Full Analysis

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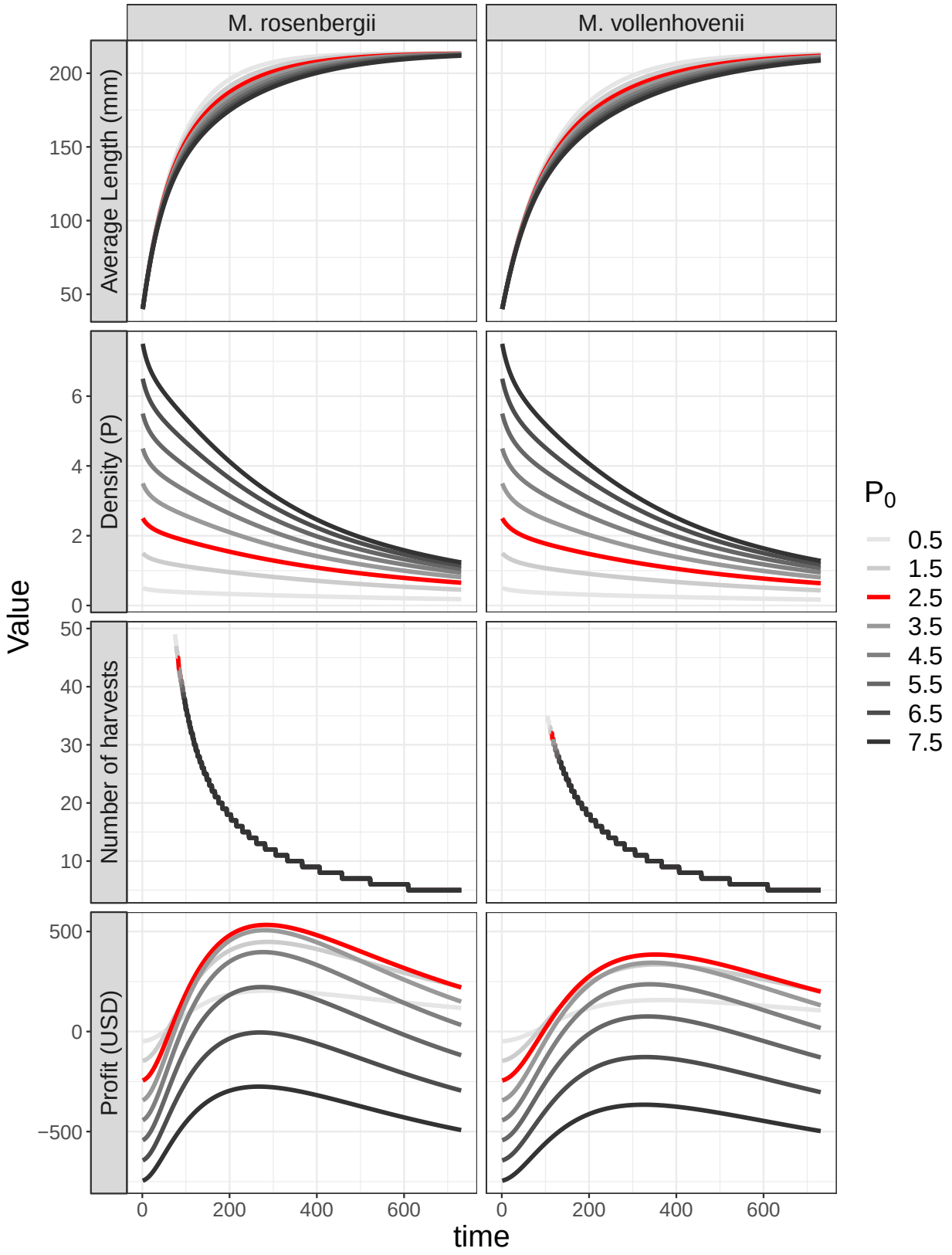
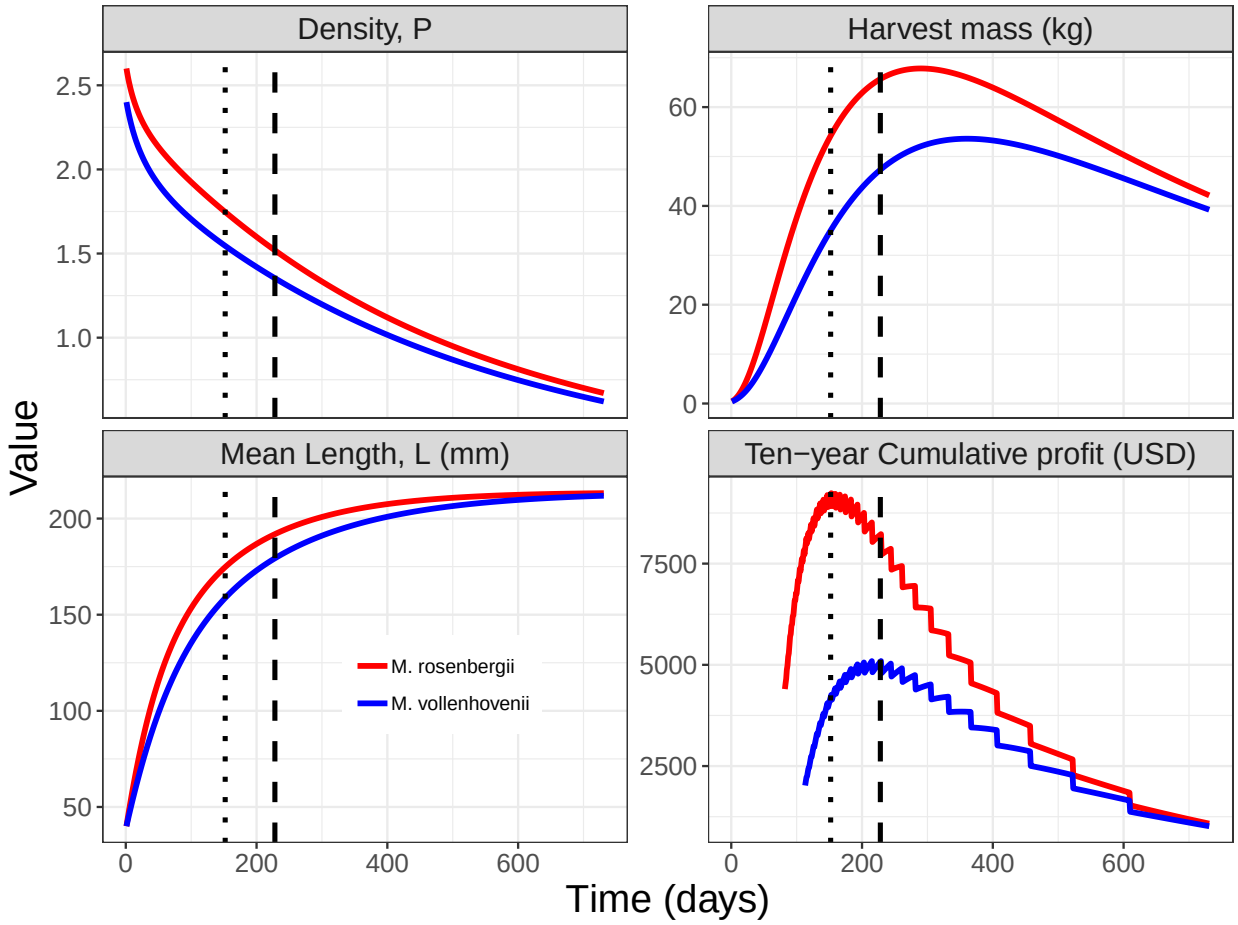
Numeric estimation of max profit

For each prawn species, shows trajectories of length, density, harvestable biomass, and profit over time over a range of stocking densities


M. rosenbergii
M. vollenhovenii
Average Length (mm)
Density (P)
Number of harvests
Profit (USD)
Value
time
P_0
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5

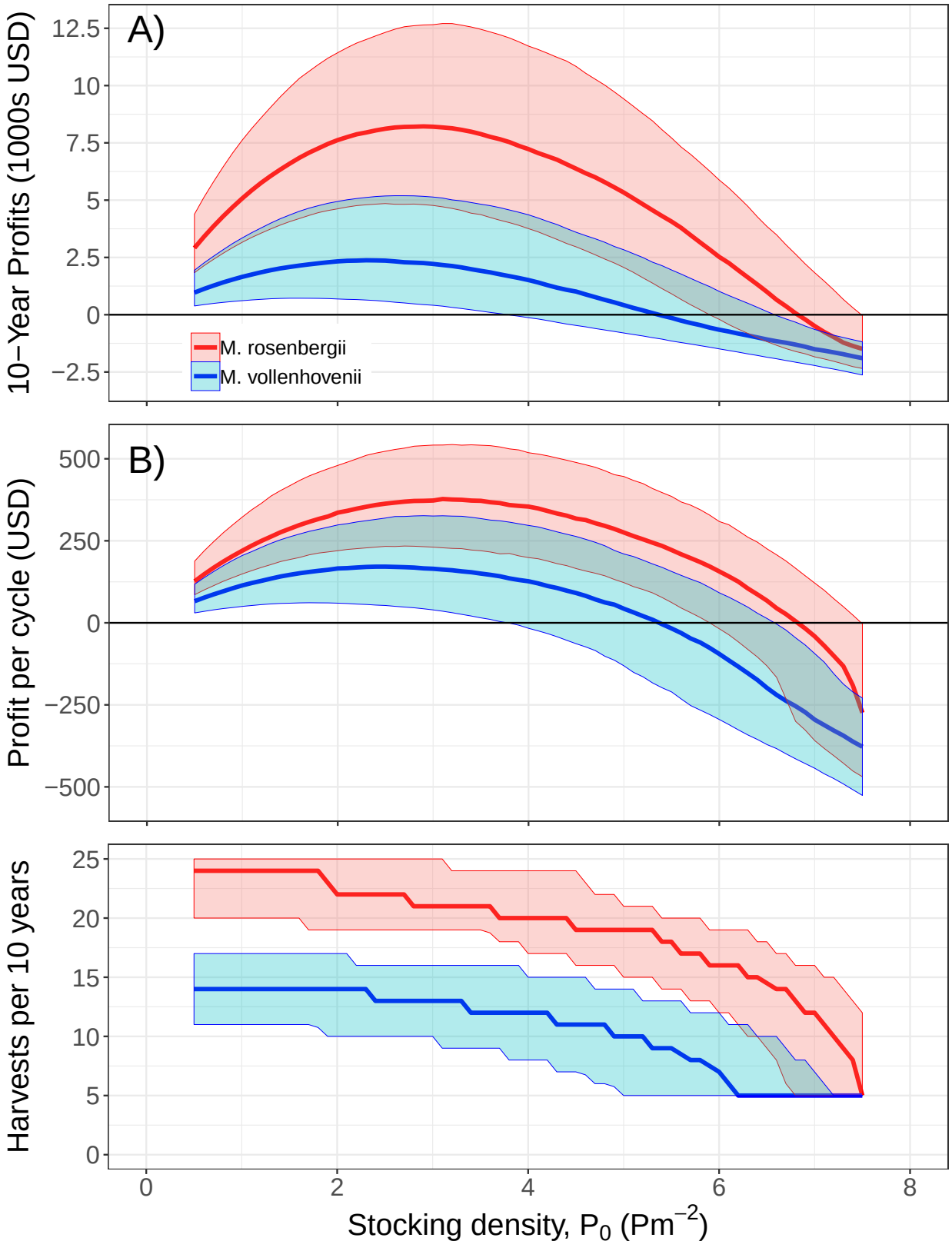
Example cycle

Figure showing prawn aquaculture dynamics through time



Eumetric curves

We want to add estimates of uncertainty to the eumetric curve in addition to the eumetric curve generated by point estimates of all parameters (above). We'll use the same parameter sets from the latin hypercube generated for the PRCC sensitivity analysis to run the model over all tested stocking densities


A)
B)
10−Year Profits (1000s USD)
Profit per cycle (USD)
Harvests per 10 years
M. rosenbergii
M. vollenhovenii
12.5
10
7.5
5
2.5
0
−2.5
500
250
0
−250
−500
25
20
15
10
5
0
0
2
4
6
8
Stocking density, P_0 (Pm^{-2})

Optimal management table

Also want a table showing set of parameters and outputs from "optimal management". Two approaches here: can either take uncertainty

Table 1: Estimates of M. vollenhovenii optimal management (uncertainty during optimization)

P_nought	2300
Cum_profit_med	2374.808
harvest_time_sum	260 (228 - 365)
harvest_mass_sum	22.91 (16.11 - 30.52)
harvest_length_sum	169.62 (162.45 - 177.62)
harvest_number_sum	815.23 (591.61 - 1036.37)
profit_cycle_sum	170.36 (55.89 - 311.42)
roi_sum	0.93 (0.33 - 1.8)
n_harvest_sum	14 (10 - 16)
cum_profit_sum	2374.81 (640.69 - 5117.8)

Table 2: Estimates of M. vollenhovenii optimal management (uncertainty during optimization)

P_nought	2900
Cum_profit_med	8218.367
harvest_time_sum	173 (146 - 192)
harvest_mass_sum	38.39 (30.74 - 46.95)
harvest_length_sum	167.66 (161.02 - 175.09)
harvest_number_sum	1505.14 (1315 - 1702.93)
profit_cycle_sum	371.89 (232.09 - 540.08)
roi_sum	1.63 (0.97 - 2.46)
n_harvest_sum	21 (19 - 25)
cum_profit_sum	8218.37 (4802.95 - 12645.21)

Table 3: Estimates of M. vollenhovenii optimal management (parametric uncertainty)

P_nought	2400
L_nought	40
harvest_time_med	280 (228 - 365)
harvest_mass_med	23.57 (16.59 - 31.36)
harvest_length_med	169.82 (162.42 - 177.77)
harvest_number_med	846.26 (611.96 - 1074.91)
profit_cycle_med	171.19 (54.07 - 315.4)
roi_med	0.89 (0.3 - 1.75)
n_harvest_med	13 (10 - 16)
cum_profit_med	2369.91 (618.51 - 5157.65)

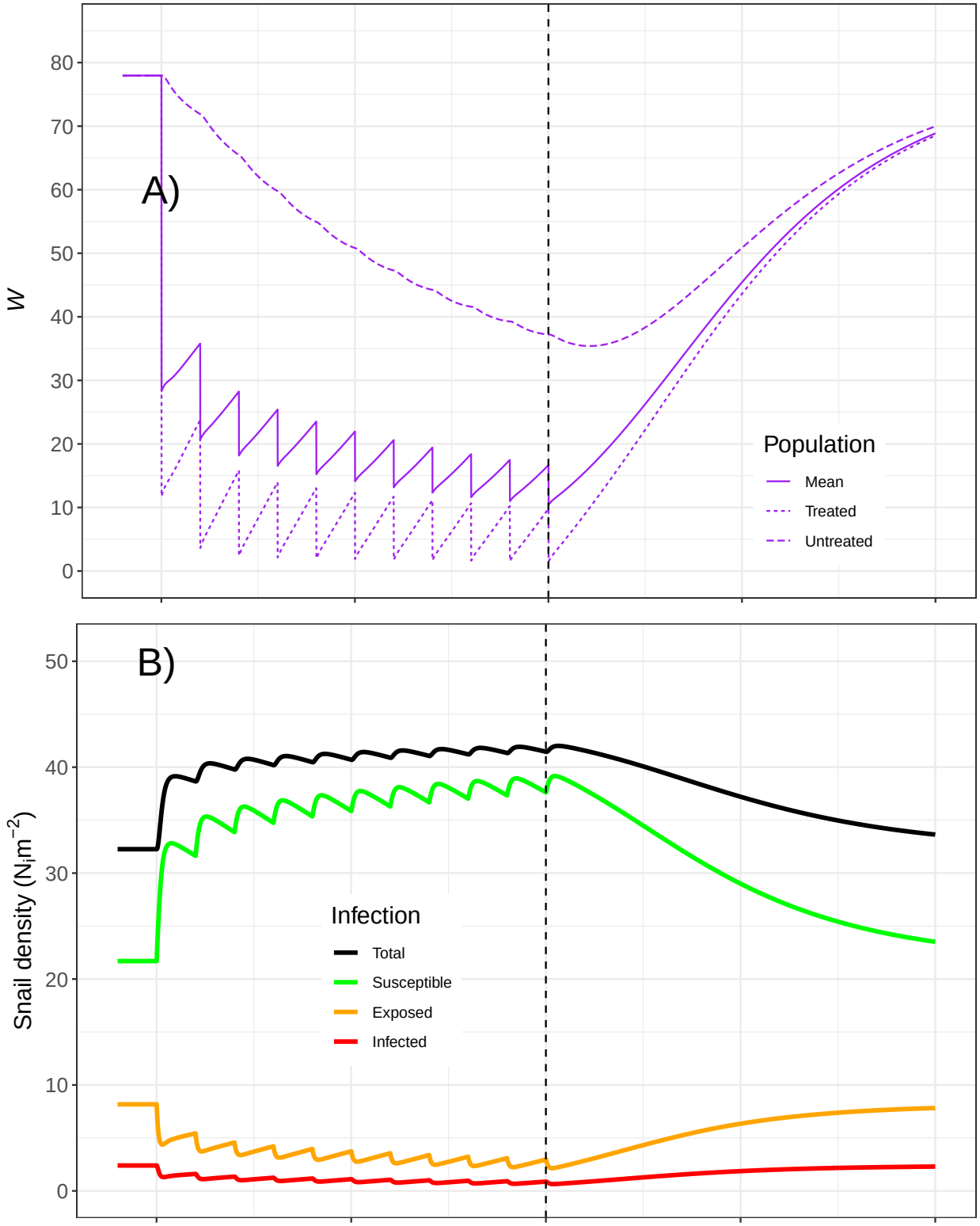
Table 4: Estimates of M. rosenbergii optimal management (parametric uncertainty)

P_nought	2600
L_nought	40
harvest_time_med	165 (146 - 192)
harvest_mass_med	36.37 (29.3 - 44.94)
harvest_length_med	168.06 (160.86 - 175.34)
harvest_number_med	1365.39 (1198.27 - 1543.09)
profit_cycle_med	366.46 (232.58 - 528.41)
roi_med	1.8 (1.08 - 2.69)
n_harvest_med	22 (19 - 25)
cum_profit_med	8171.43 (4821.01 - 12459.85)

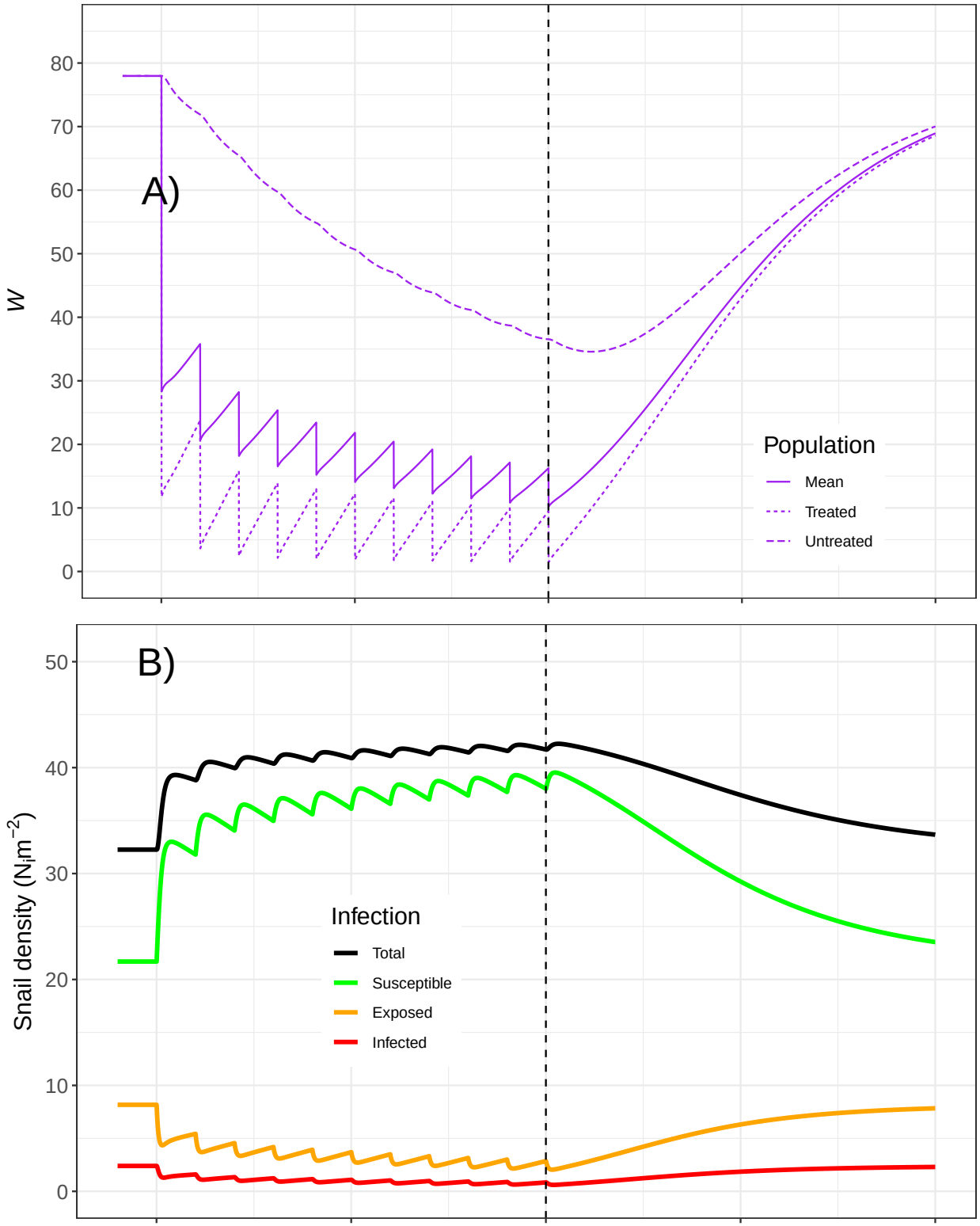
Epi simulations

MDA Intervention

With migration



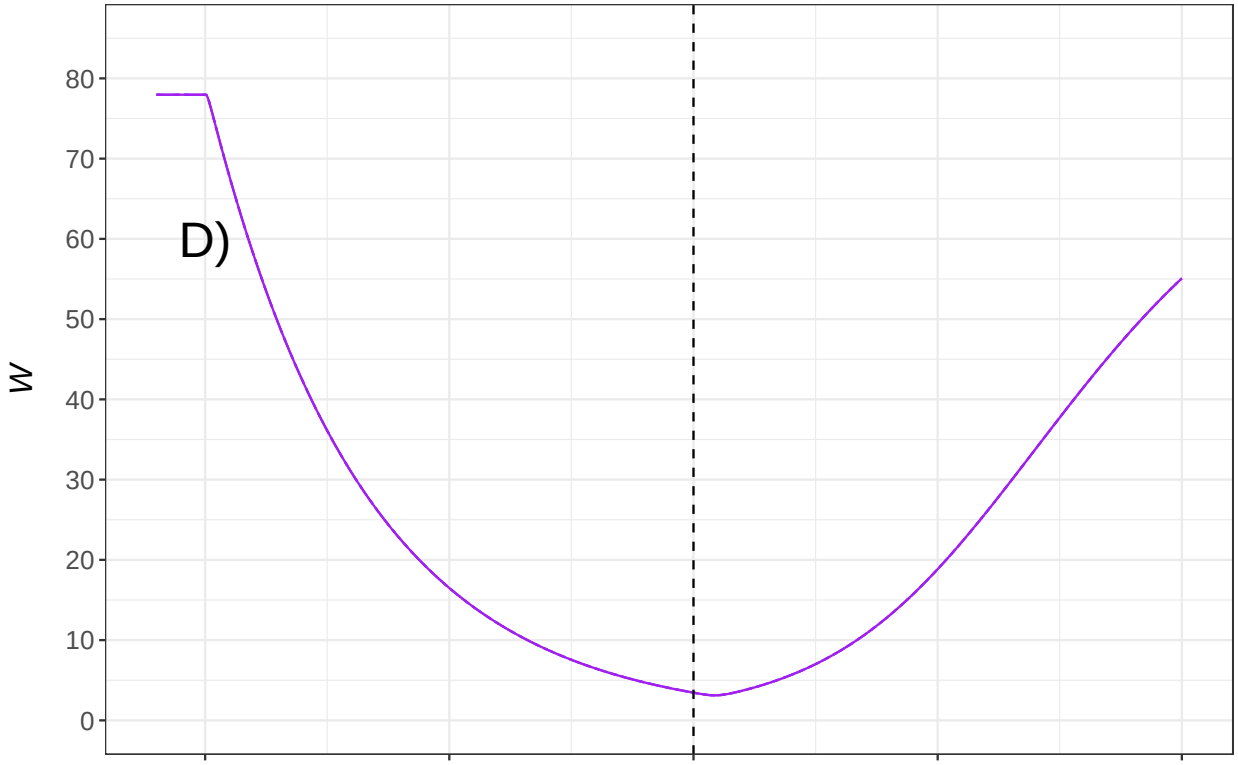
No migration

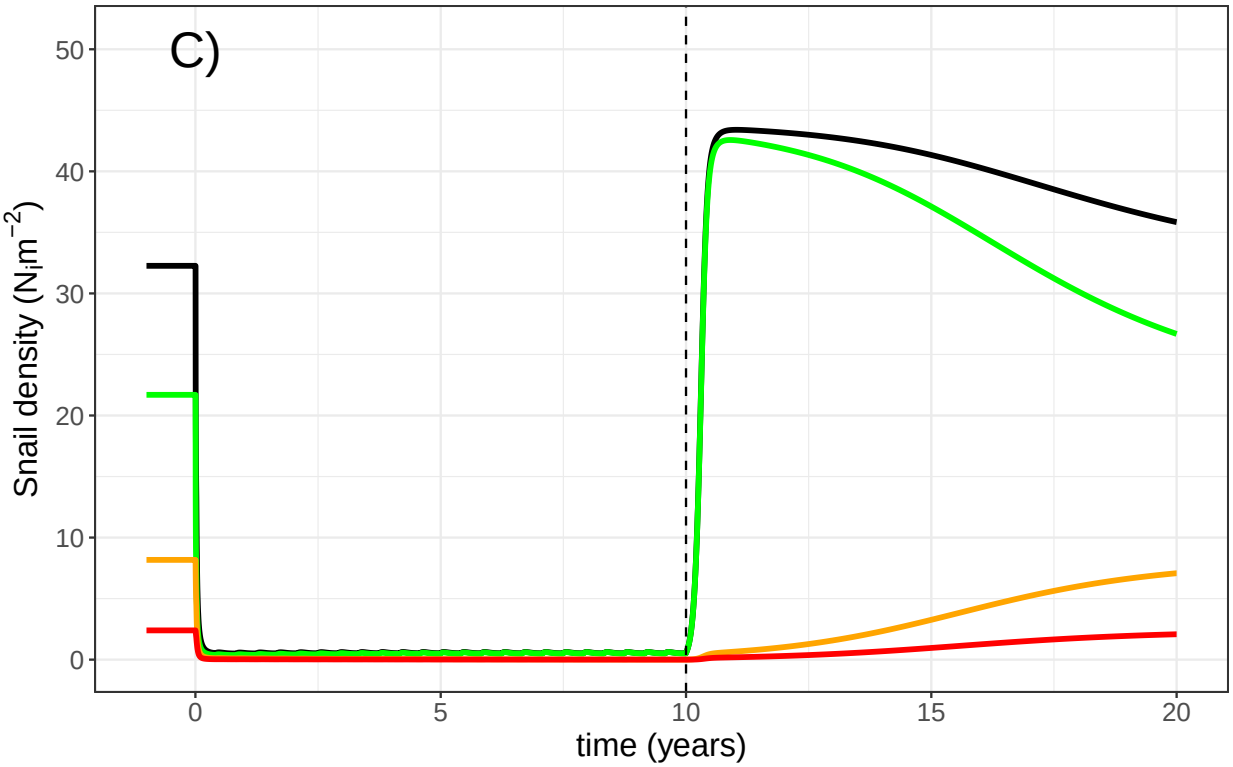


Prawn-only Intervention

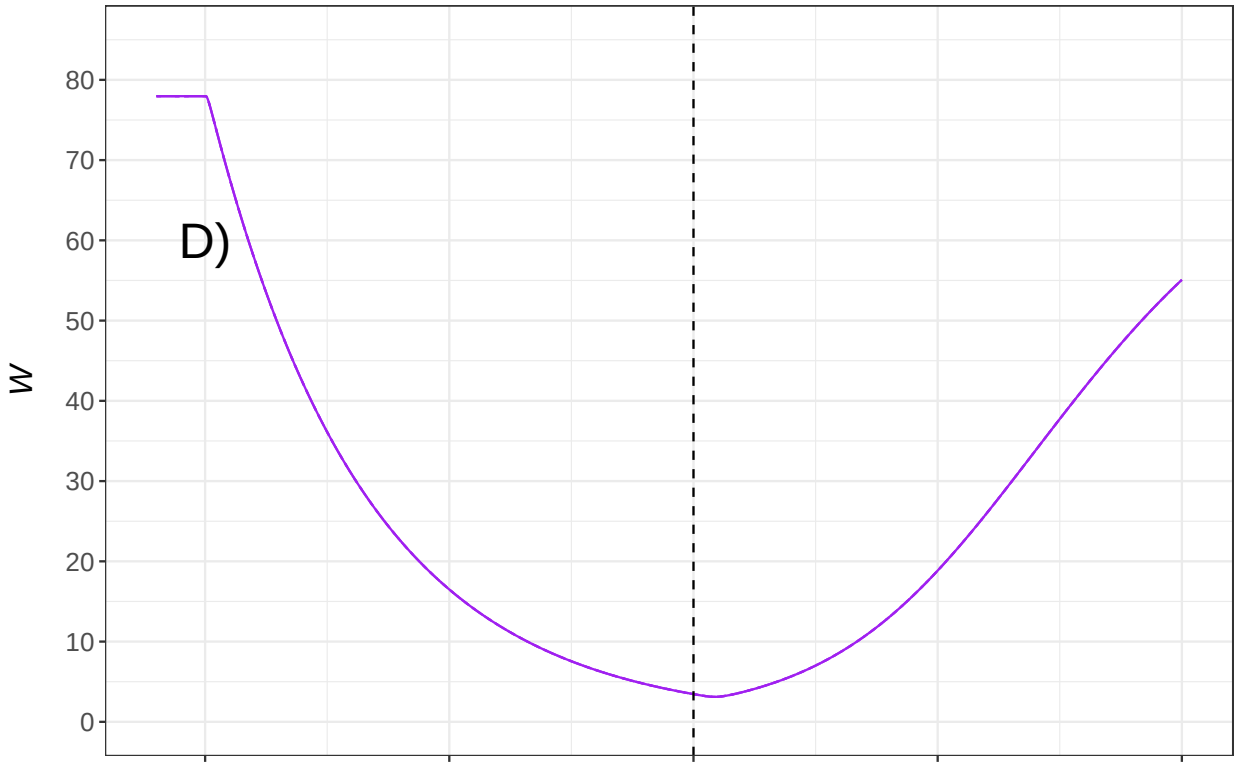
M. rosenbergii

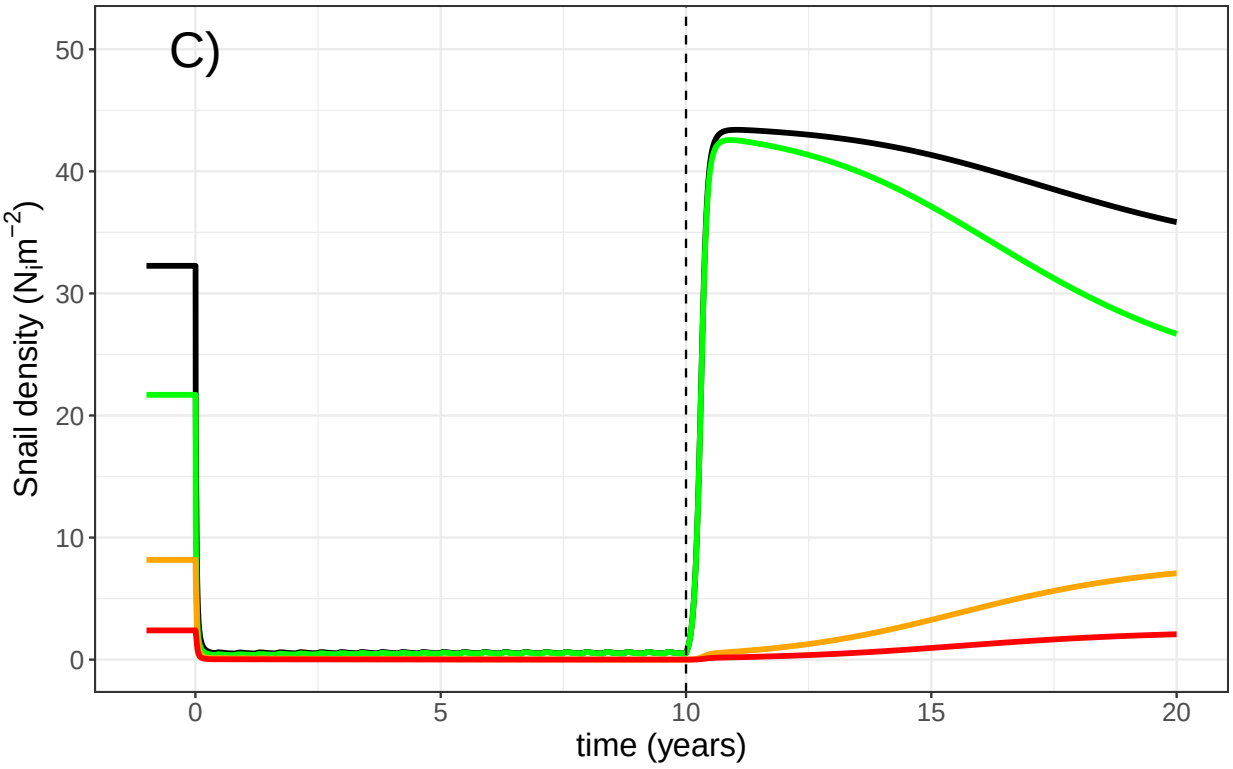
With migration





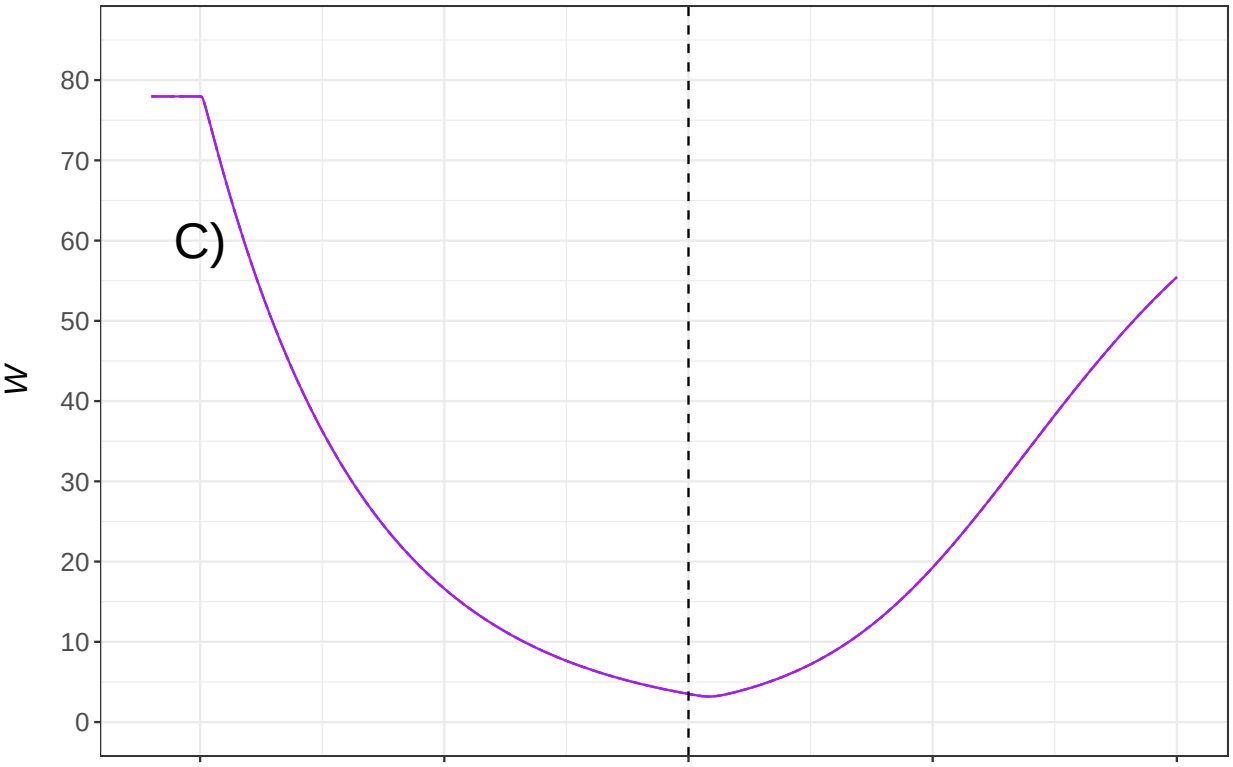
No migration

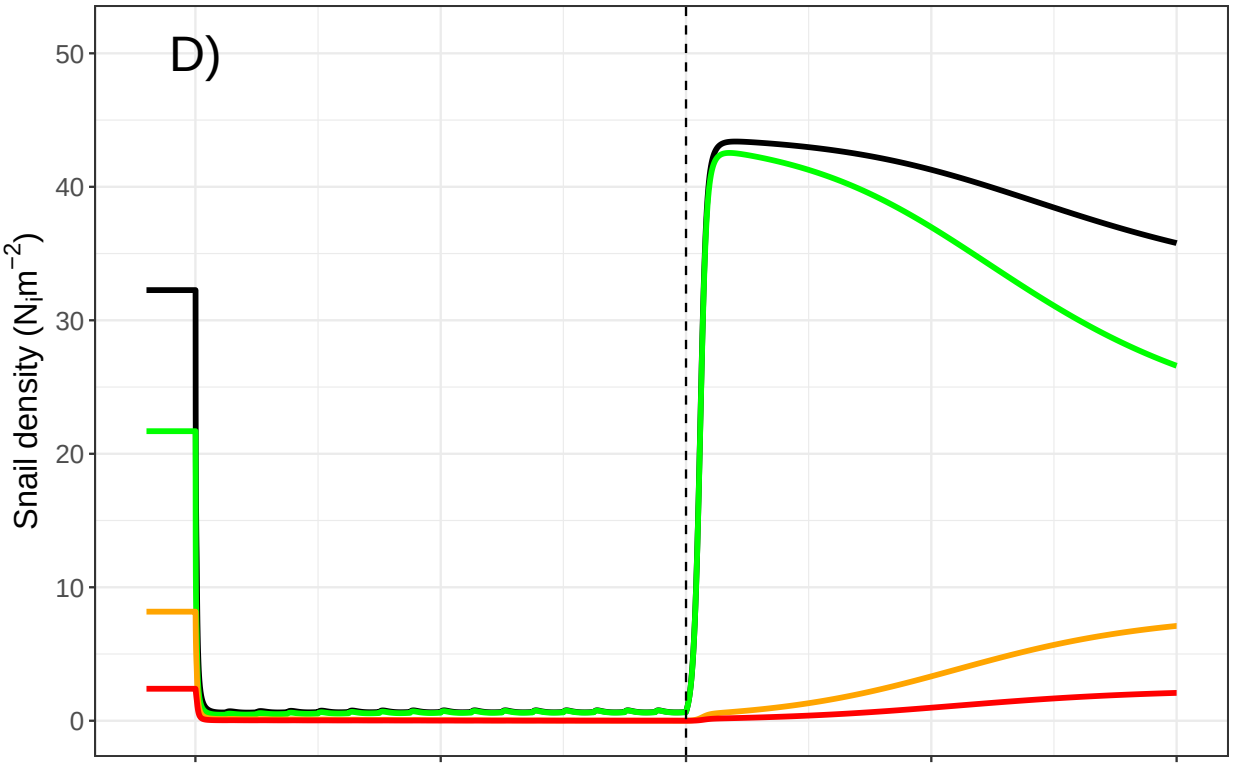




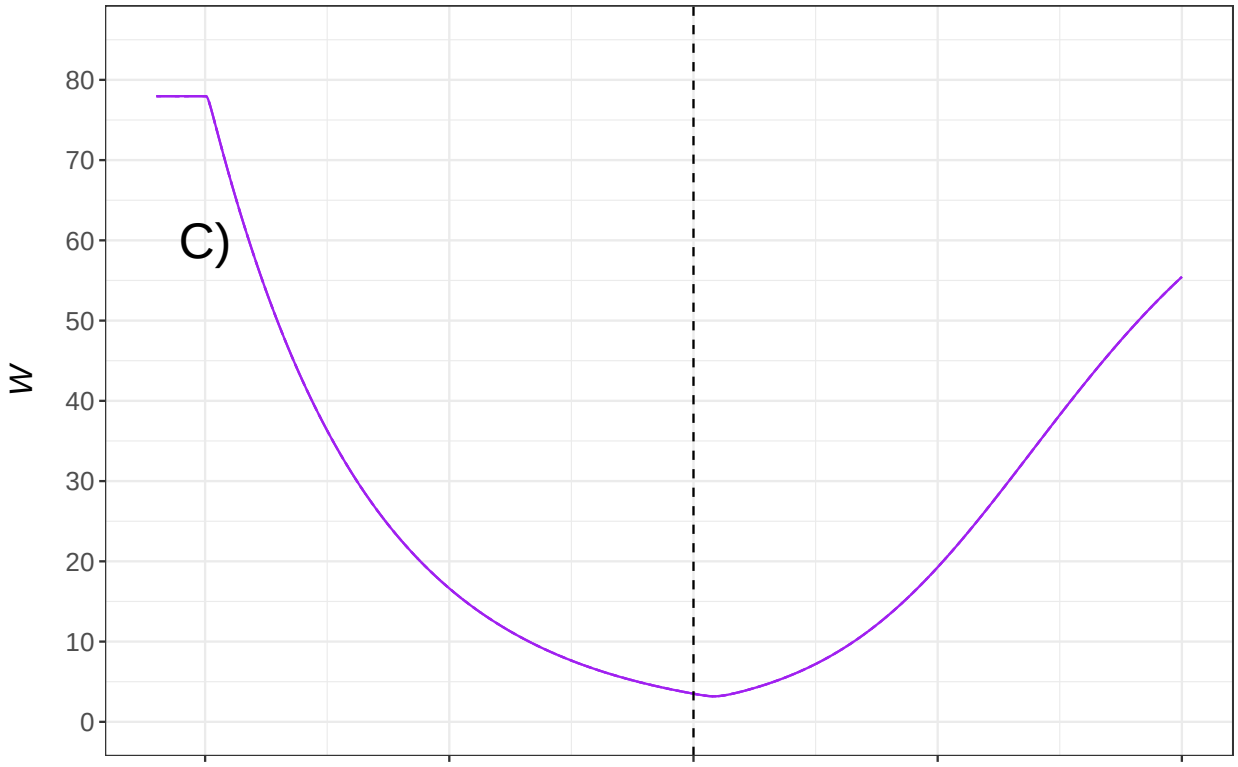
M. vollenhovenii

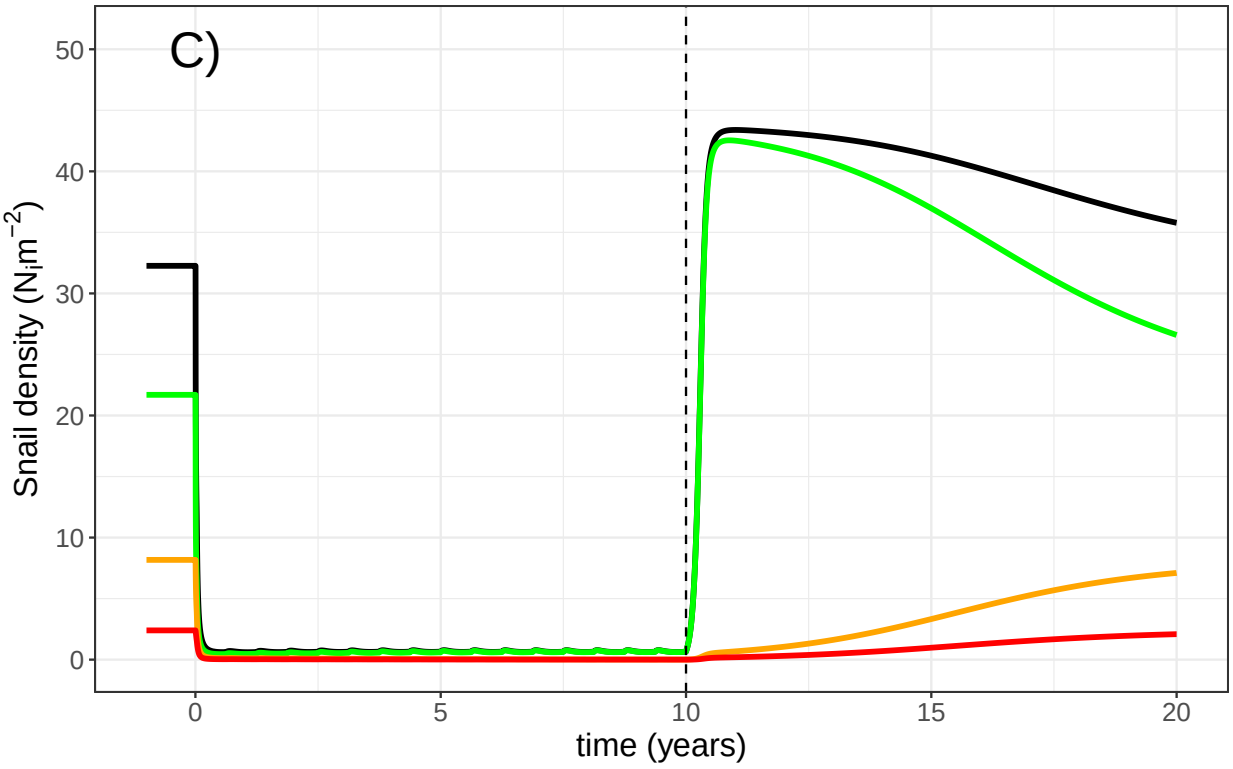
With migration





No migration

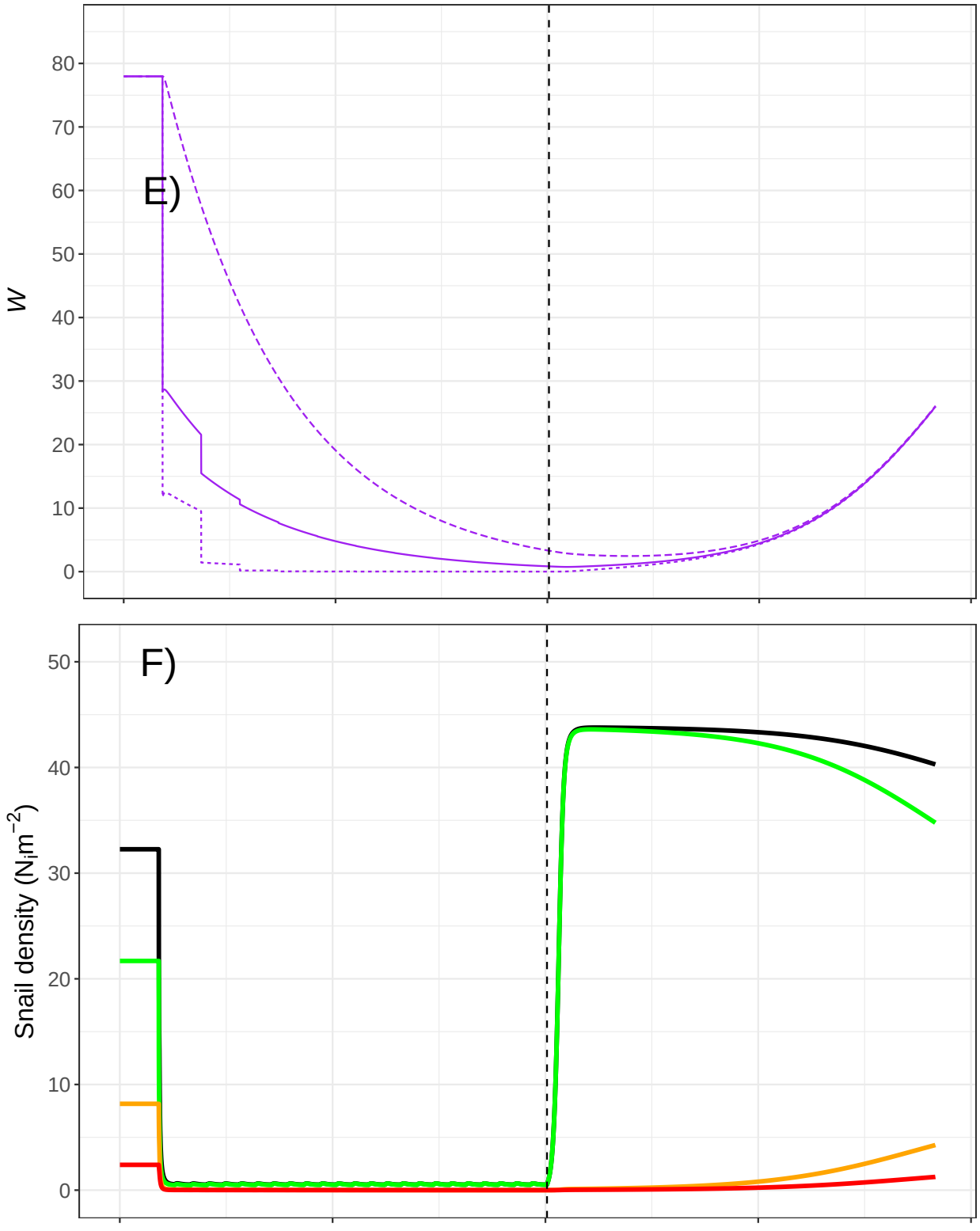




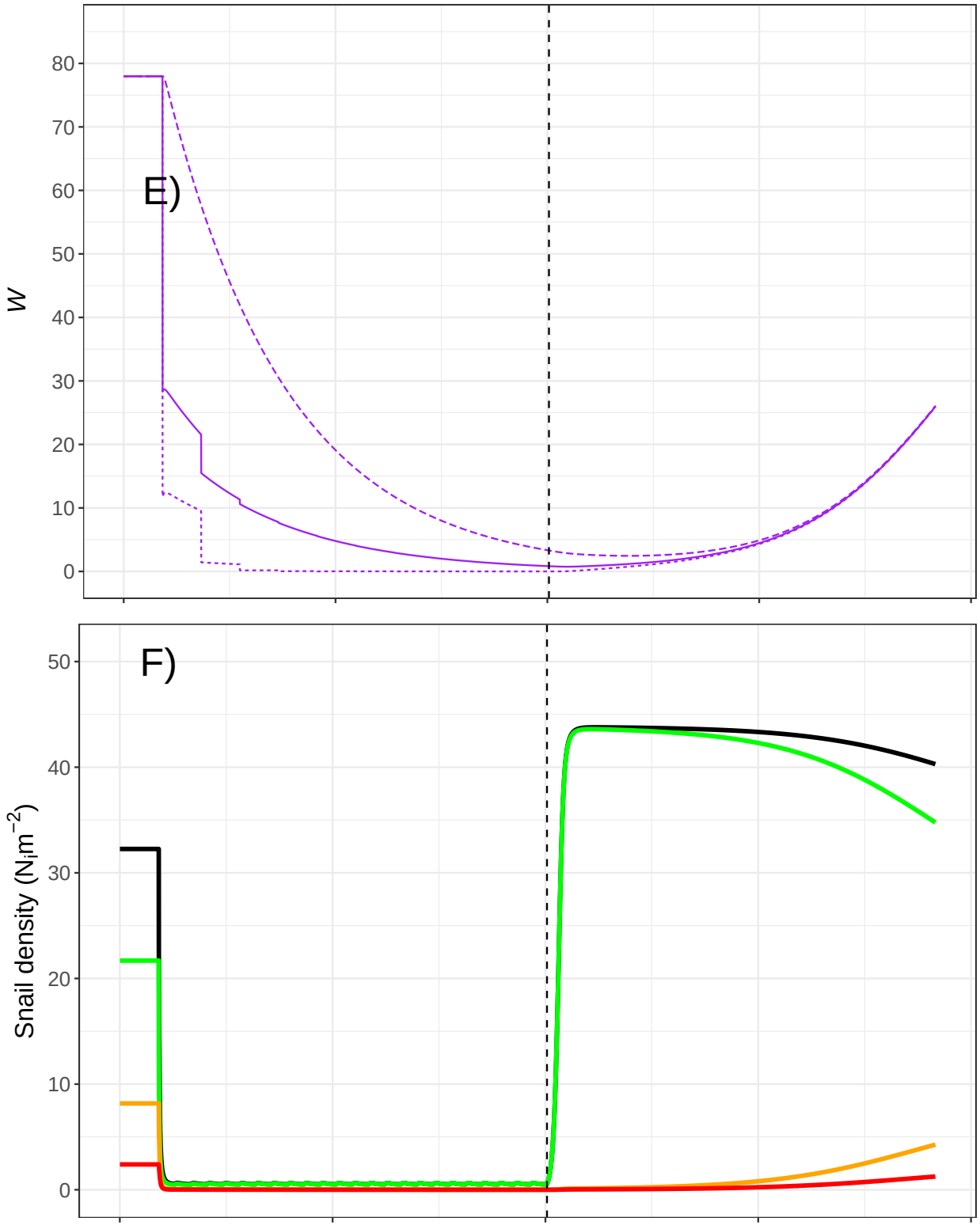
Combined Intervention

M. rosenbergii

With migration

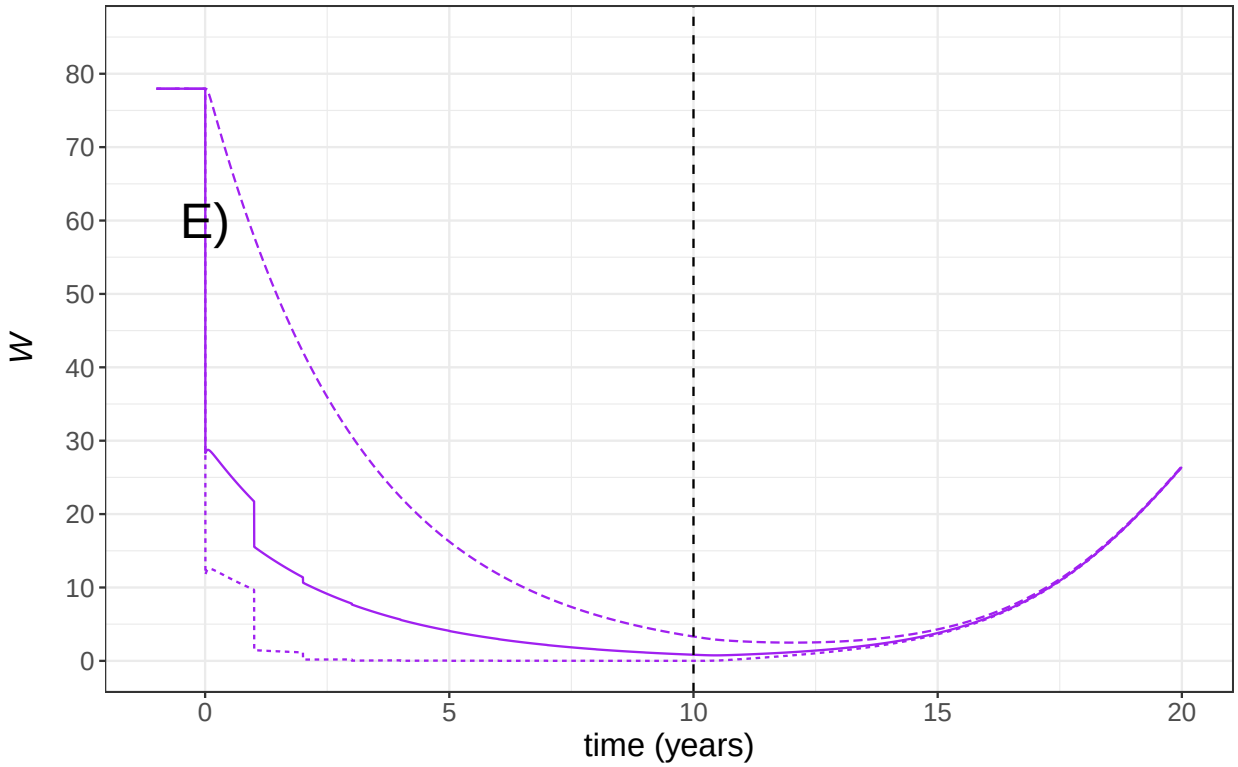


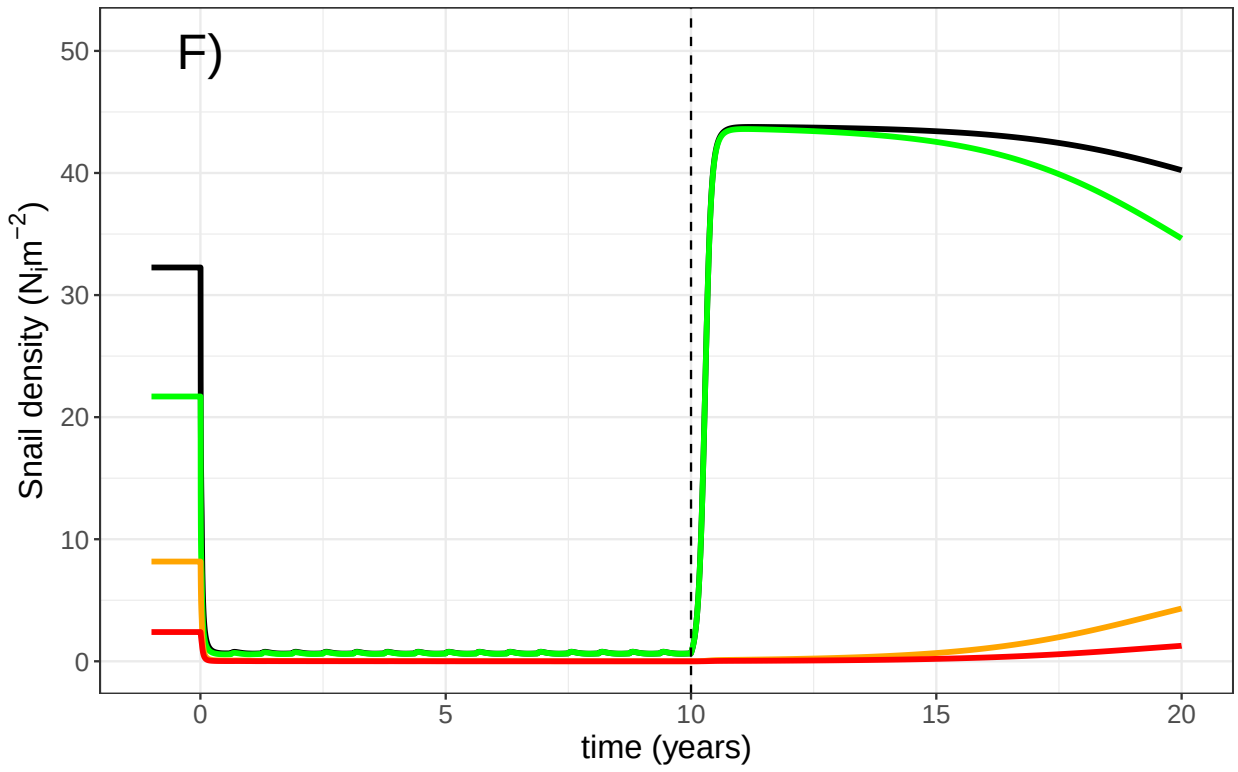
No migration



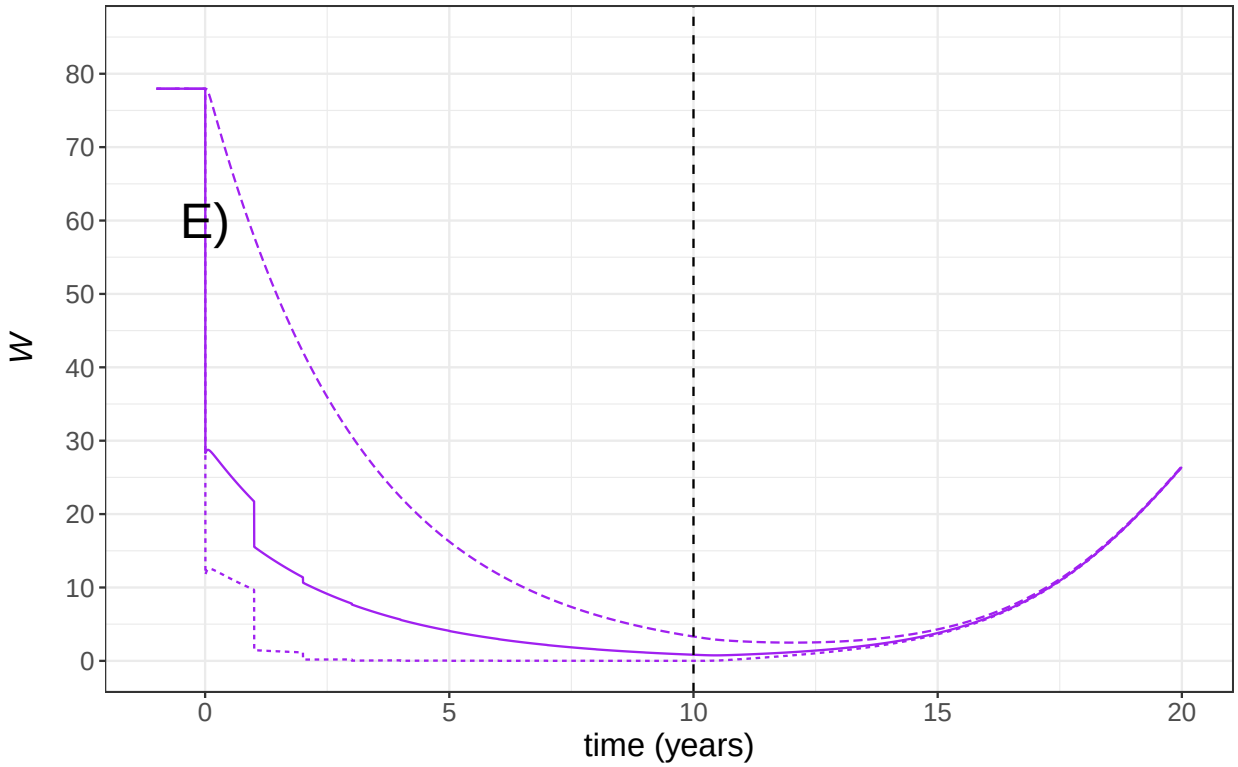
M. vollenhovenii

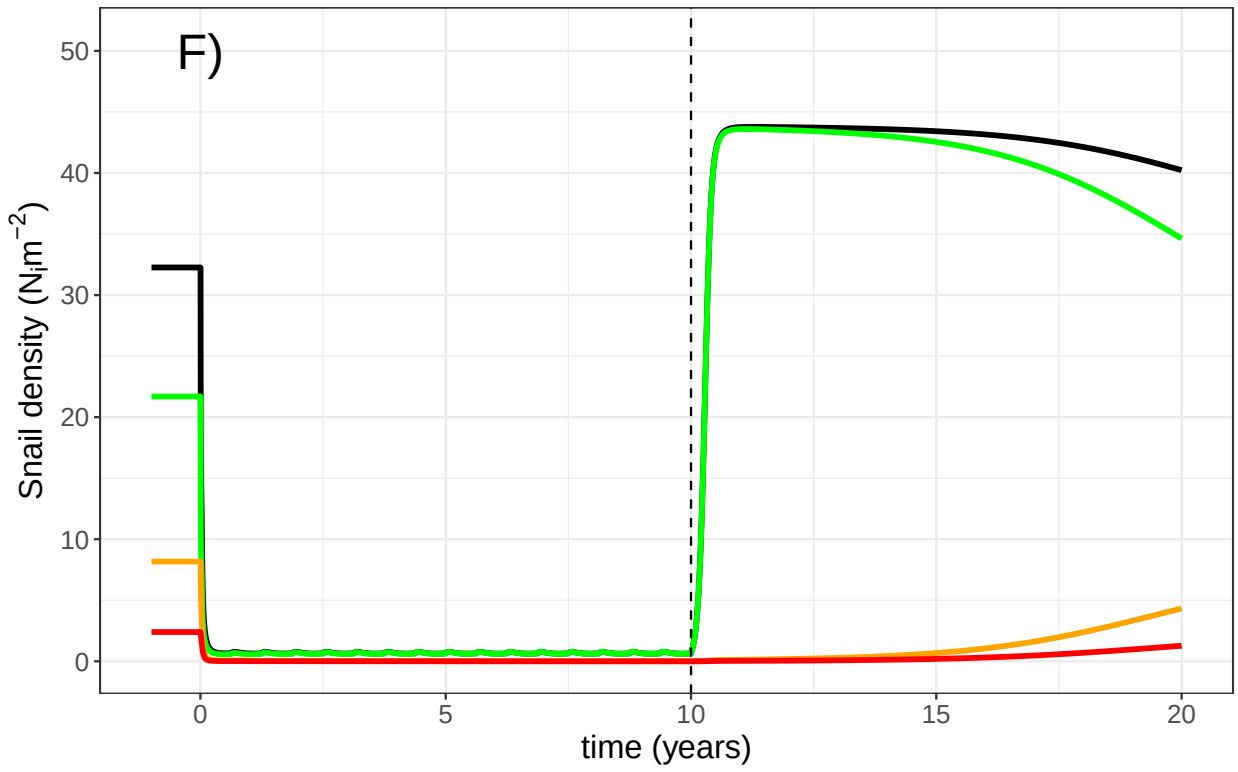
With migration





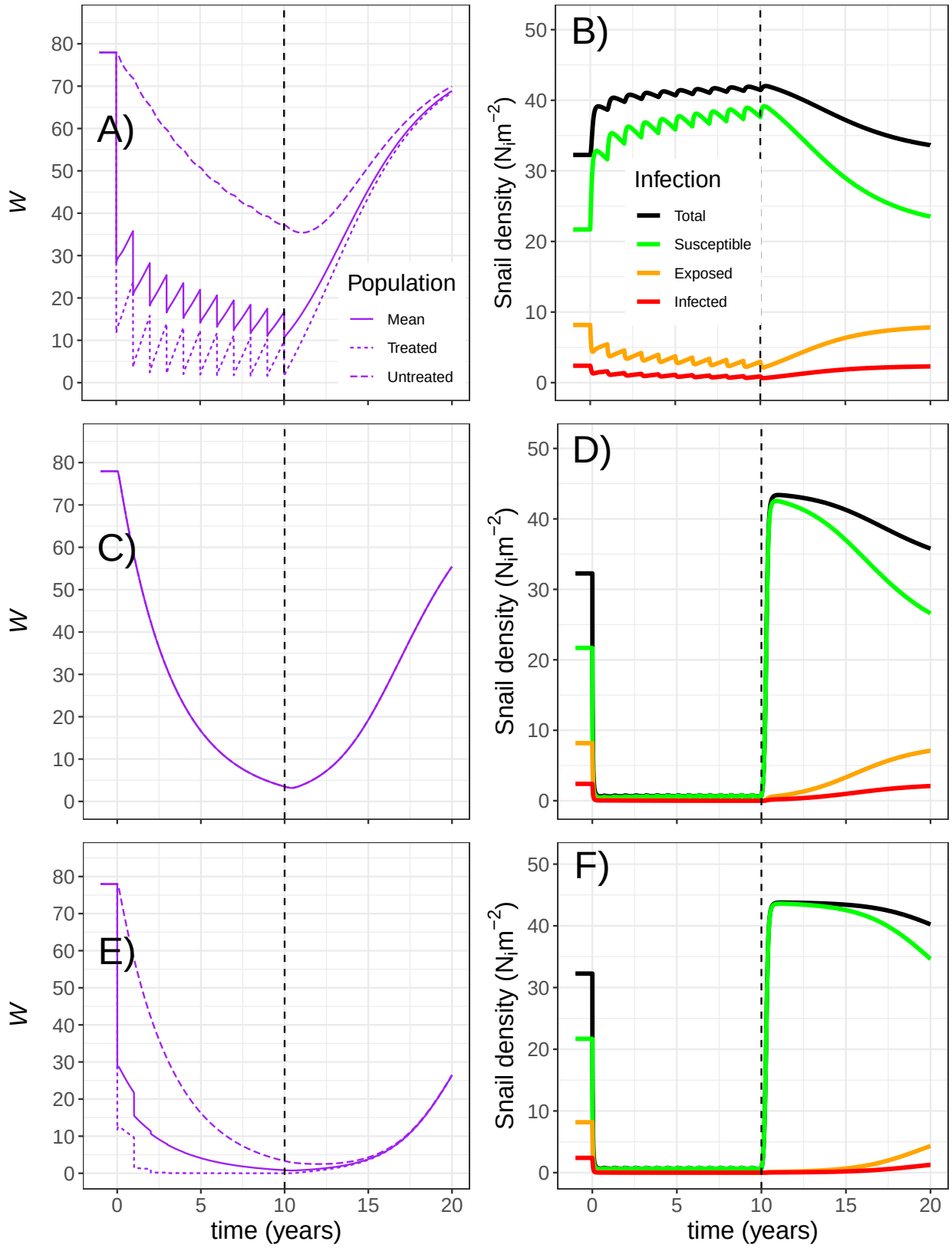
No migration


E)
W
80
70
60
50
40
30
20
10
0
0
5
10
15
20
time (years)


F)
Snail density (N¡m^{-2})
50
40
30
20
10
0
0
5
10
15
20
time (years)

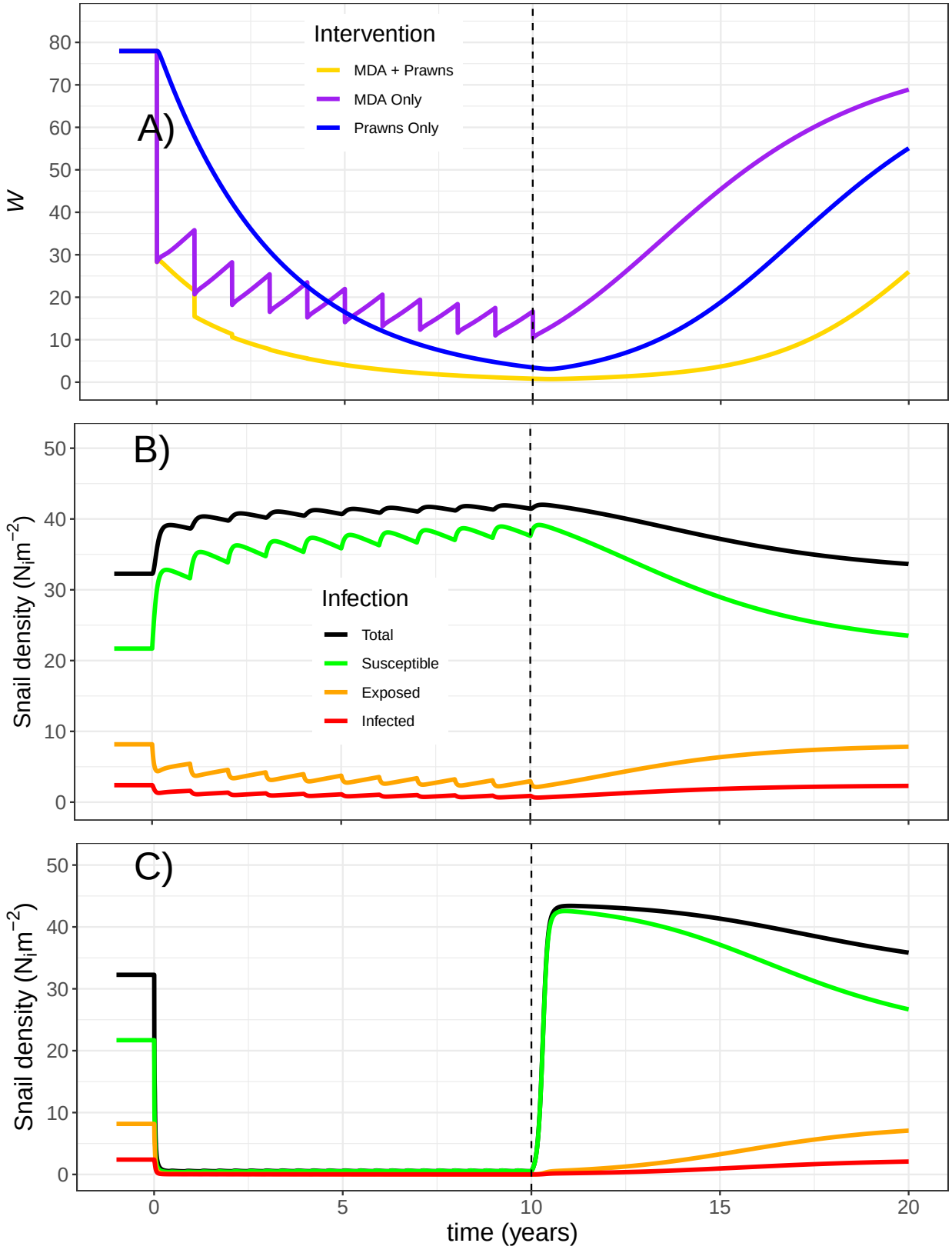
Combined epi plots

Six panel variety

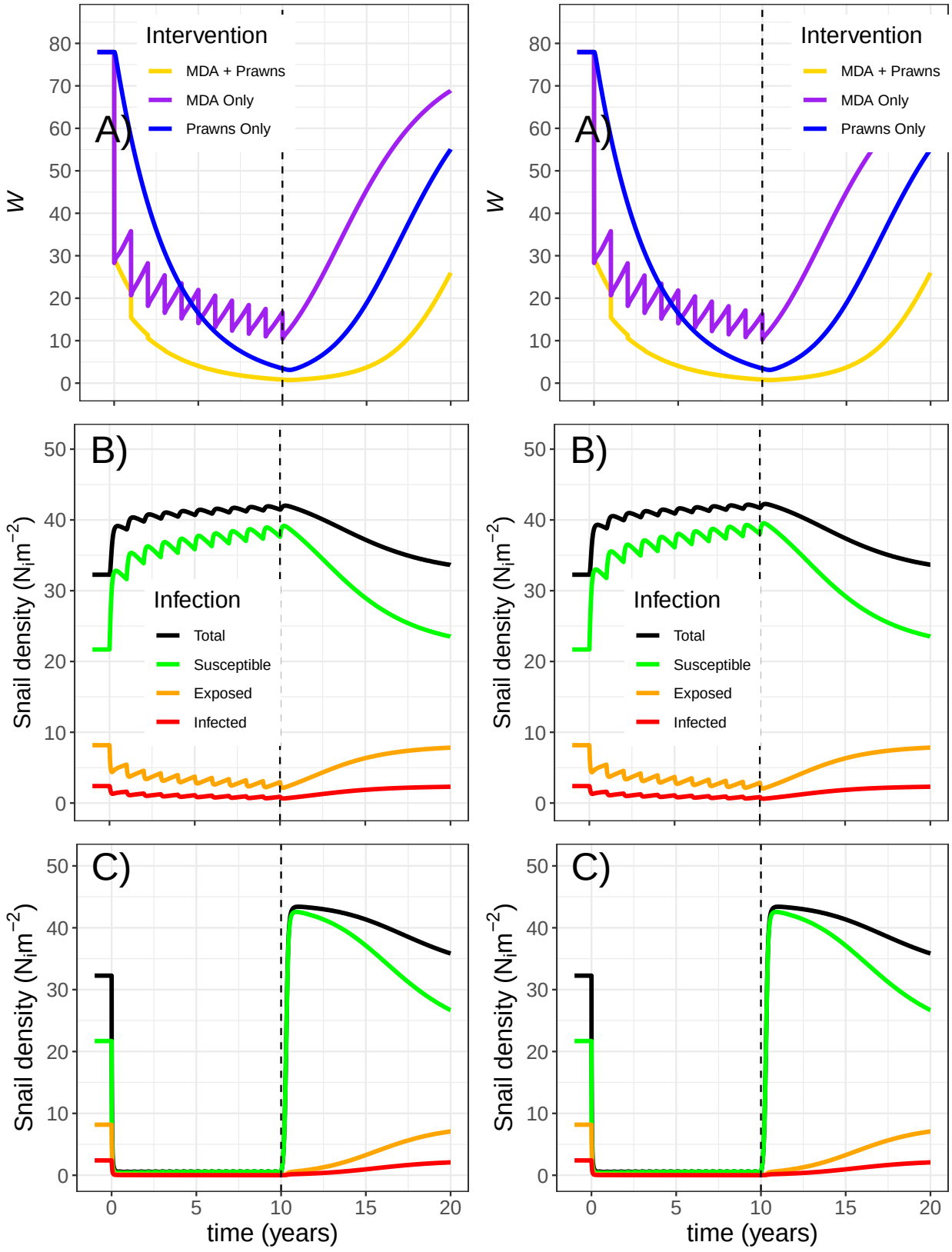


Combined worm burden plots

Three panel essentials



6-panel migration vs no migration comparison

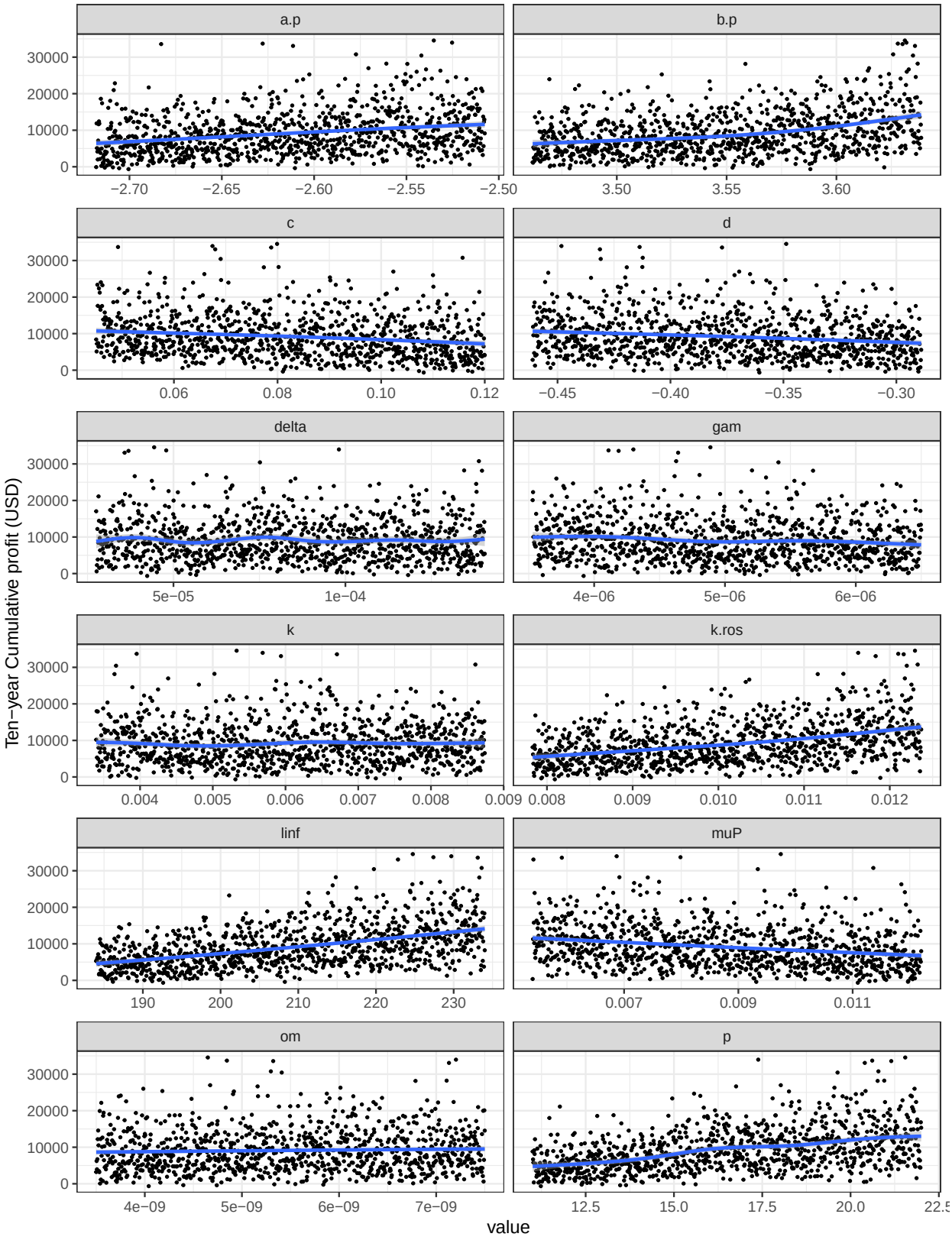


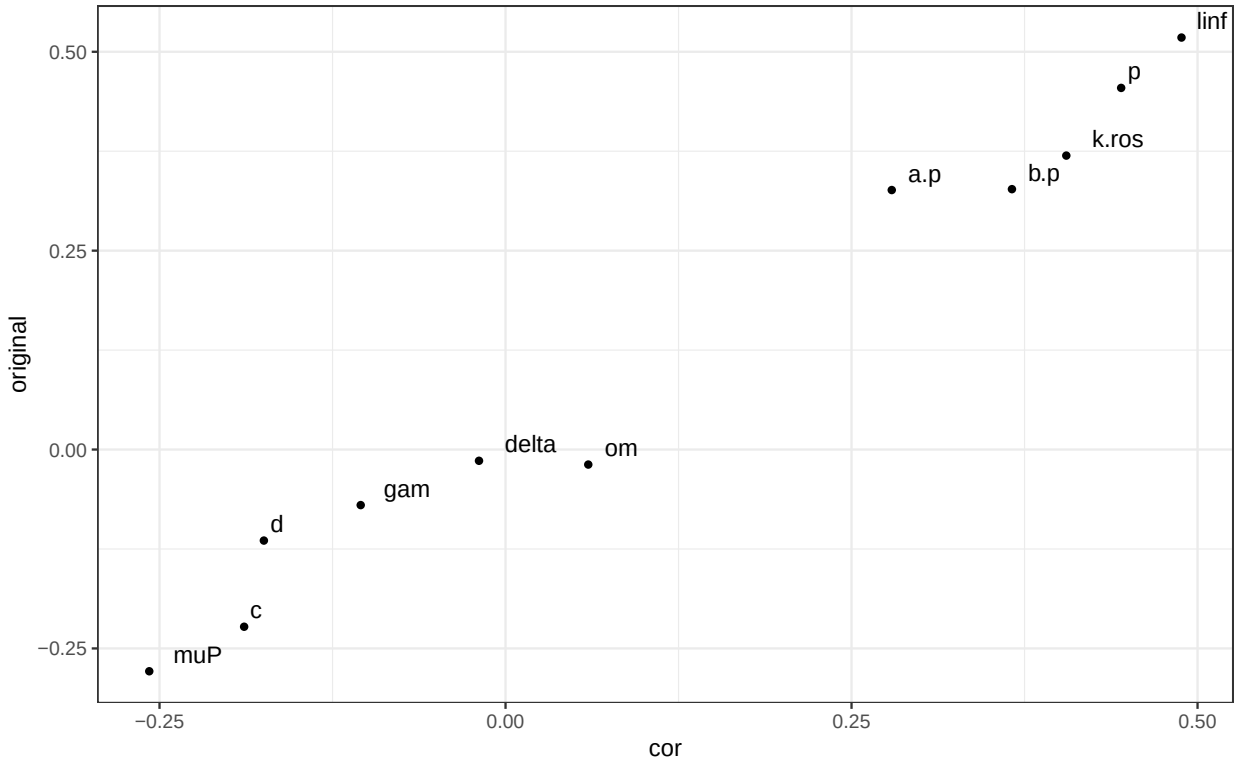
Sensitivity analysis

Check monotinicity of response variables to relevant parameters then quantify influence with PRCC

Prawn aquaculture model

```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```


a.p
b.p
c
d
delta
gam
k
k.ros
linf
muP
om
p
Ten−year Cumulative profit (USD)
value
0
10000
20000
30000
−2.70
−2.65
−2.60
−2.55
−2.50
3.50
3.55
3.60
0.06
0.08
0.10
0.12
−0.45
−0.40
−0.35
−0.30
5e−05
1e−04
4e−06
5e−06
6e−06
0.004
0.005
0.006
0.007
0.008
0.009
0.008
0.009
0.010
0.011
0.012
190
200
210
220
230
0.007
0.009
0.011
4e−09
5e−09
6e−09
7e−09
12.5
15.0
17.5
20.0



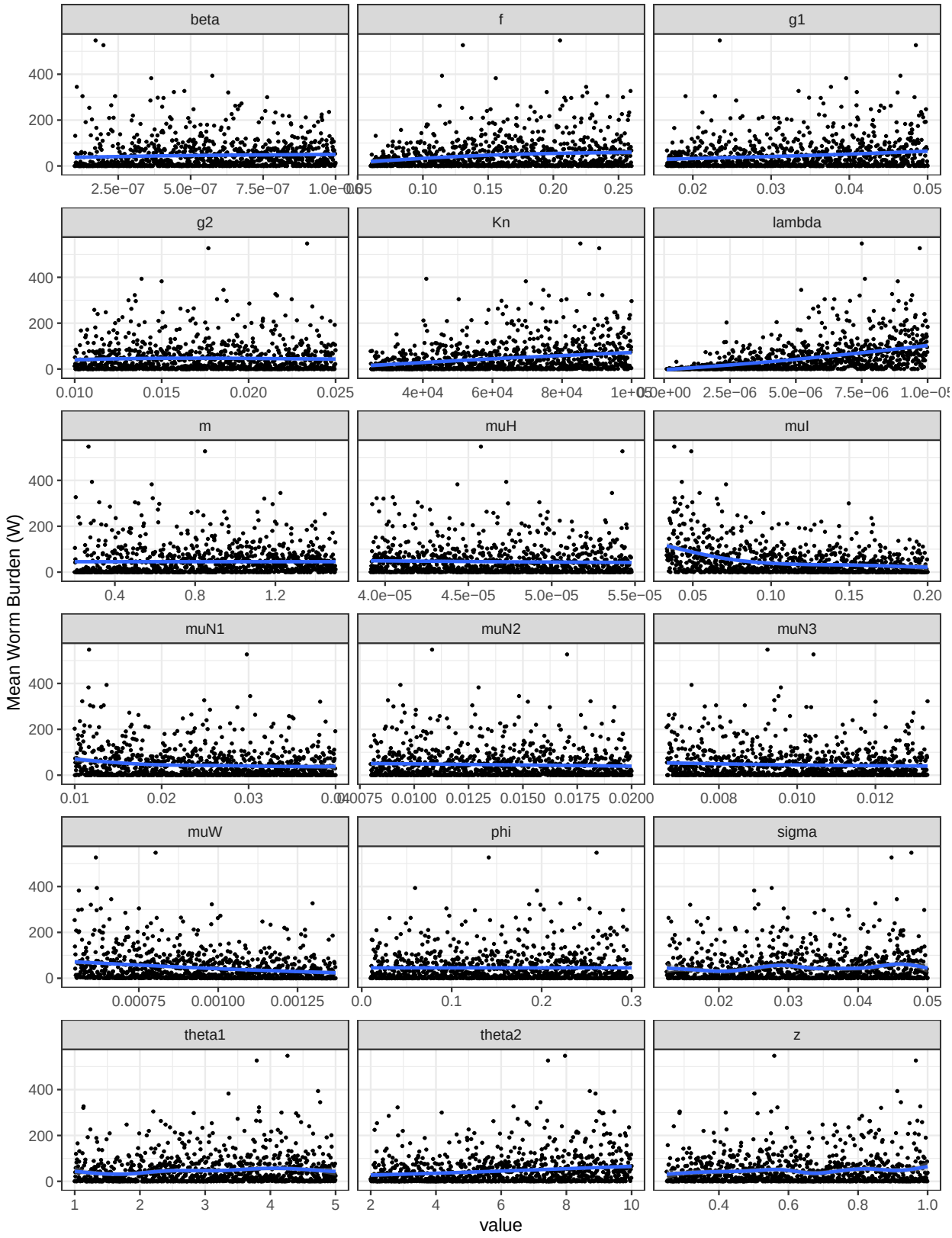
Snail epi model

```
##      Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
```

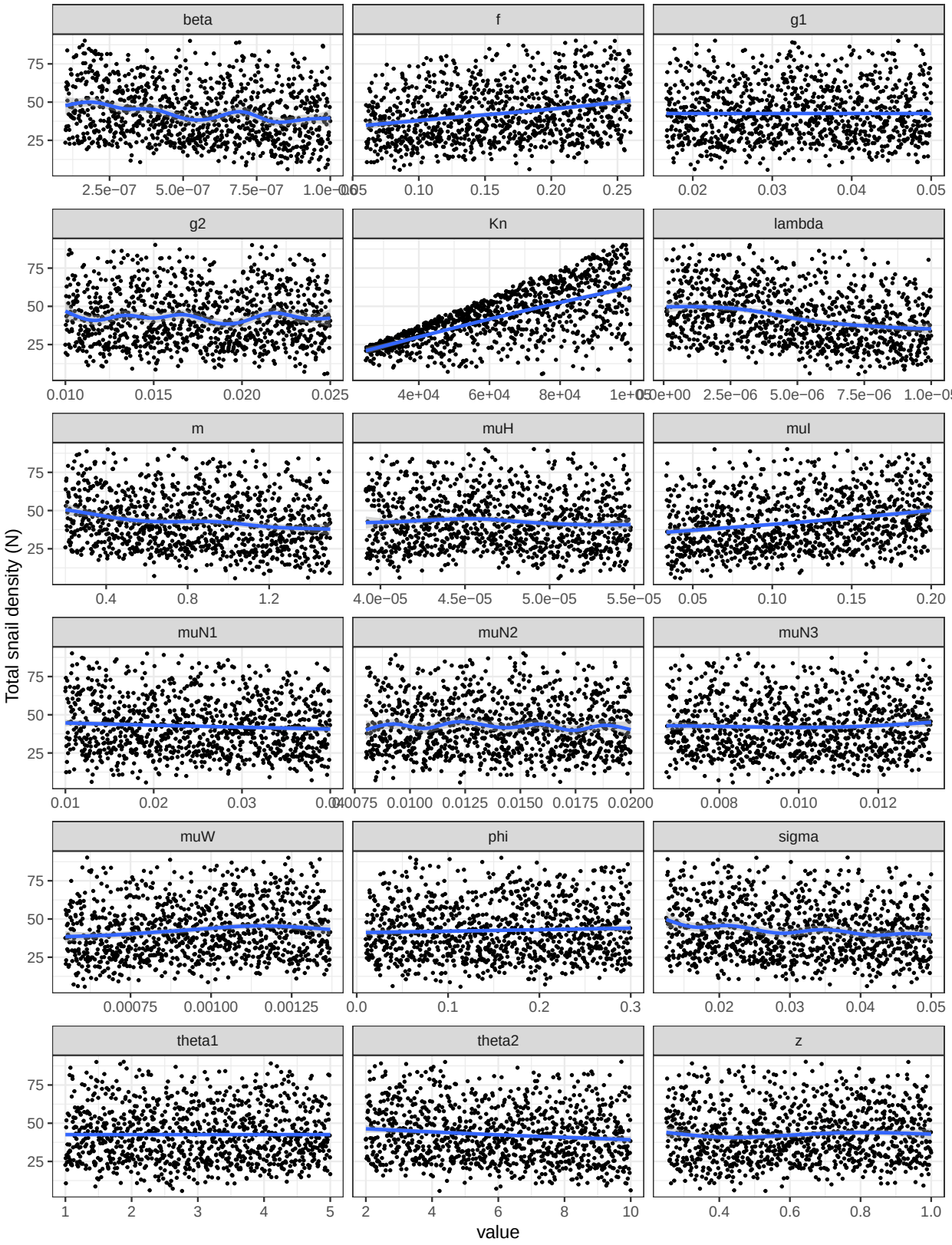
```
##   0.0032   1.2094  18.9987  45.3967  65.9190 547.4042
```

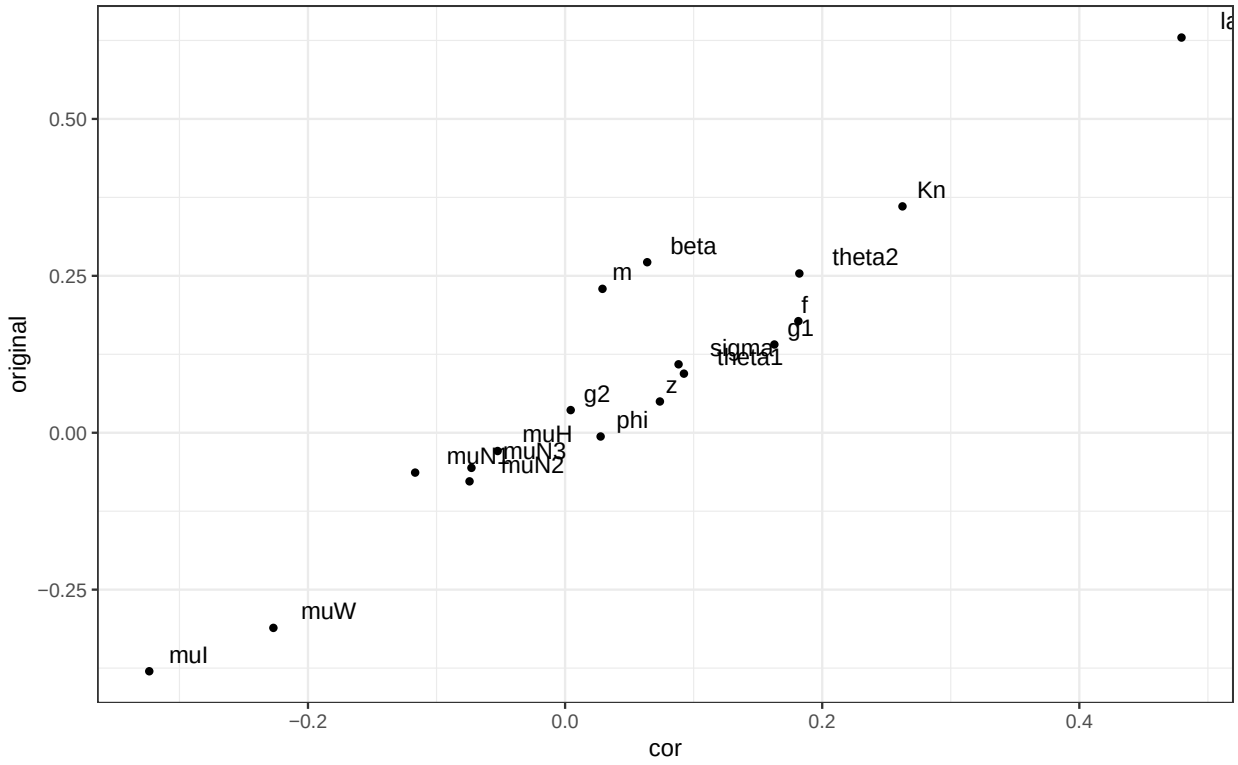
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    5.70   28.25   40.25   42.55   54.61   90.19
```

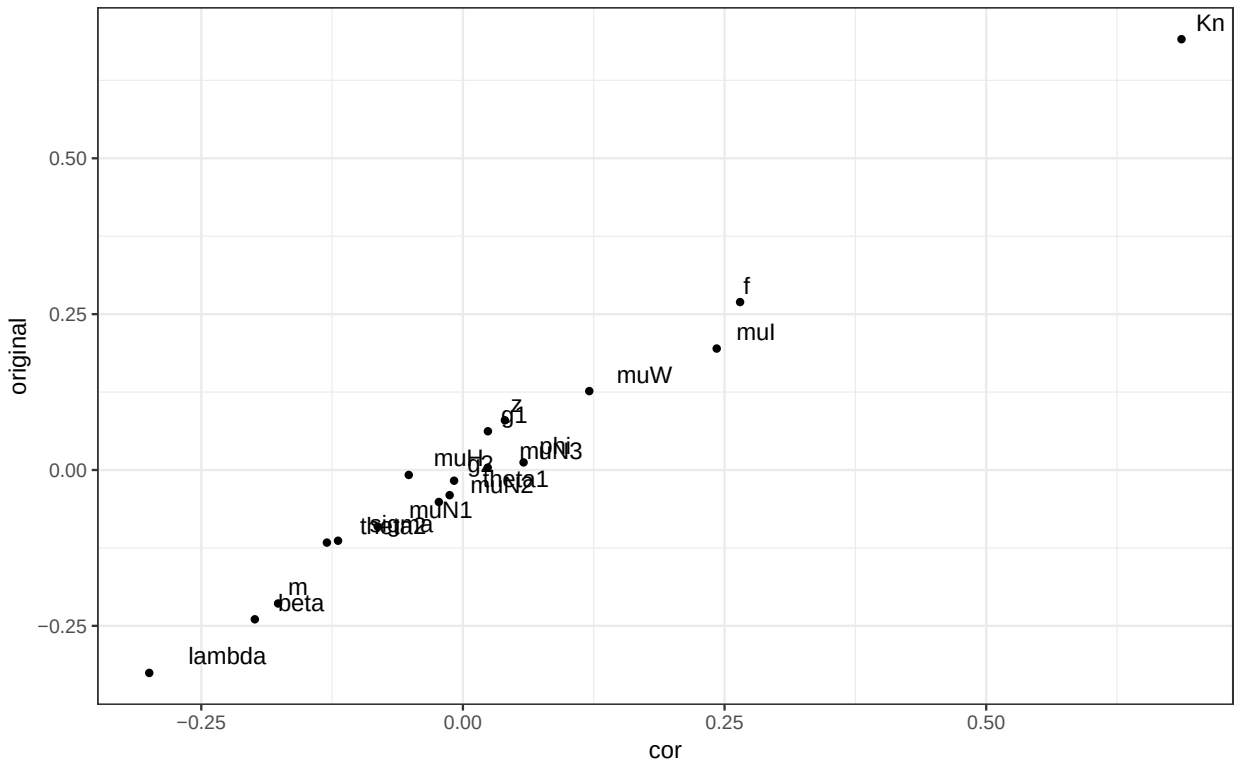
```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```

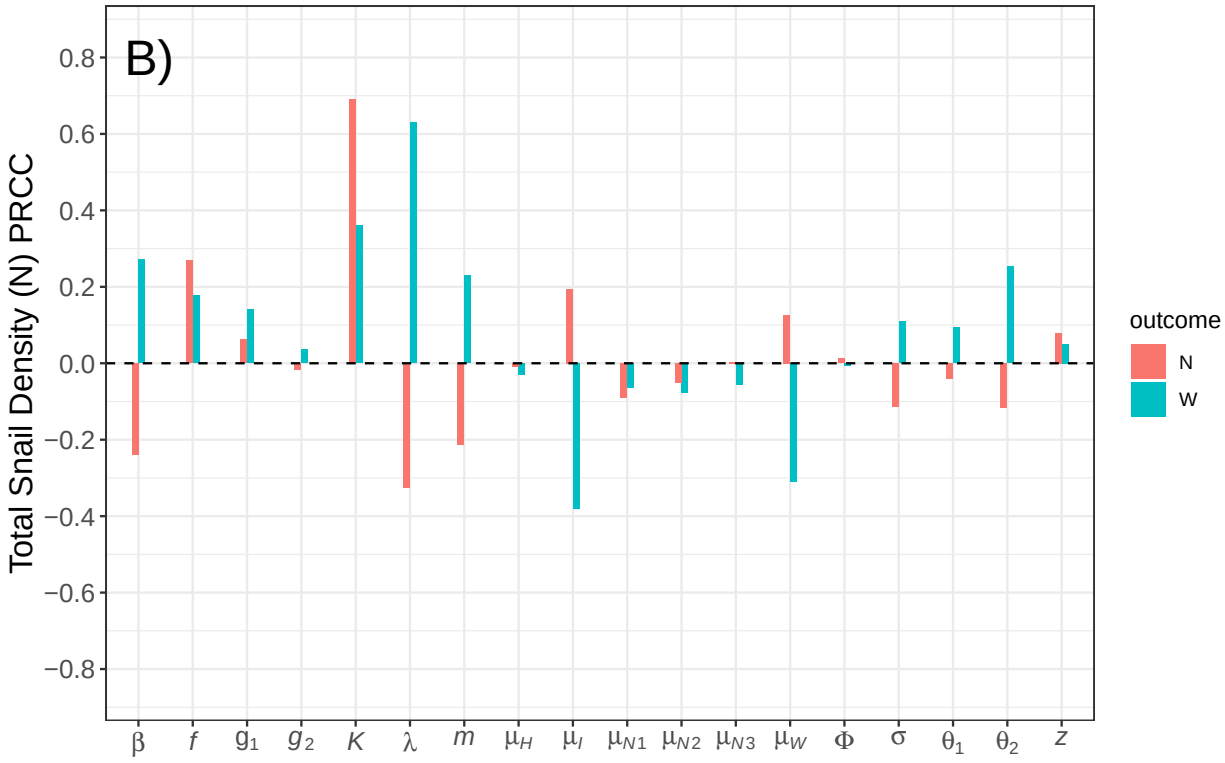



```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```


beta
f
g1
g2
Kn
lambda
m
muH
muI
muN1
muN2
muN3
muW
phi
sigma
theta1
theta2
z
Total snail density (N)
value


original
cor
0.50
0.25
0.00
−0.25
−0.2
0.0
0.2
0.4
la
Kn
beta
theta2
m
f
g1
sigma2
theta1
z
g2
phi
muH
muN3
muN1
muN2
muW
muI


original
cor
0.50
0.25
0.00
−0.25
−0.25
0.00
0.25
0.50
Kn
f
muI
muW
z
g1
muH
g2
muN3
muN2
muN1
m
beta
lambda



Integrated model with interventions