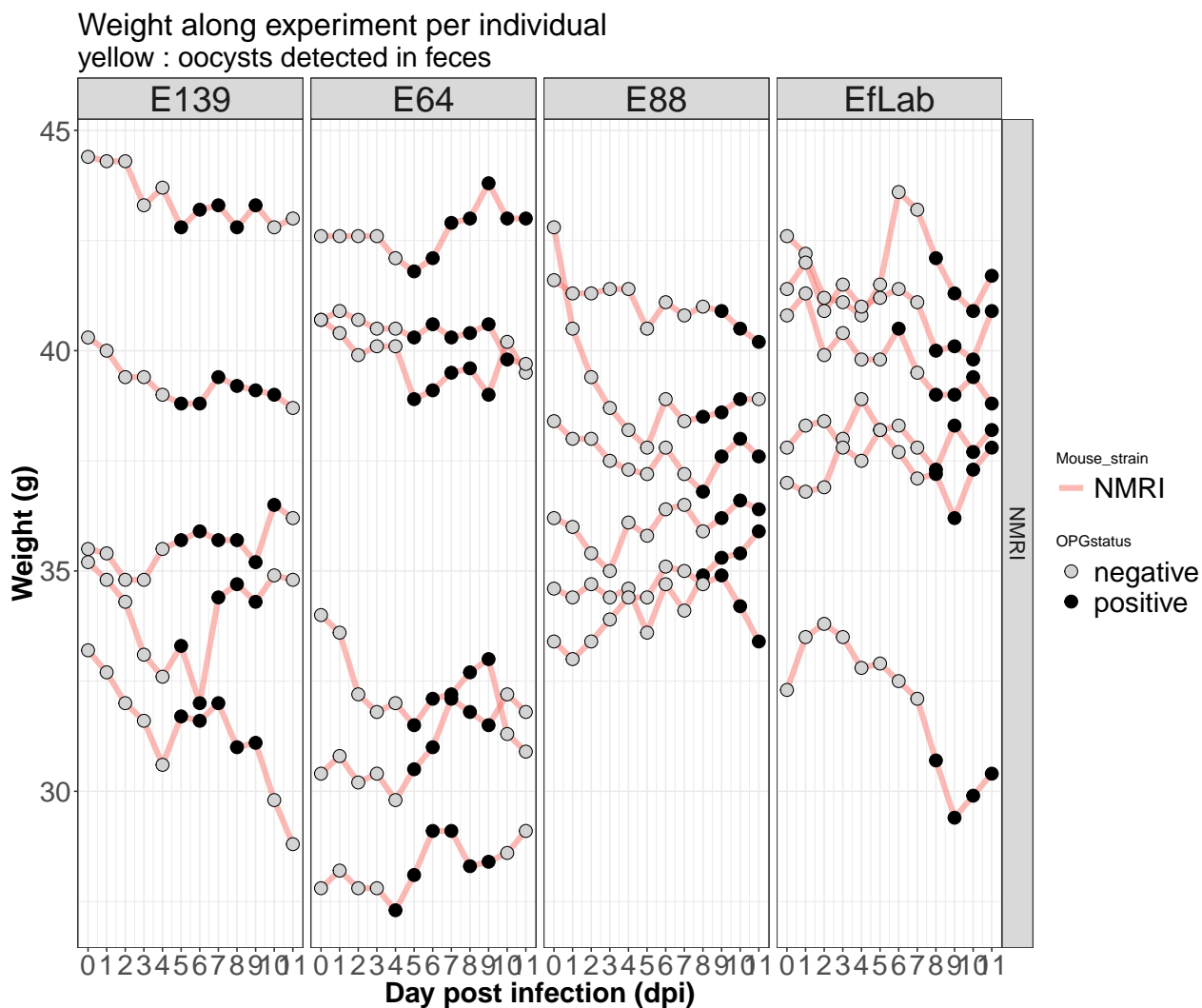
(Eflab, E88, E139, E64) in NMRI. 2 mice per cage. Only OPG recorded

Parasite shedding

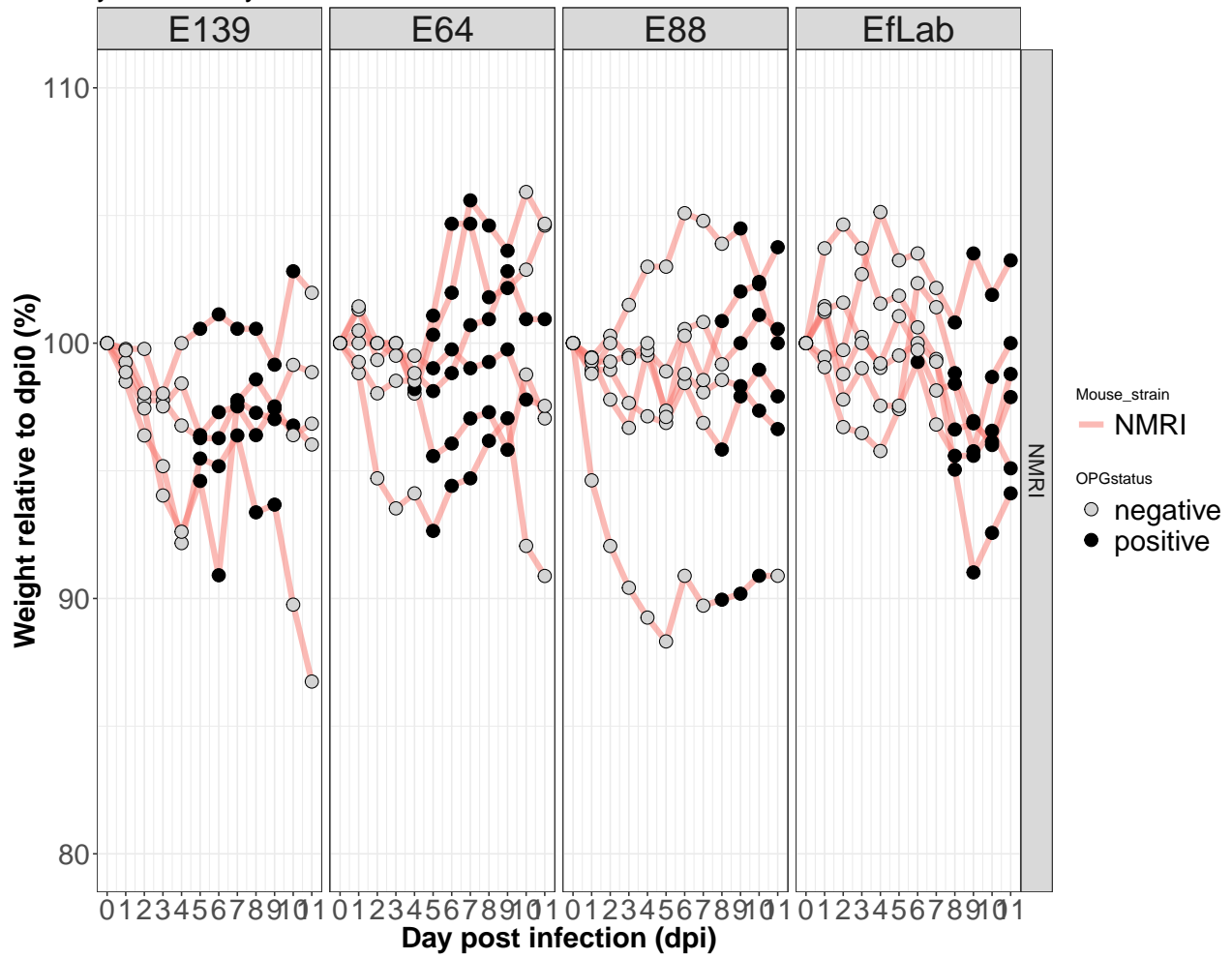


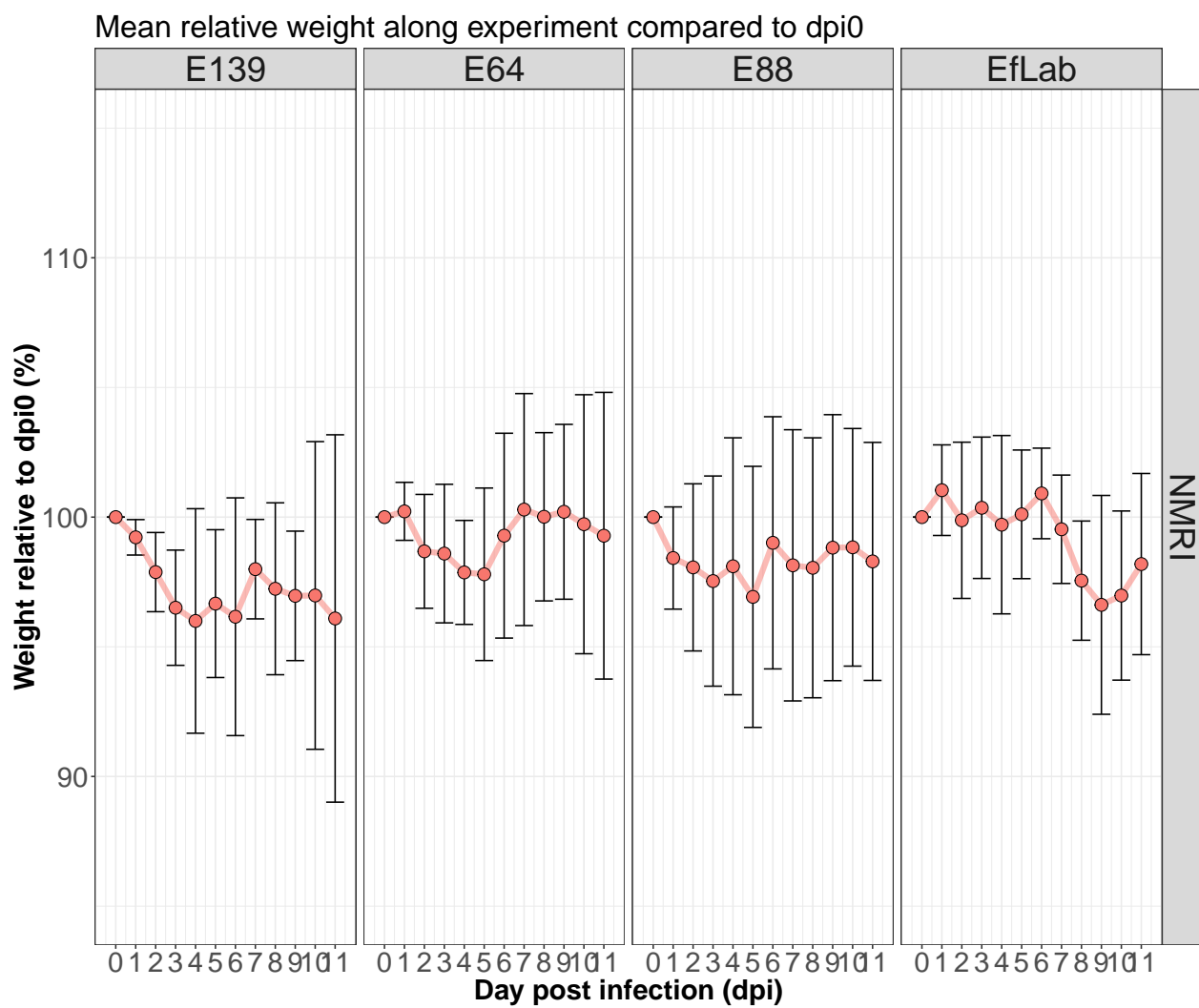
Expe_002: March 2018, NMRI mice infected with 4 *Eimeria* strains (Eflab, E88, E139, E64)

1. Weight loss

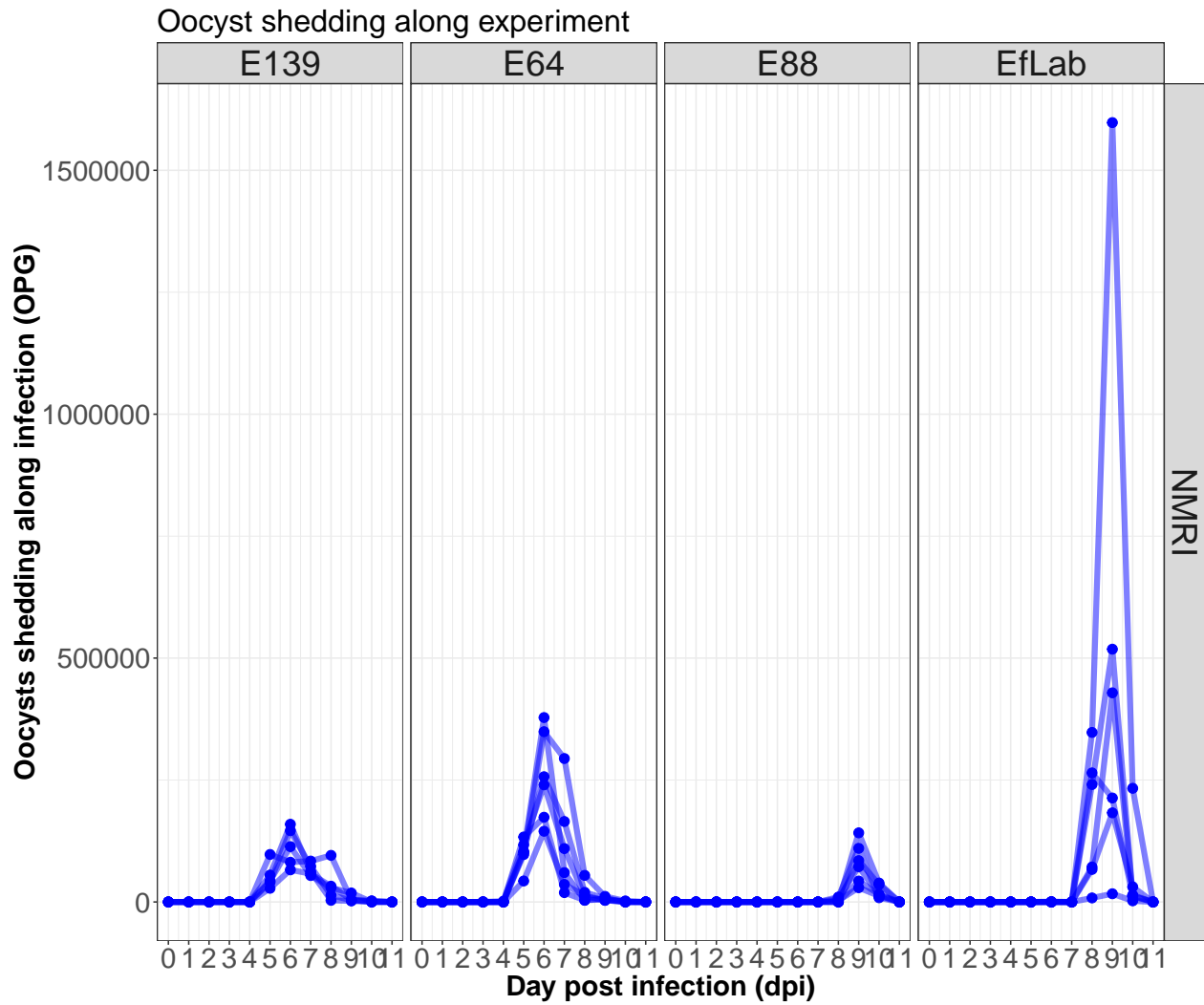


Relative weight along experiment compared to dpi0
yellow : oocysts detected in feces

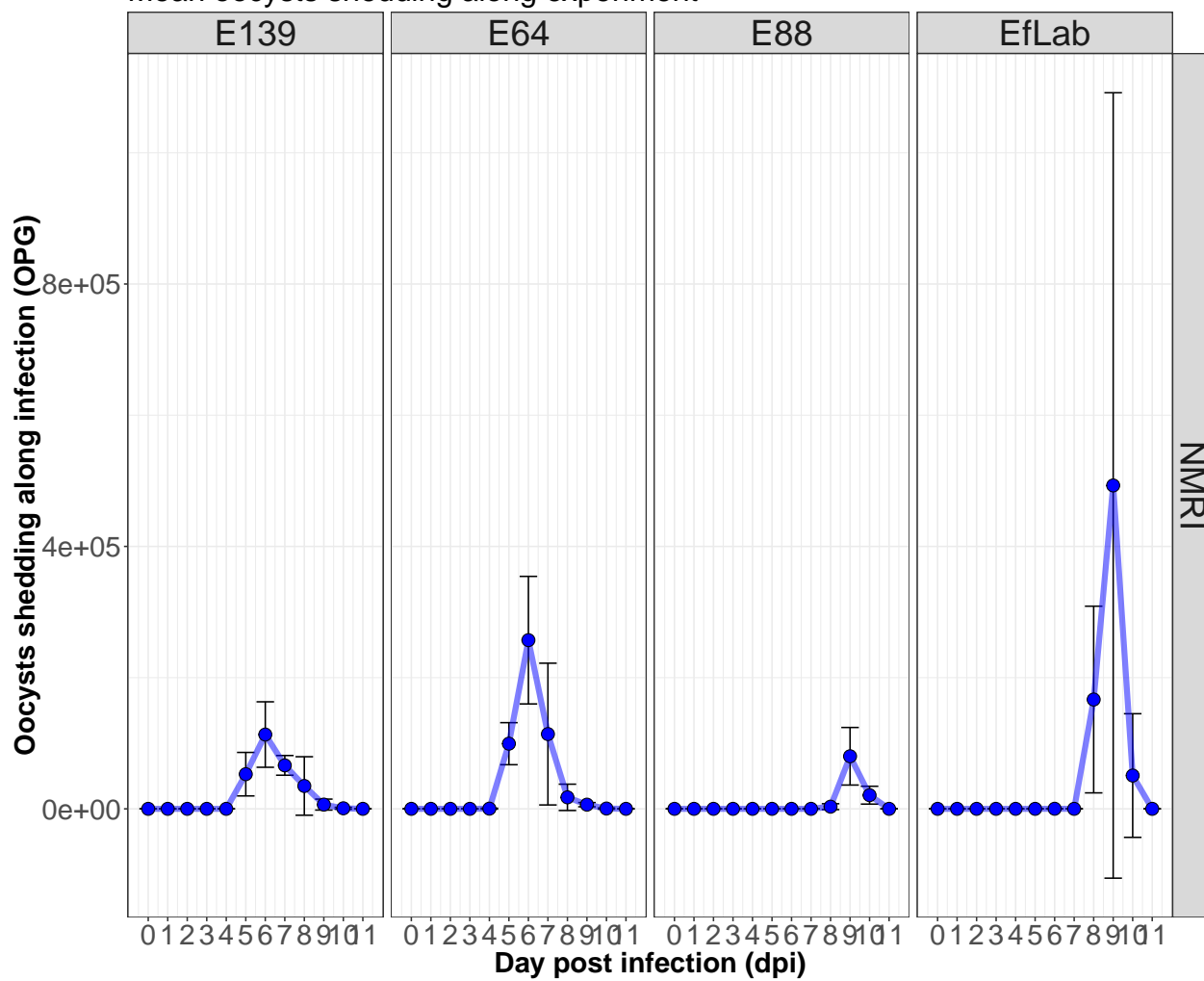




2. Parasite shedding



Mean oocysts shedding along experiment



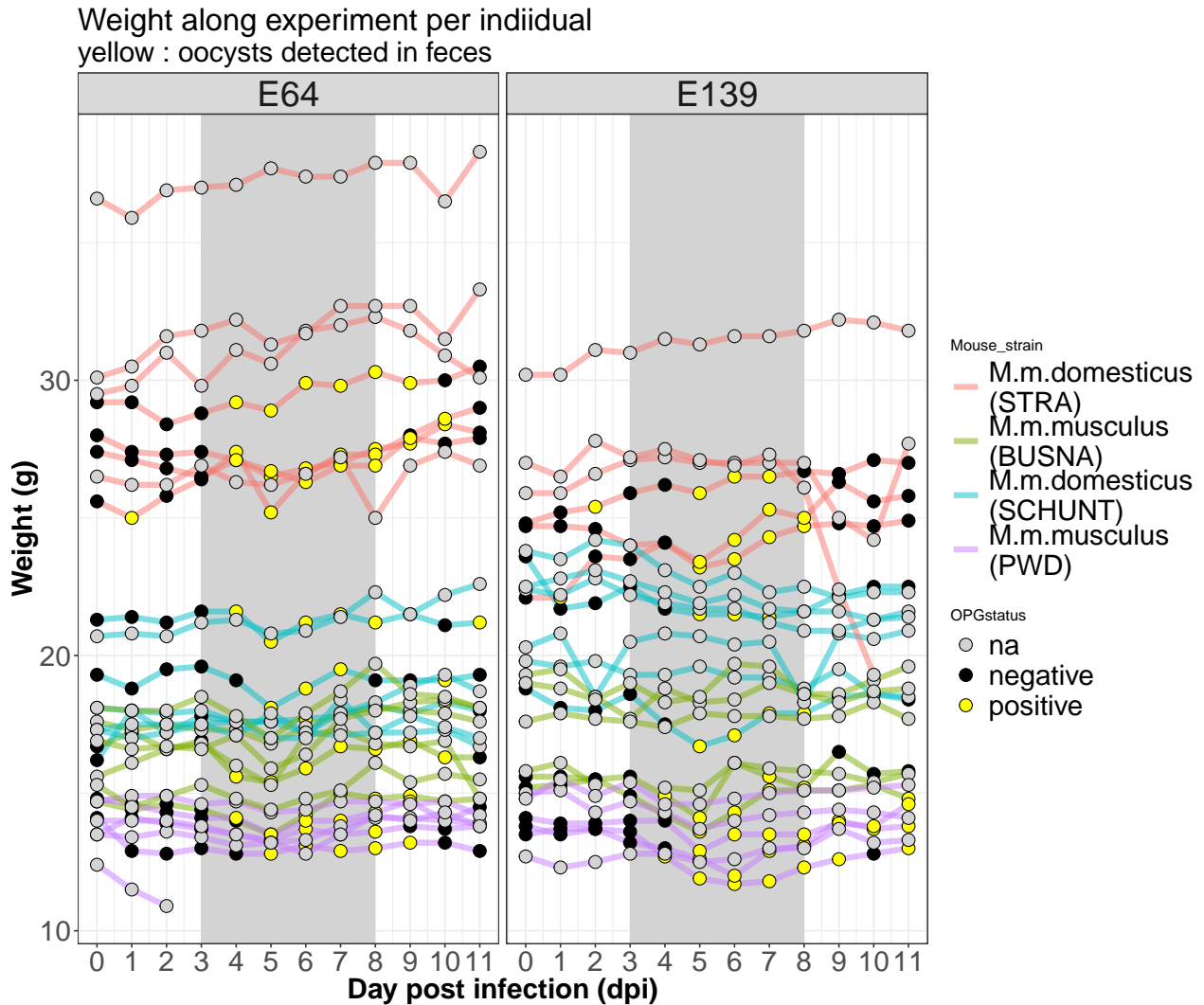
3. Comparison host/parasite proxy



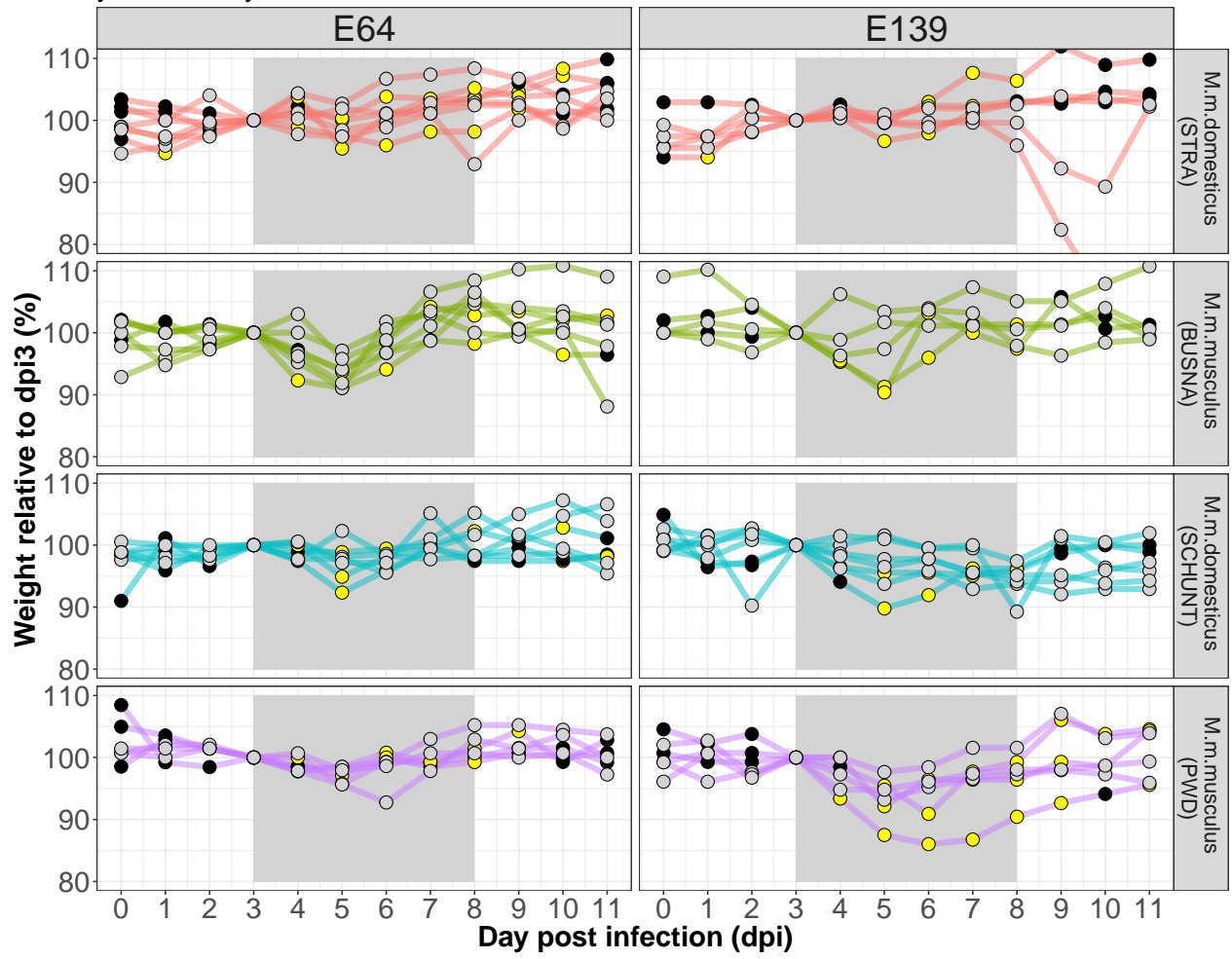
Figure 3: Weight as a function of OPG

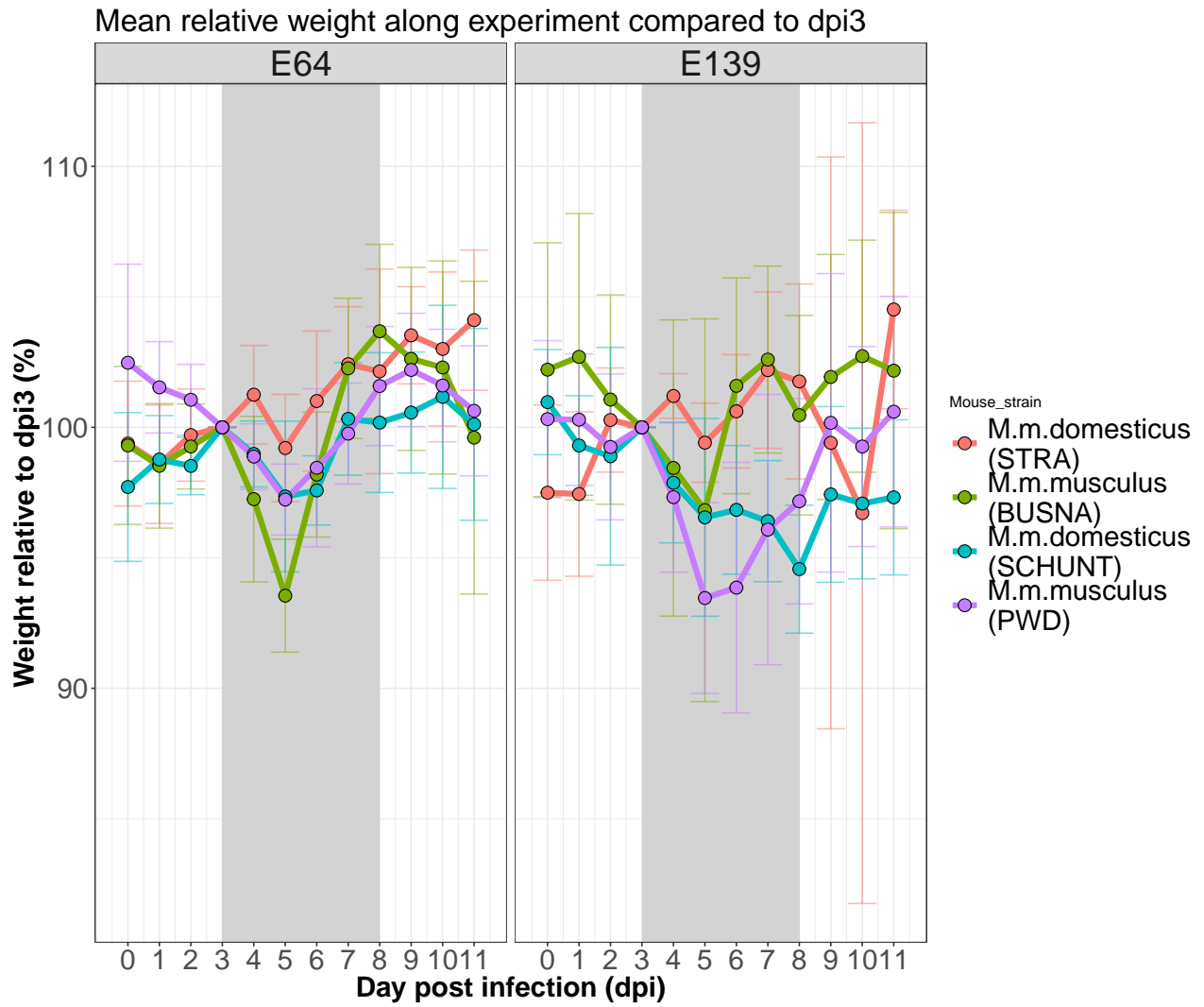
Expe_003 & Expe_004, April-May 2018, first batch Parental strains (F0) BUSNA, STRA, SCHUNT, PWD, infection with Eferrisi (E64 and E139) [2 batches]

1. Weight loss

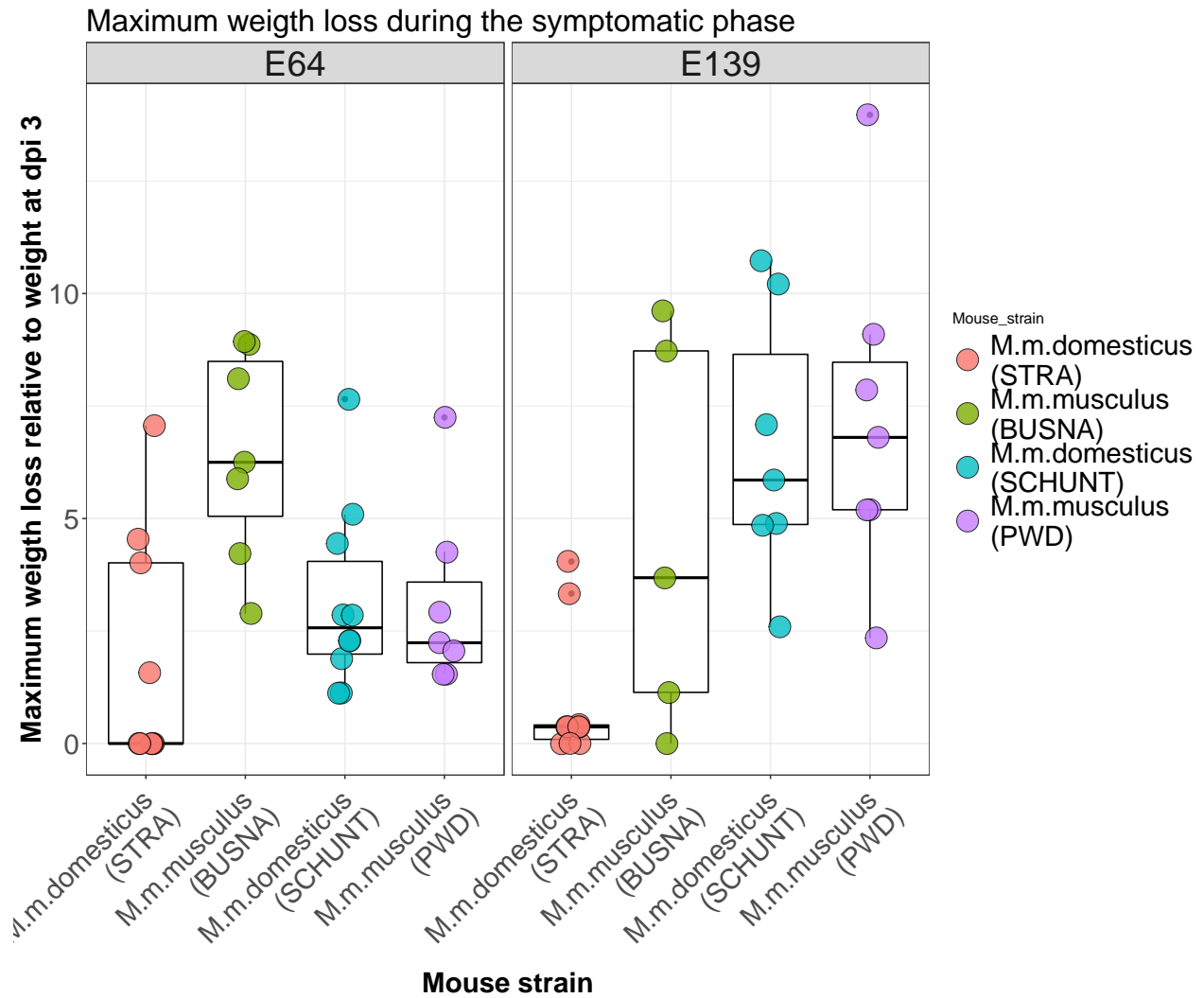


Relative weight along experiment compared to dpi3
yellow : oocysts detected in feces



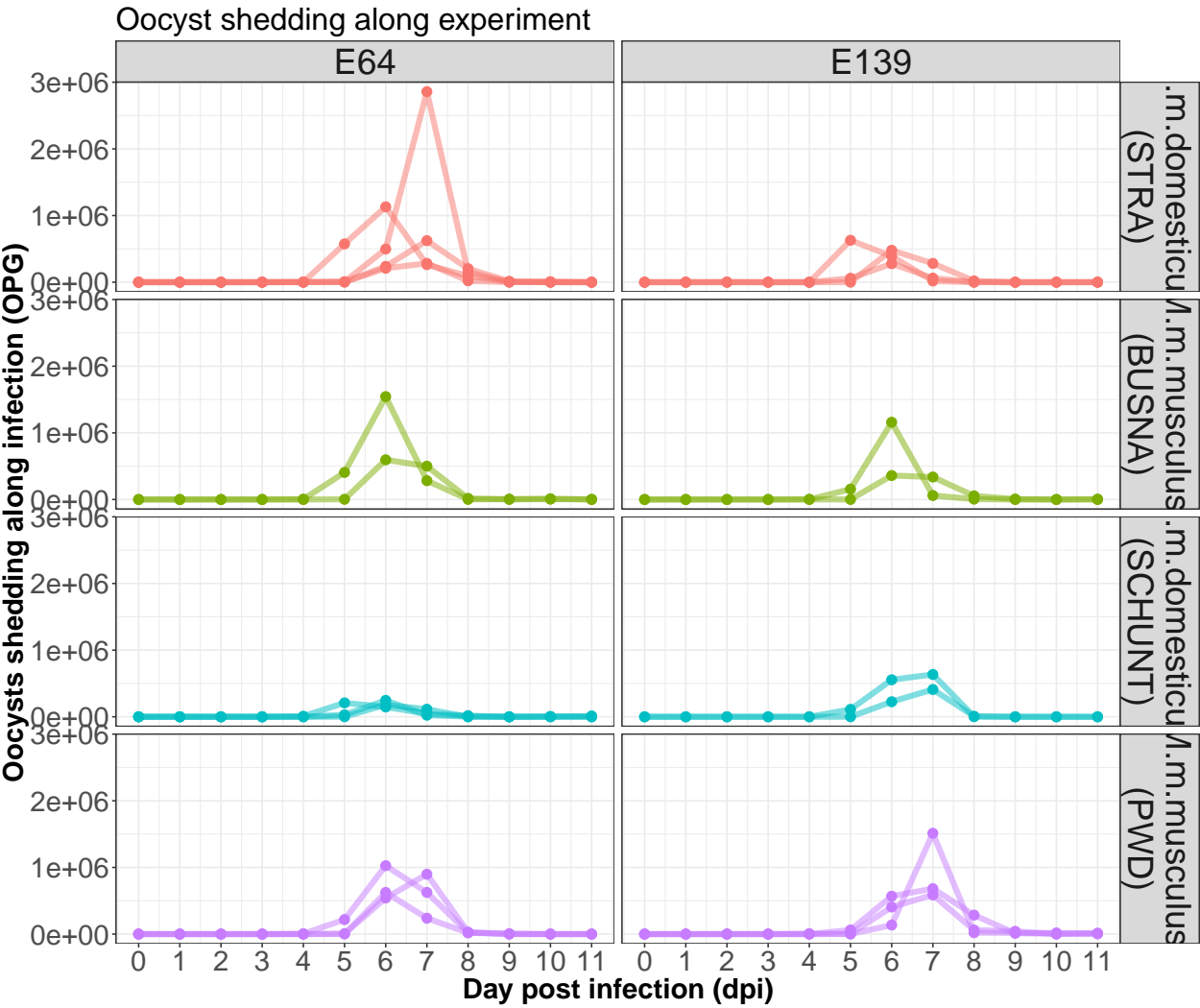


For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).

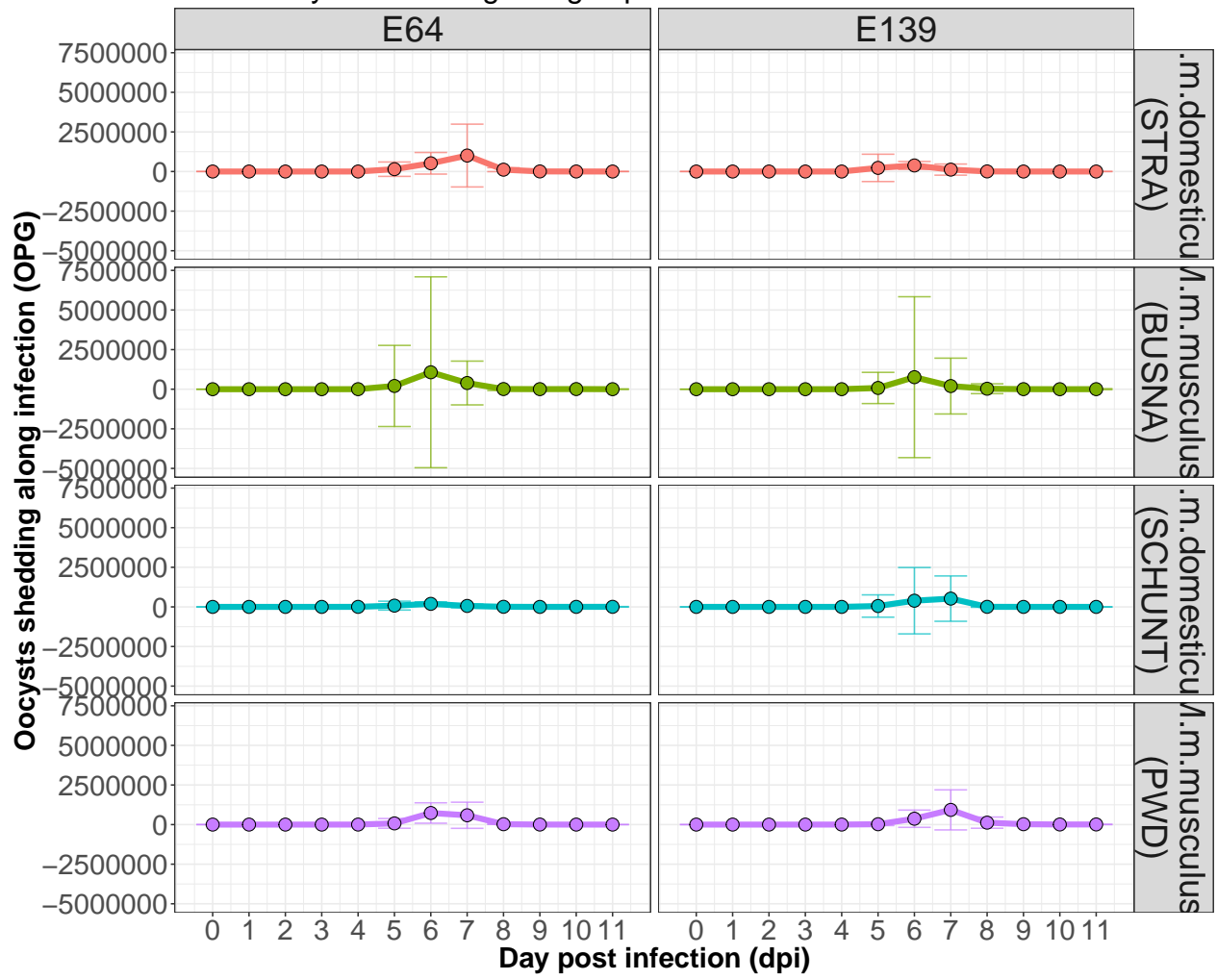


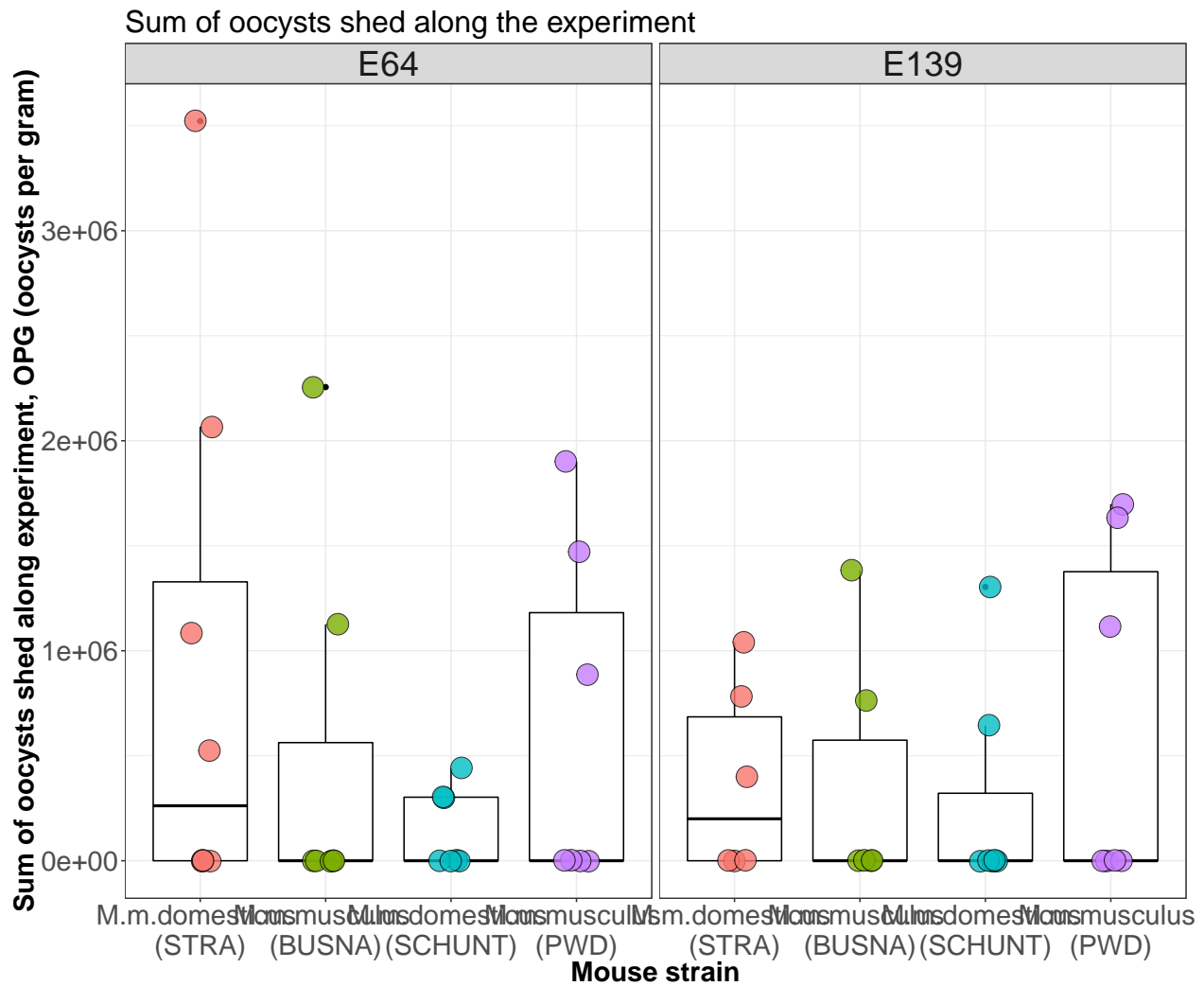
```
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by Mouse_strain
## Kruskal-Wallis chi-squared = 20.177, df = 3, p-value = 0.000156
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: max.loss_003_4$relativeWeight and max.loss_003_4$Mouse_strain
##
##           M.m.domesticus \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



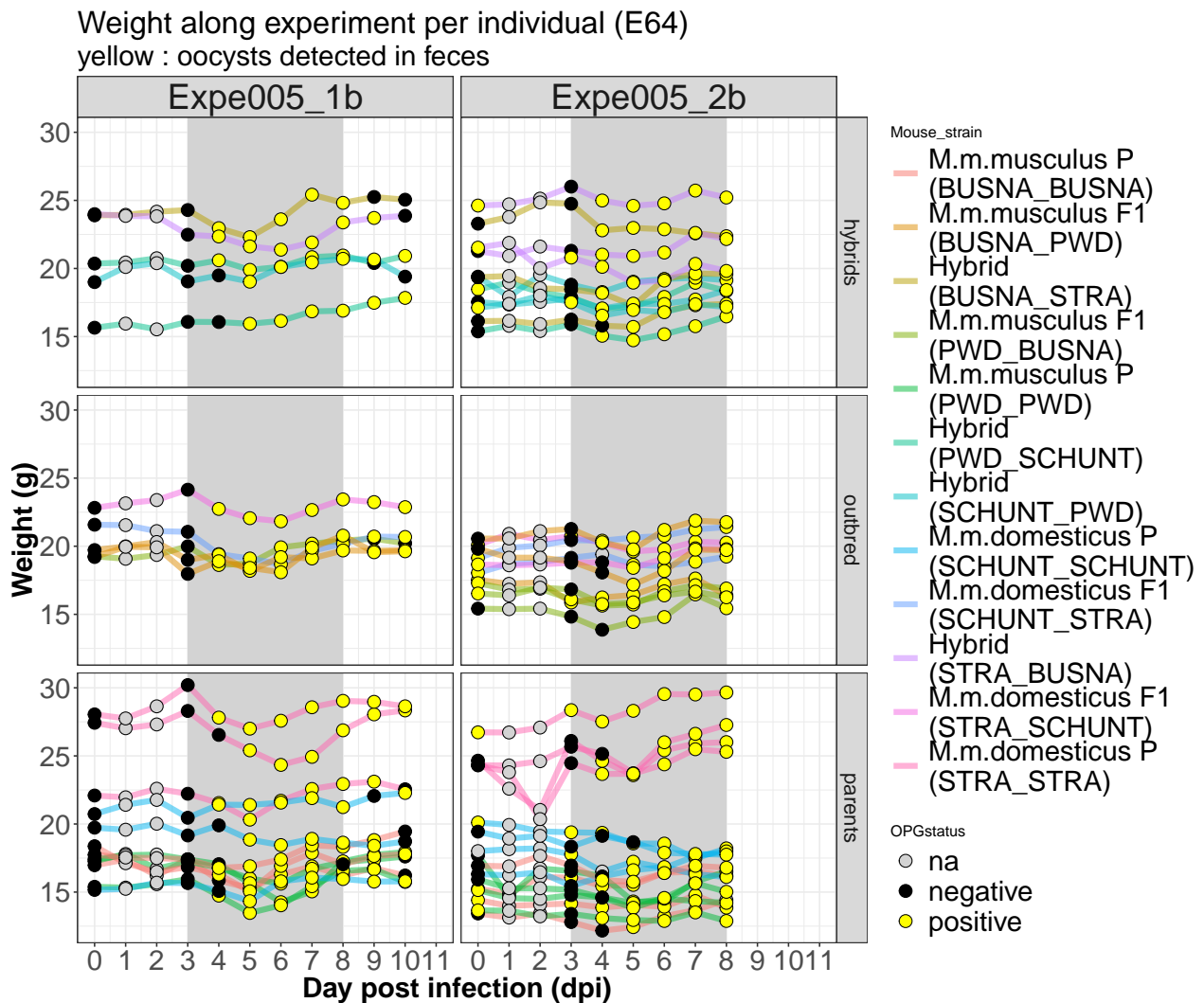


```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by Mouse_strain
## Kruskal-Wallis chi-squared = 1.8585, df = 3, p-value = 0.6023
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_003_4$sum.oo and sum.oocysts_003_4$Mouse_strain
##
##           M.m.domesticus \n(STRA) 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)

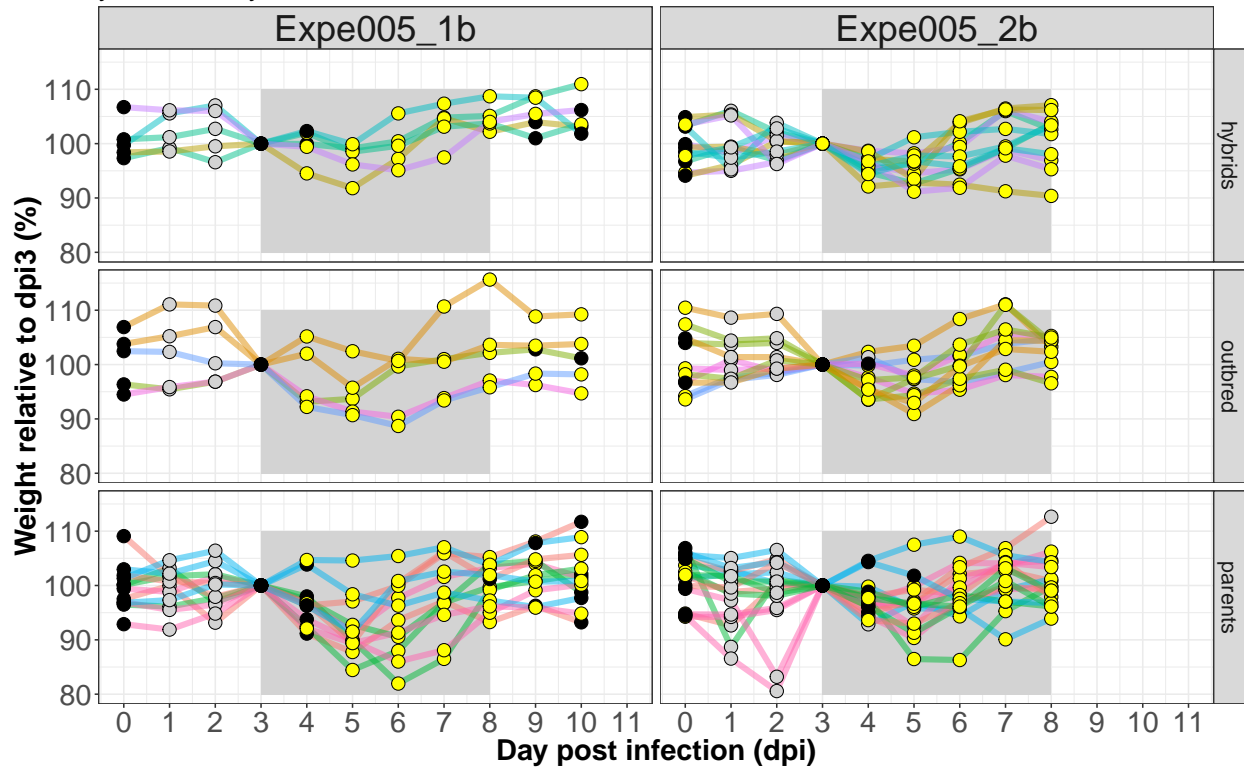
1. Weight loss

Eimeria ferrisi



Relative weight along experiment compared to dpi3 (E64)

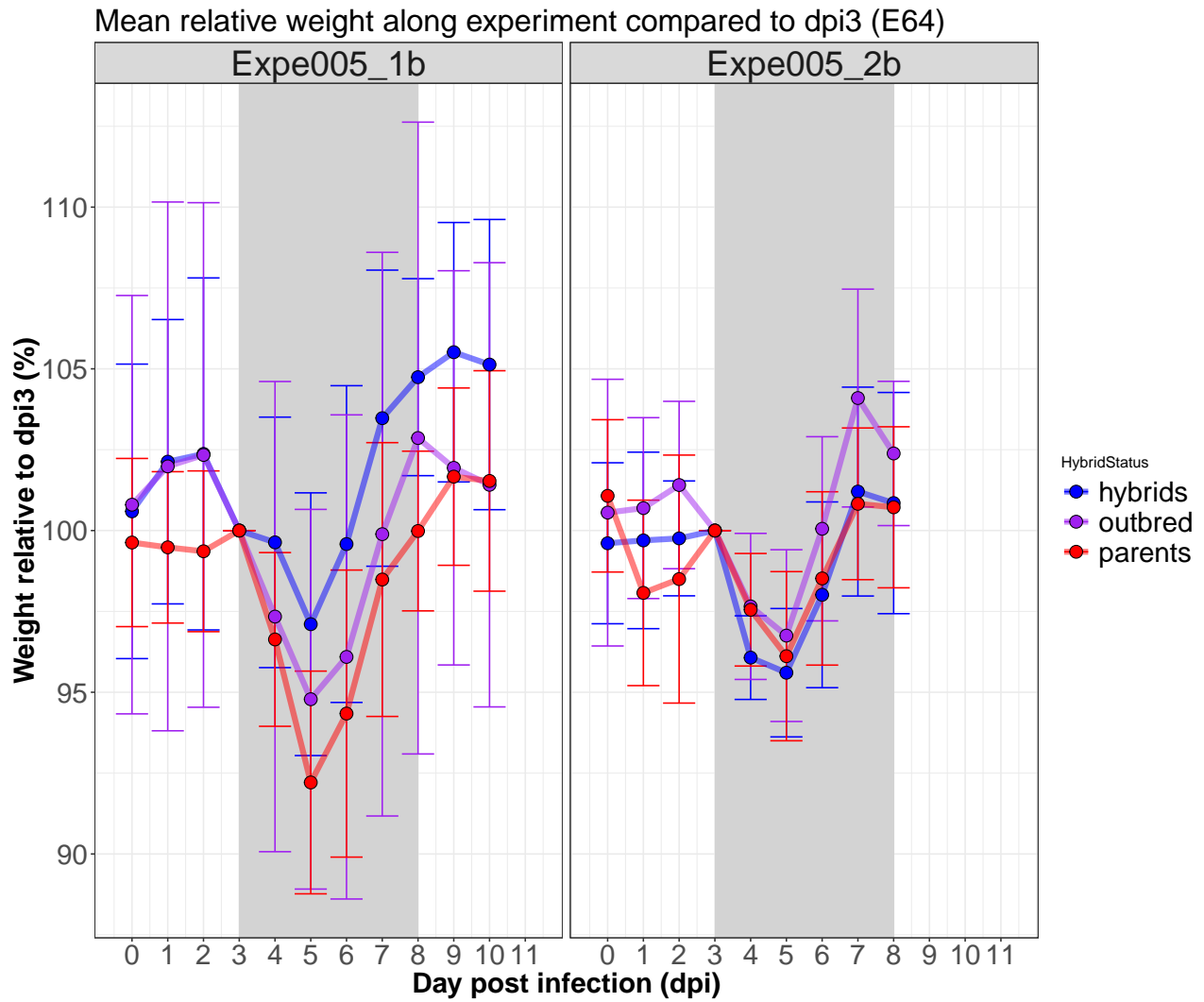
yellow : oocysts detected in feces



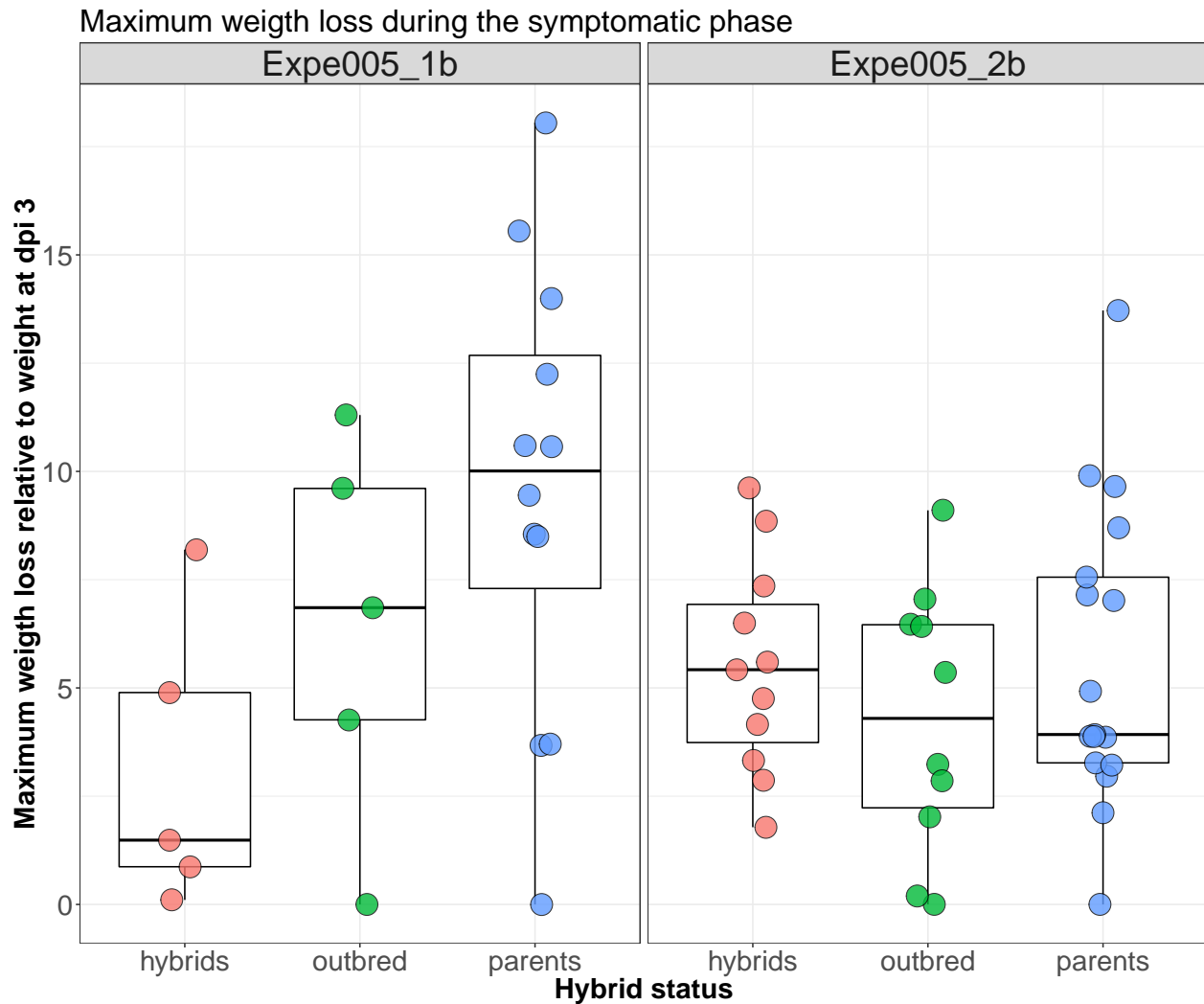
gative ● positive

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)



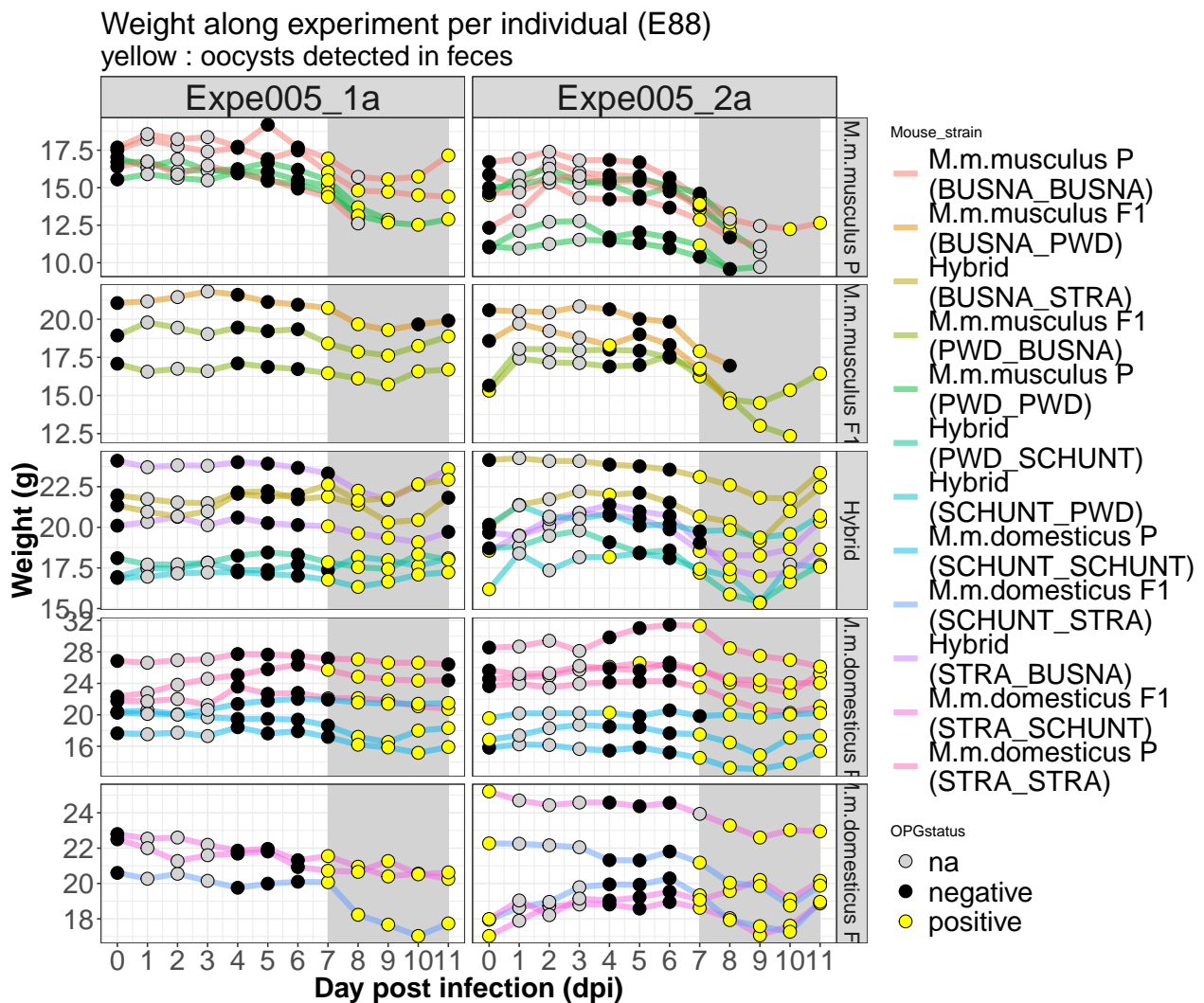
For statistical analysis, we compare the maximum relative weight loss between the different groups. We limit our analysis to the period : dpi3 to dpi8 (symptomatic period for E64 strain).



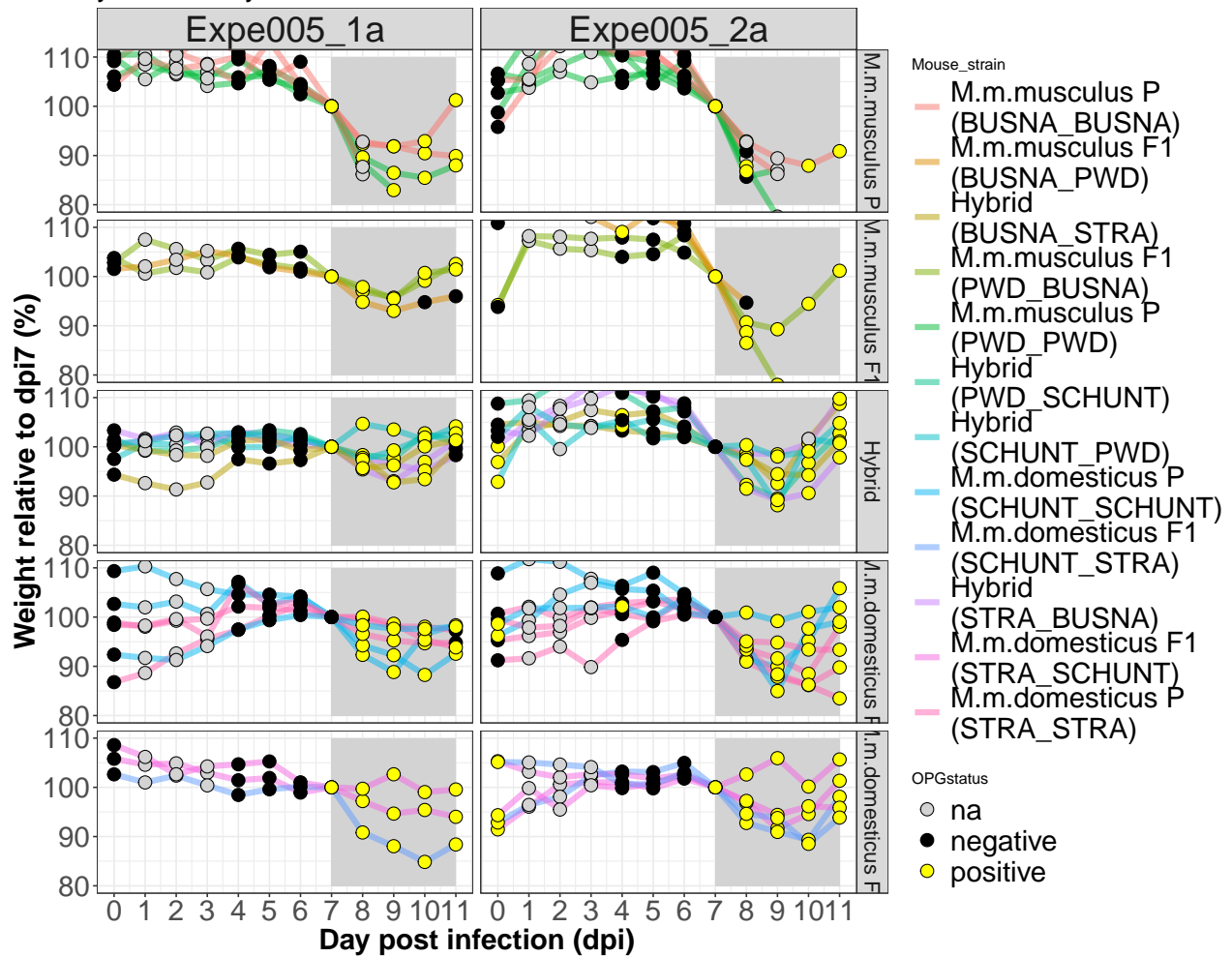
```
## [1] "first batch"
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 5.0441, df = 2, p-value = 0.0803
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E64B1$relativeWeight and maxloss_E64B1$HybridStatus
##
##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

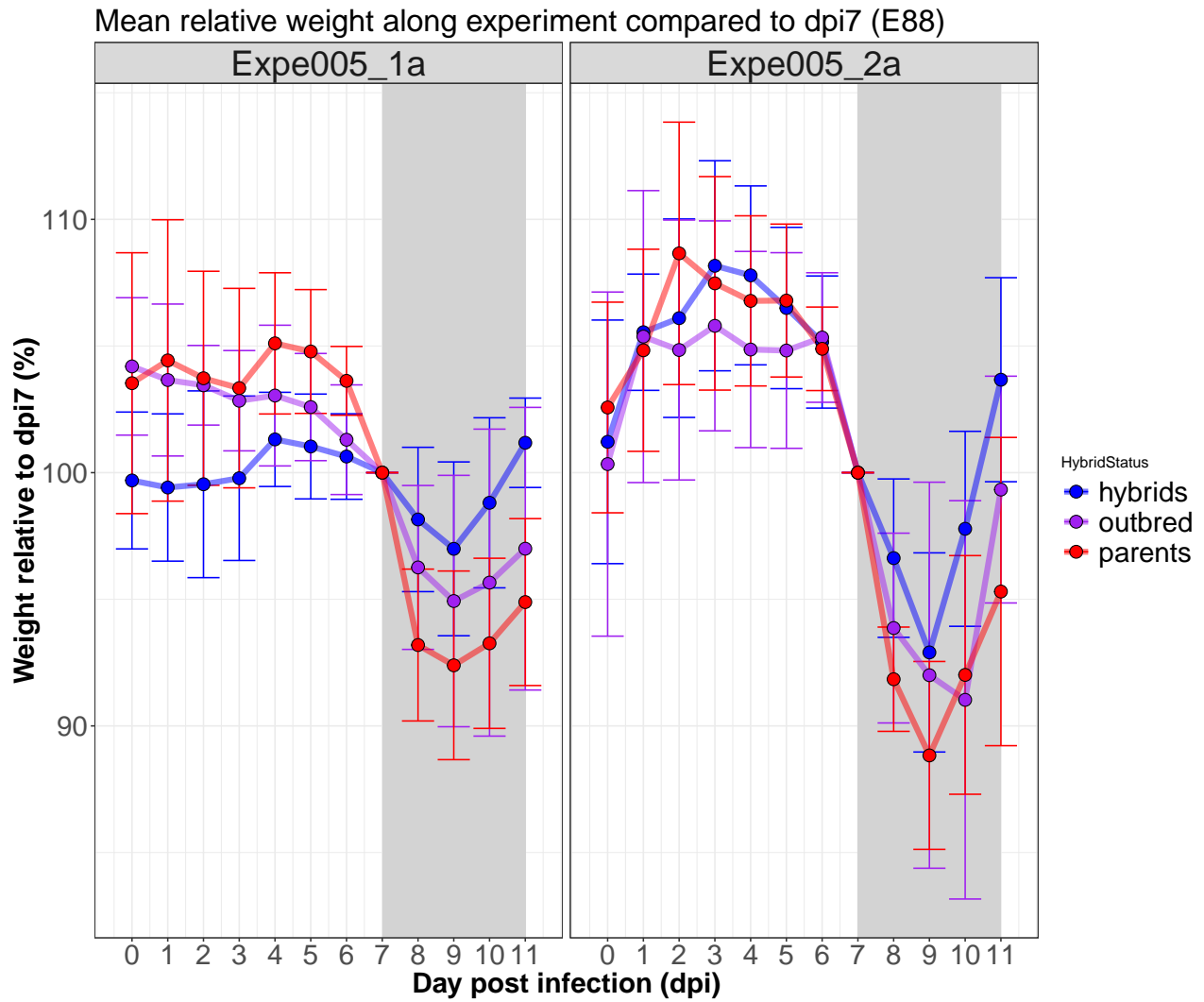
```
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 1.3931, df = 2, p-value = 0.4983
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E64B2$relativeWeight and maxloss_E64B2$HybridStatus
##
## hybrids outbred
## outbred 0.52 -
## parents 0.93 0.52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

Eimeria falciformis

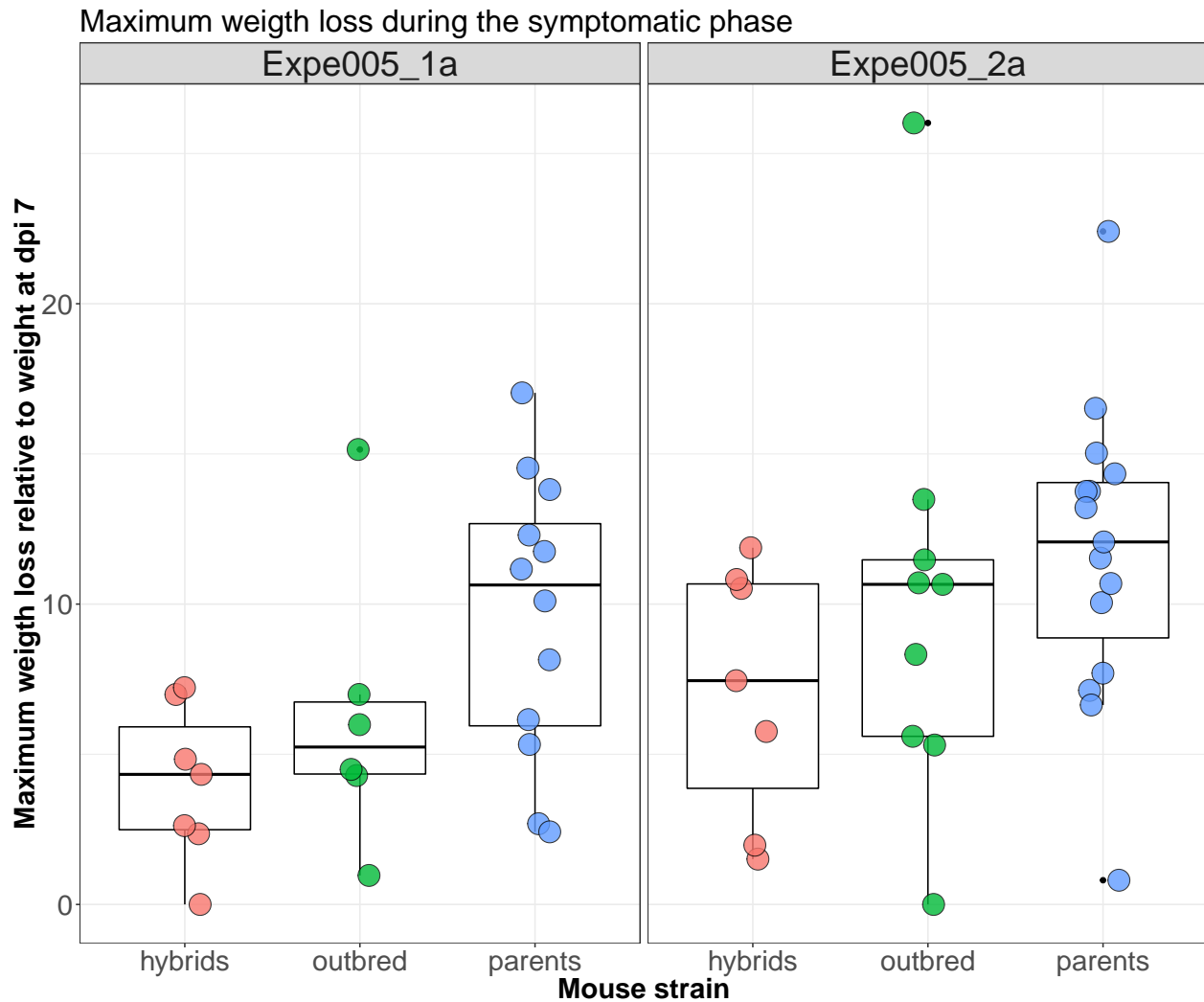


Relative weight along experiment compared to dpi7 (E88)
yellow : oocysts detected in feces





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).

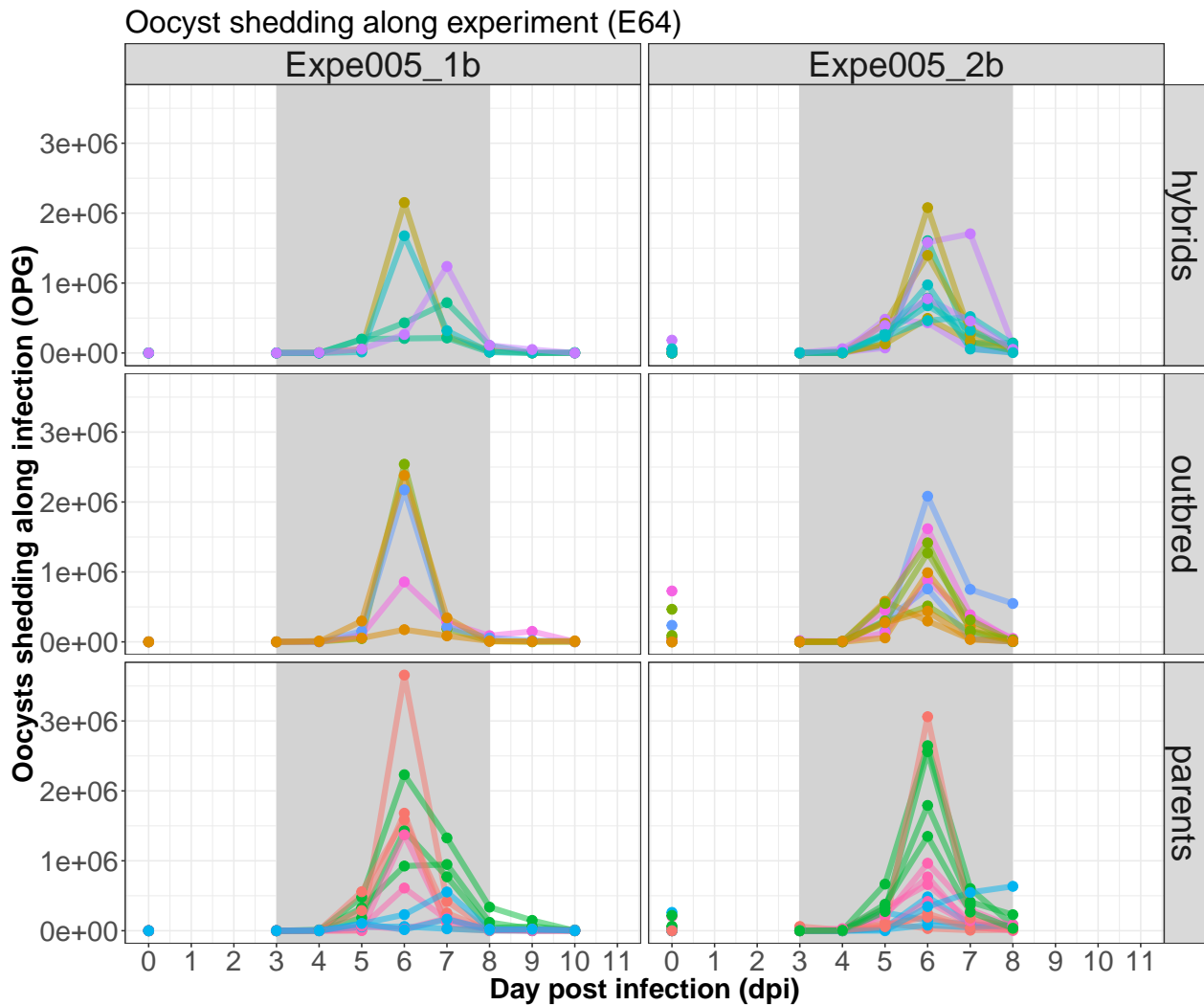


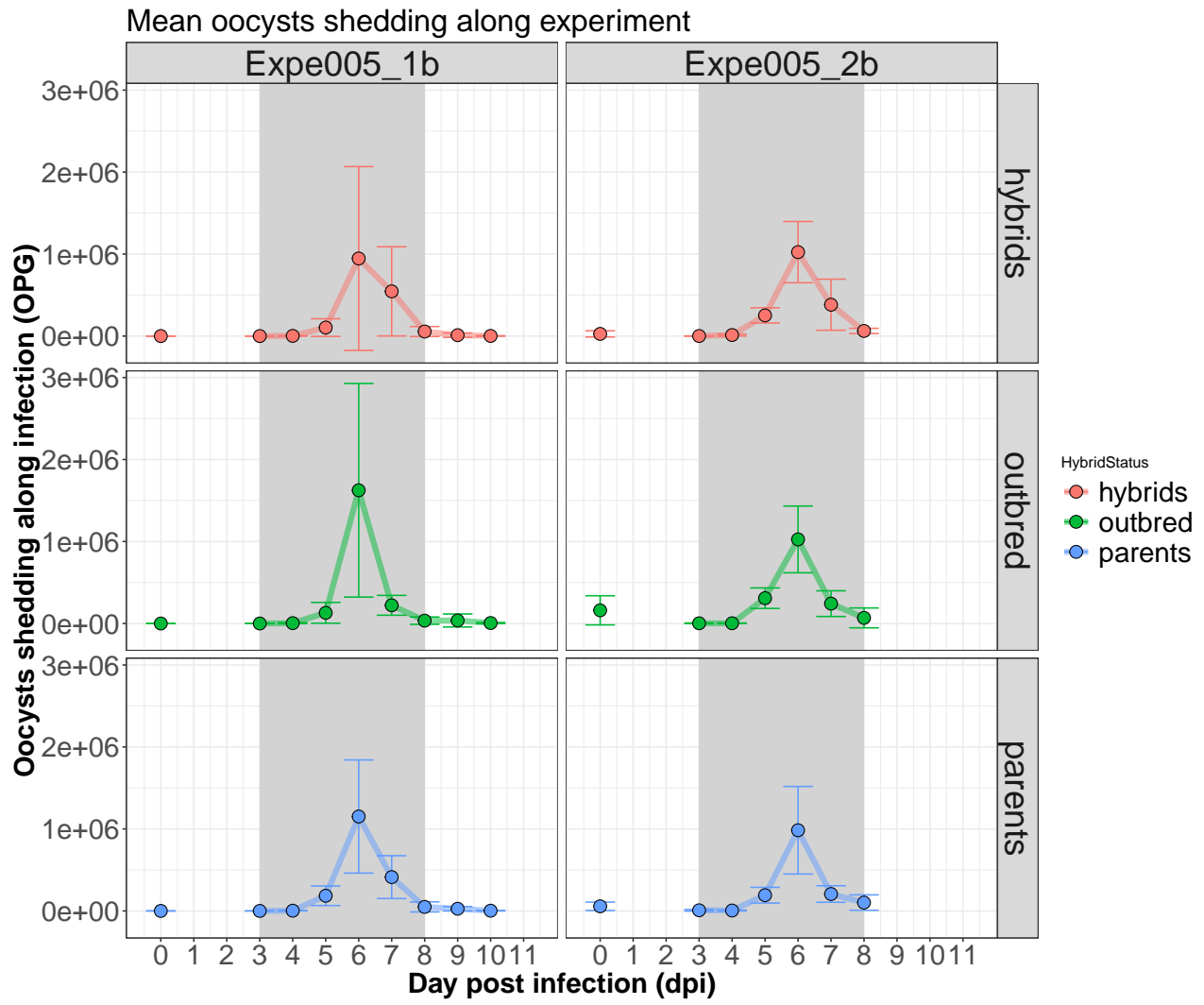
```
## [1] "first batch"

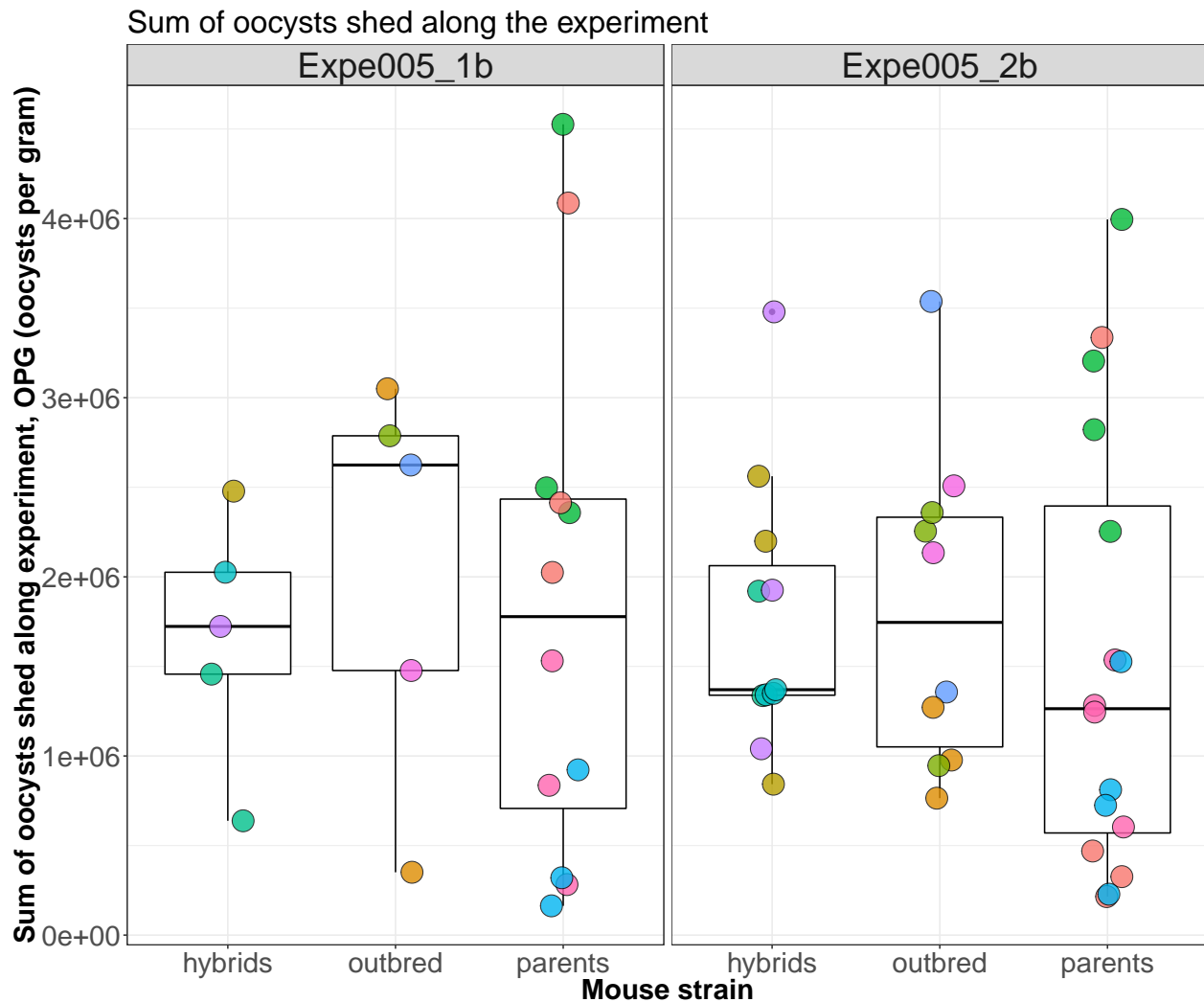
##
## Kruskal-Wallis rank sum test
##
## data: relativeWeight by HybridStatus
## Kruskal-Wallis chi-squared = 6.1426, df = 2, p-value = 0.04636
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: maxloss_E88B1$relativeWeight and maxloss_E88B1$HybridStatus
##
##      hybrids outbred
## 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



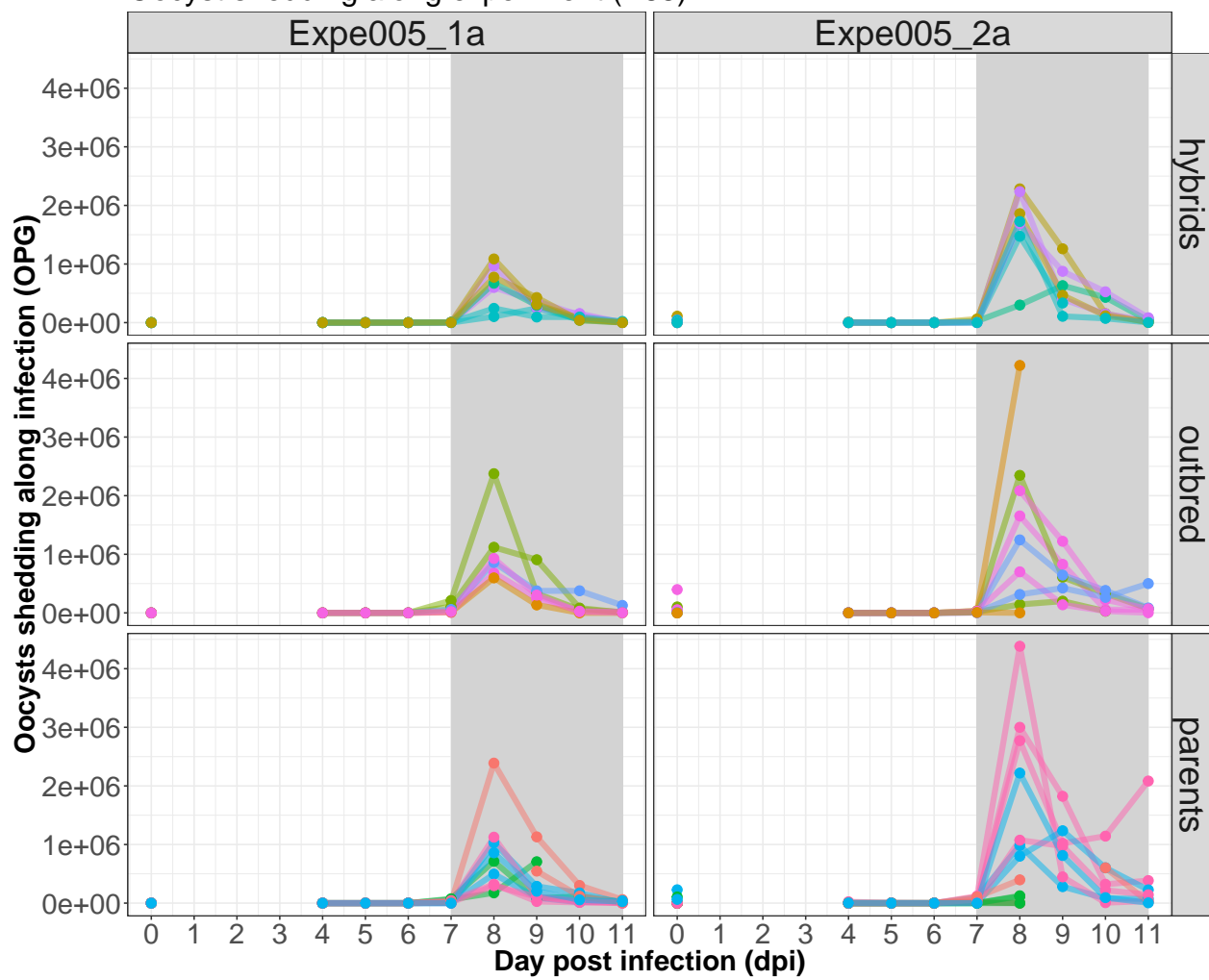




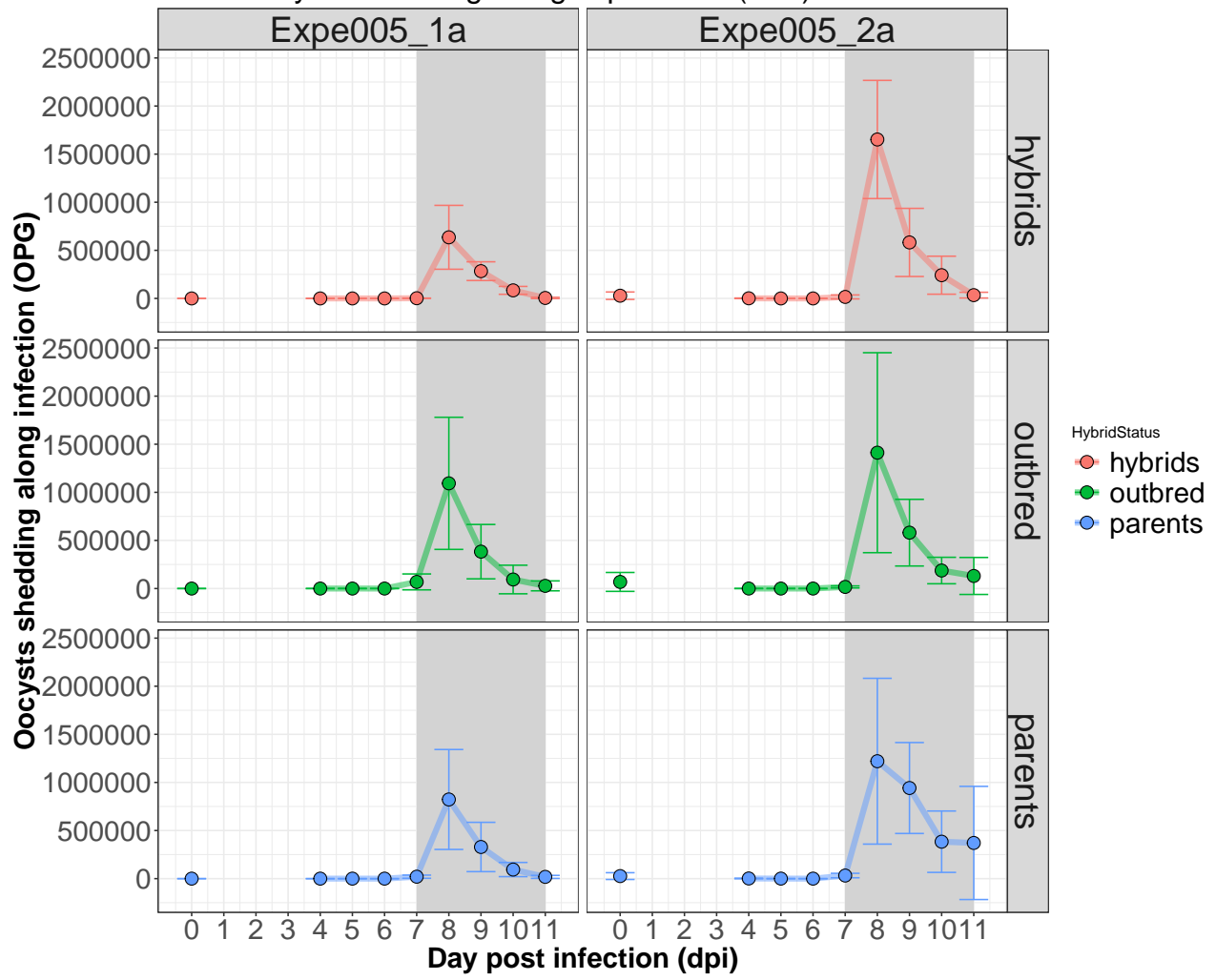
```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by HybridStatus
## Kruskal-Wallis chi-squared = 1.4151, df = 2, p-value = 0.4929
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_005_64$sum.oo and sum.oocysts_005_64$HybridStatus
##
##      hybrids outbred
## outbred 0.57      -
## parents 0.57      0.57
##
## P value adjustment method: BH
```

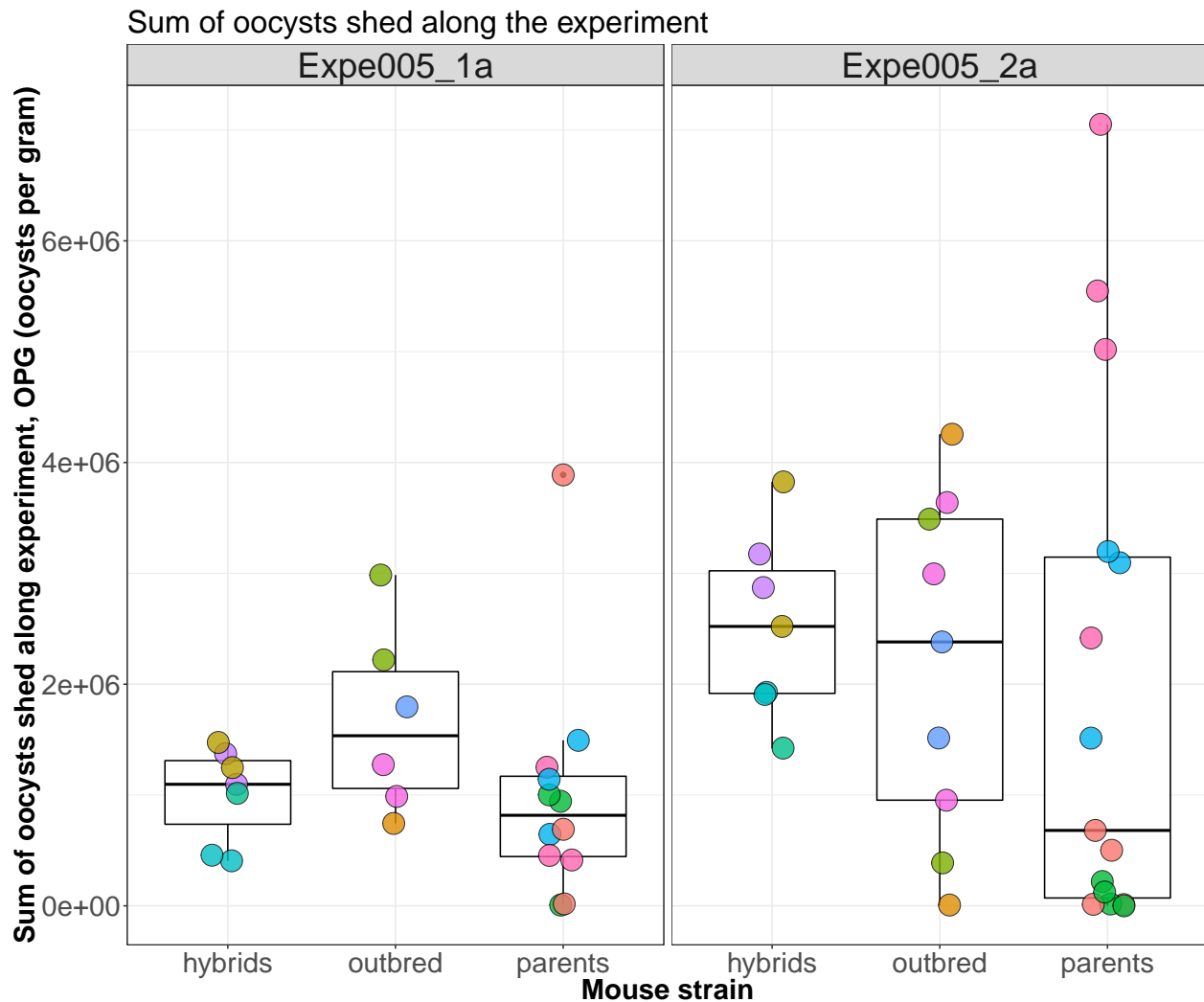
Eimeria falciformis

Oocyst shedding along experiment (E88)



Mean oocysts shedding along experiment (E88)





```
##
## Kruskal-Wallis rank sum test
##
## data: sum.oo by HybridStatus
## Kruskal-Wallis chi-squared = 3.918, df = 2, p-value = 0.141
##
## Pairwise comparisons using Wilcoxon rank sum test
##
## data: sum.oocysts_005_88$sum.oo and sum.oocysts_005_88$HybridStatus
##
##      hybrids outbred
## outbred 0.81      -
## parents 0.16      0.16
##
## 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.
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