

BauchModel_4

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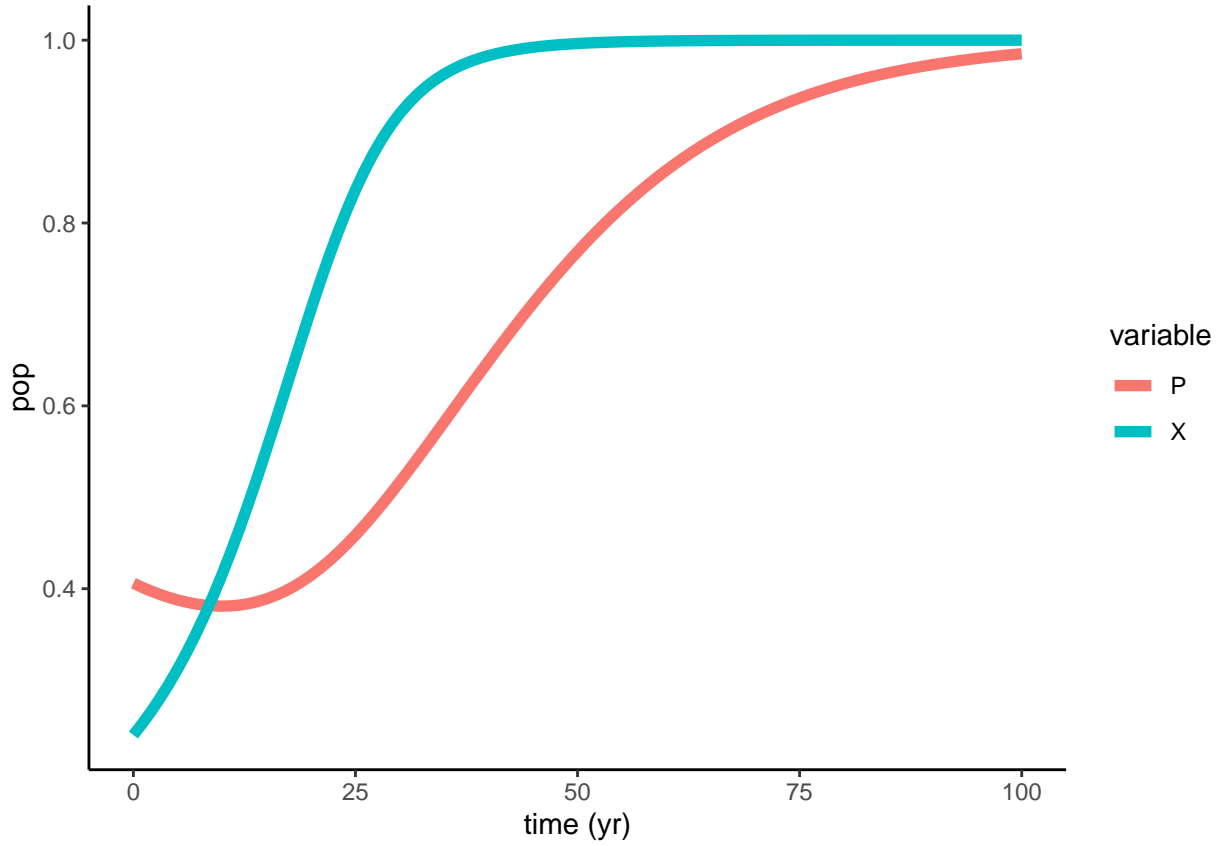


Figure 1: Original Bauch Model

See derivation in notes but this is the new equations (still unsure about interaction terms):

$$\frac{dP_1}{dt} = r_1 P_1 (1 - P_1) - \frac{h_1 * P_1 (1 - X_1)}{P_1 + s_1} + \rho_1 * \frac{P_2 - P_1}{2}$$

$$\frac{dX_1}{dt} = k_1 X_1 (1 - X_1) \left[\frac{1}{P_1 + c_1} - w_1 + d_1 (2X_1 - 1) \right] + k_2 X_1 (1 - X_2) \left[\frac{1}{P_1 + c_1} - w_1 + d_2 (2X_2 - 1) \right] + k_2 X_1 X_2 \left[\frac{1}{P_1 + c_1} + d_2 X_2 \right] + k_2 (1 - X_1) (1 - X_2) [-w_1 + d_2 (1 - X_2)]$$

$$\frac{dP_2}{dt} = r_2 P_2 (1 - P_2) - \frac{h_2 * P_2 (1 - X_2)}{P_2 + s_2} + \rho_2 * \frac{P_1 - P_2}{2}$$

$$\frac{dX_2}{dt} = k_2 X_2 (1 - X_2) \left[\frac{1}{P_2 + c_2} - w_2 + d_2 (2X_2 - 1) \right] + k_1 X_2 (1 - X_1) \left[\frac{1}{P_2 + c_2} - w_2 + d_1 (2X_1 - 1) \right] + k_1 X_1 X_2 \left[\frac{1}{P_2 + c_2} + d_1 X_1 \right] + k_1 (1 - X_2) (1 - X_1) [-w_2 + d_1 (1 - X_1)]$$

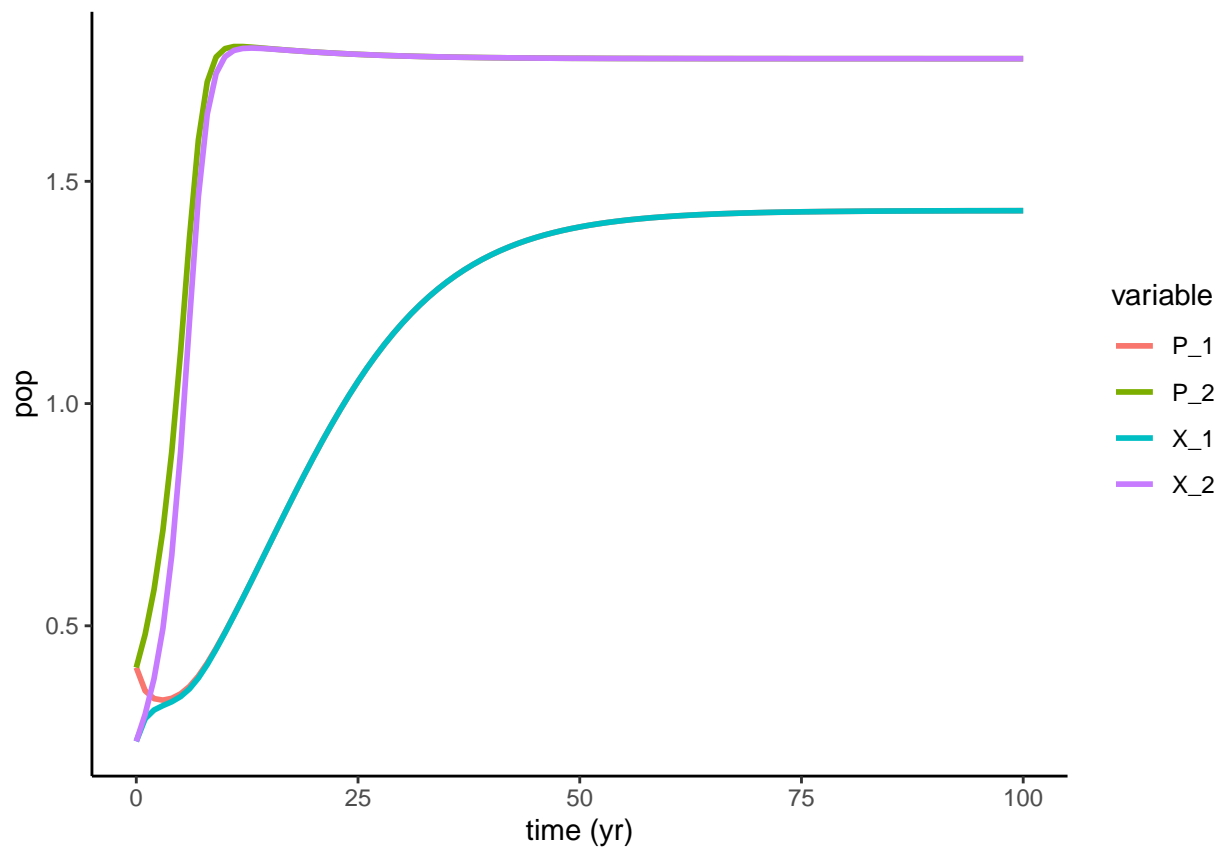


Figure 2: New Model with default paramters

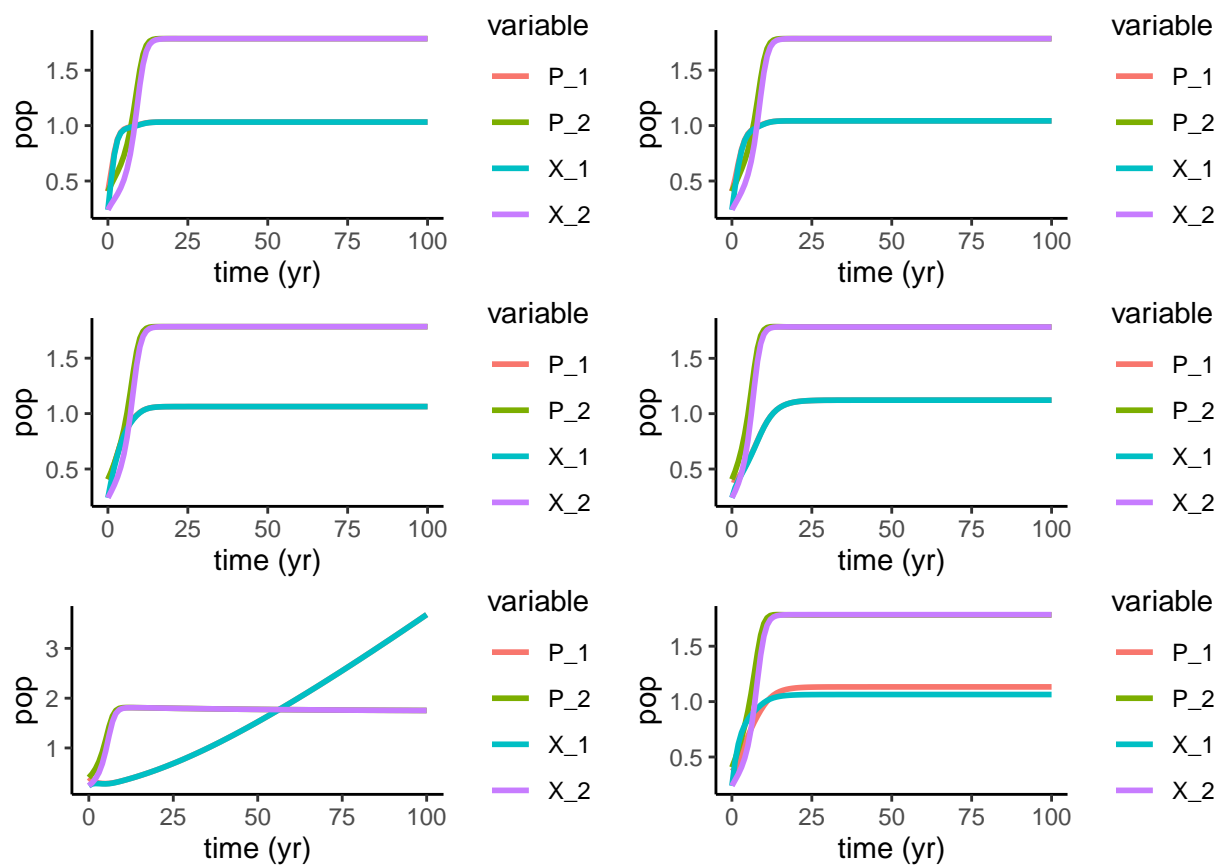


Figure 3: R - Net growth/fecundity, range 0 to 1

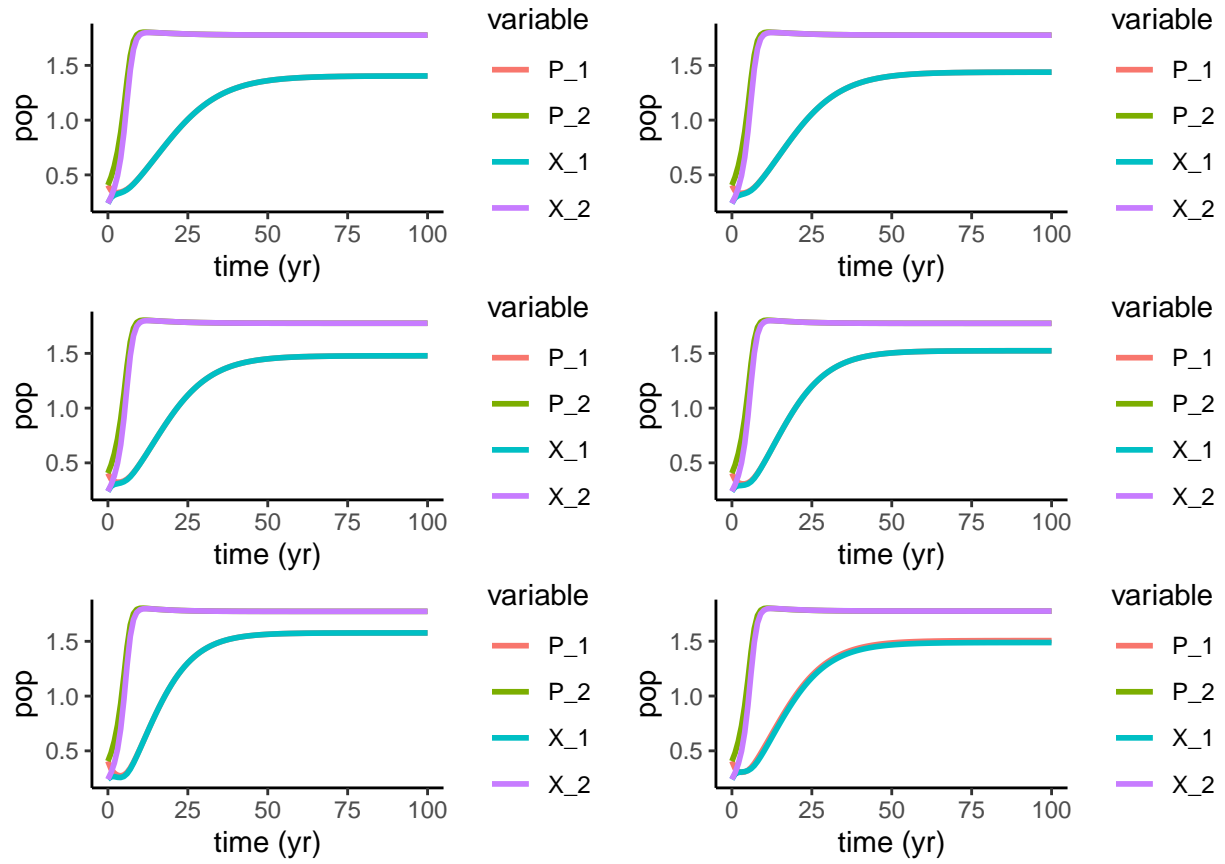


Figure 4: S - supply and demand, range 0.1 to 1

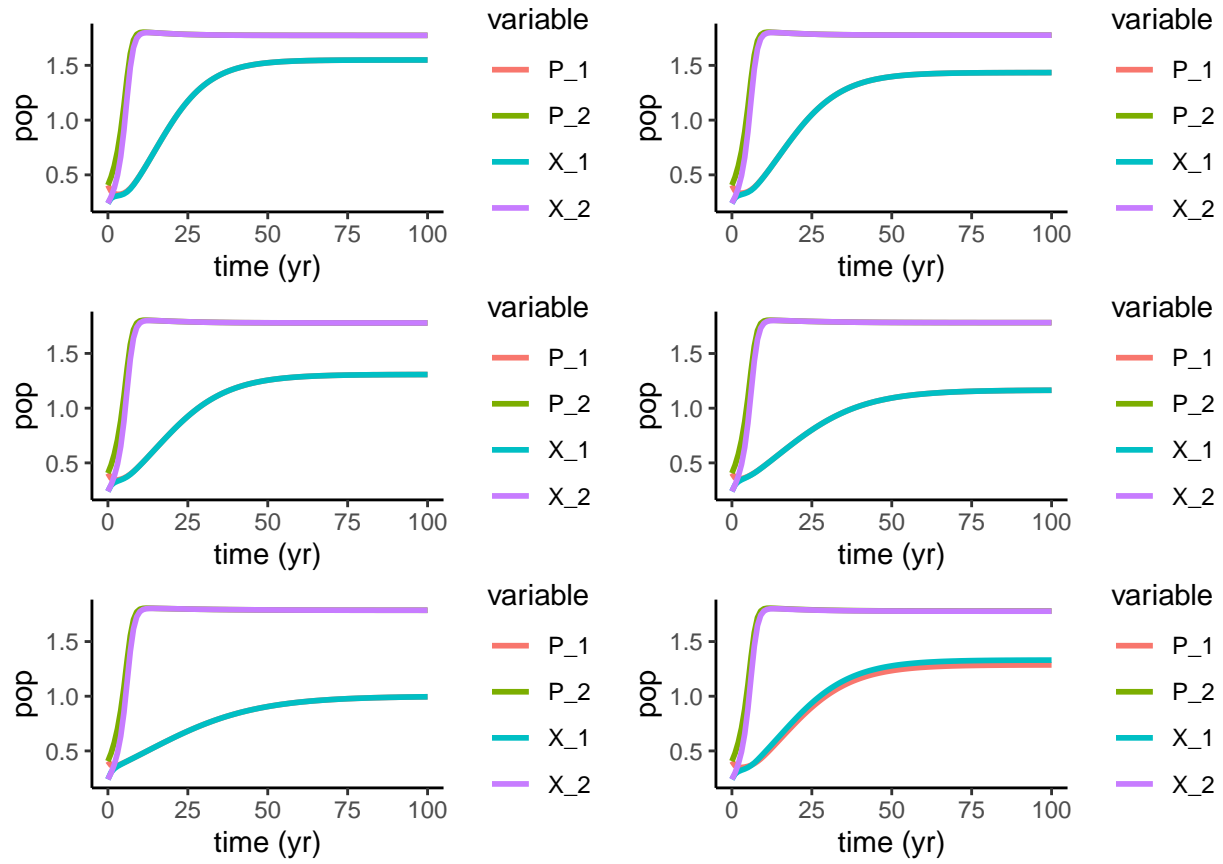


Figure 5: h - Harvesting efficiency, range 0 to 0.1. Note, default is .075

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## DLSODA- At T (=R1) and step size H (=R2), the
##         corrector convergence failed repeatedly
##         or with ABS(H) = HMIN
## In above message, R1 = 1.94169, R2 = 6.15744e-11
##

```

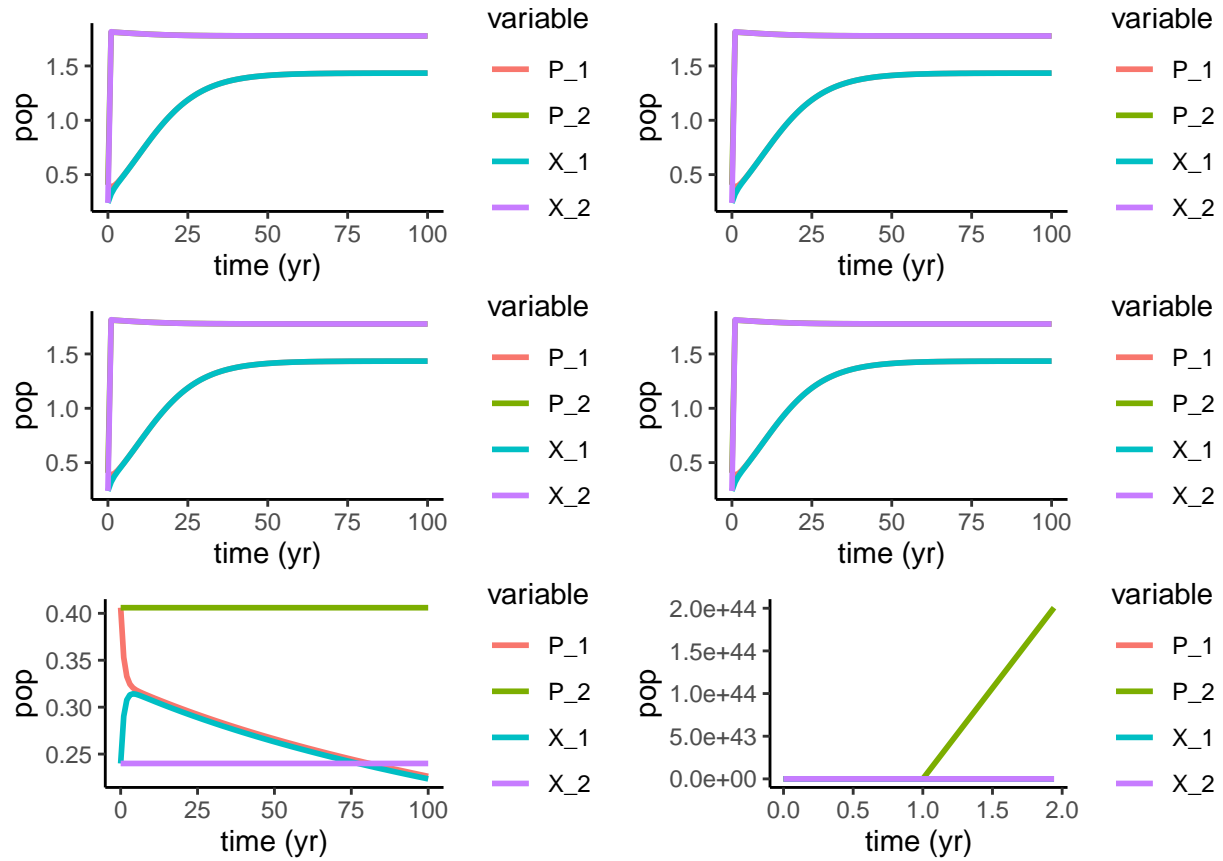


Figure 6: K - Social learning rate 0 to 100

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## DLSODA- At T (=R1) and step size H (=R2), the
##         corrector convergence failed repeatedly
##         or with ABS(H) = HMIN
## In above message, R1 = 1.94169, R2 = 6.15744e-11
##

```

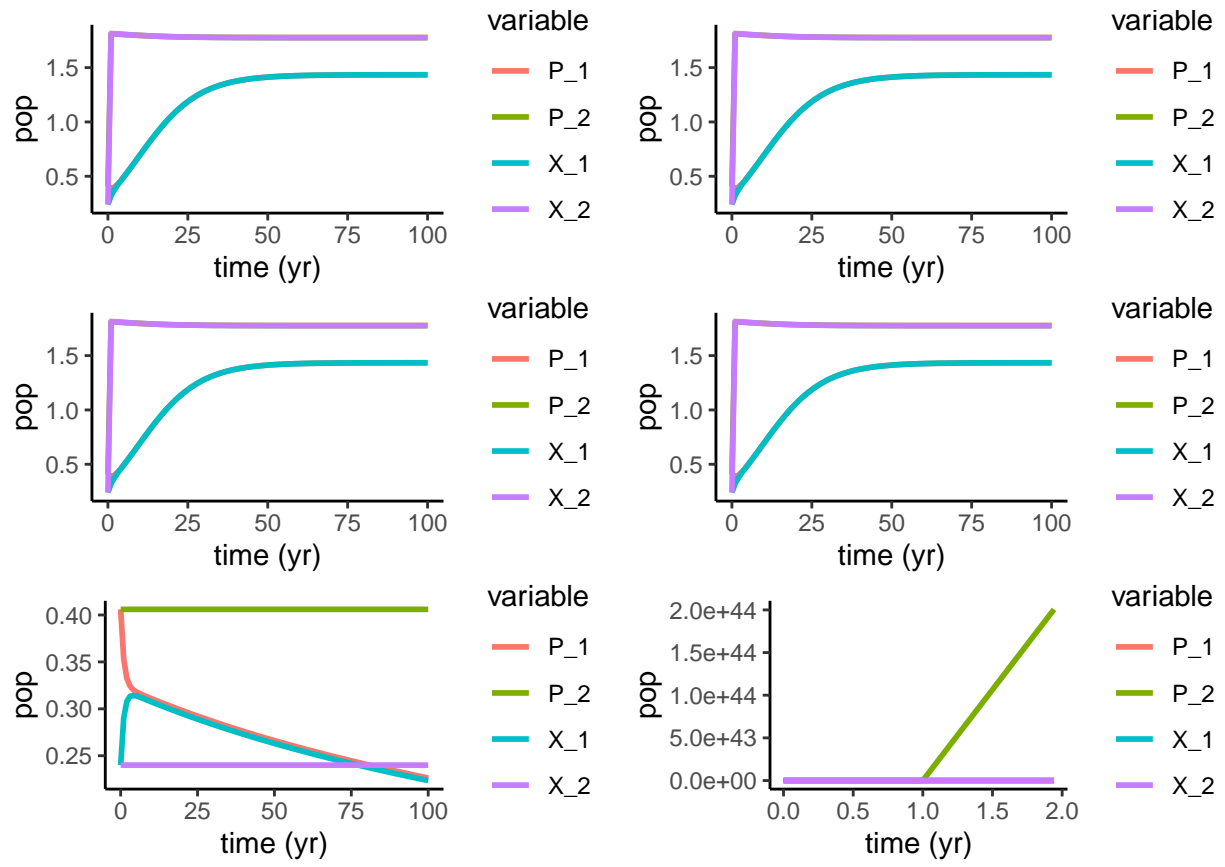


Figure 7: K - Social learning rate 0 to 100

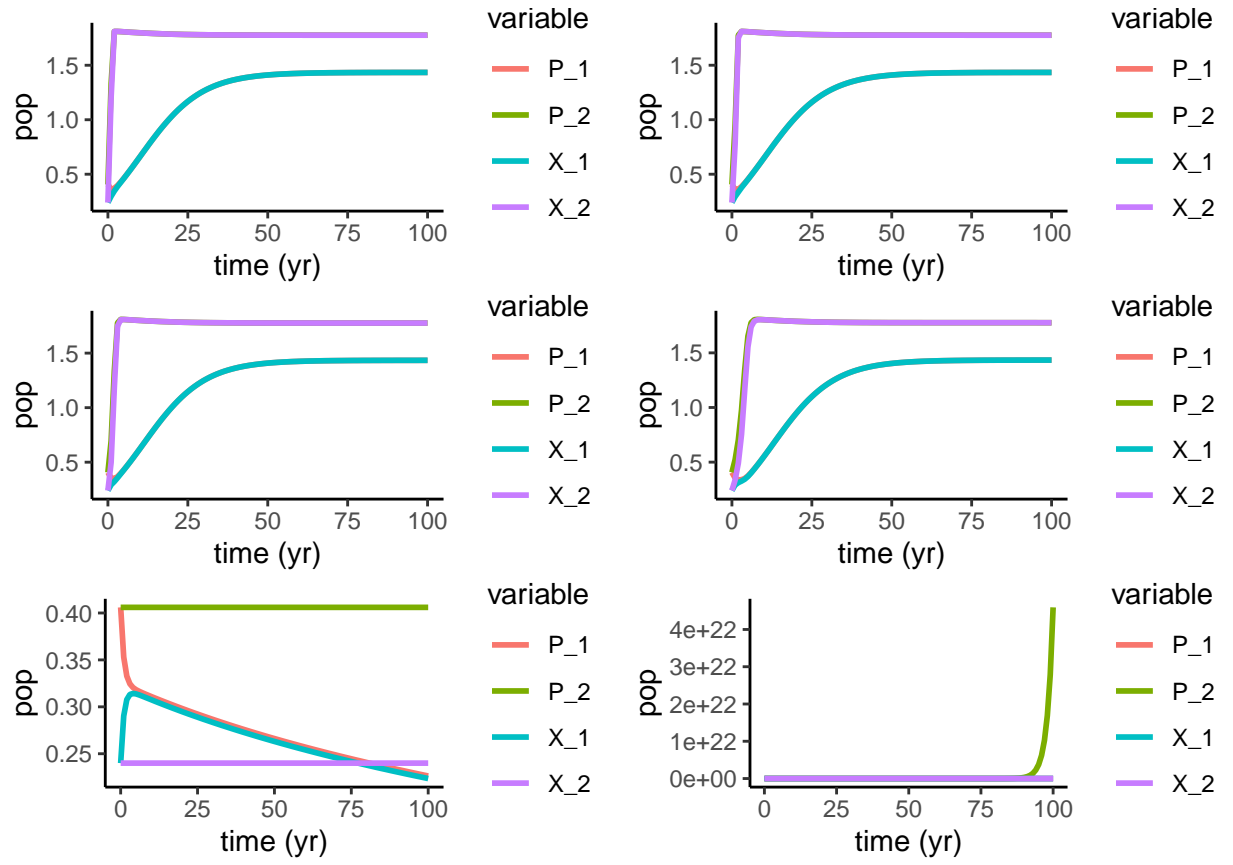


Figure 8: K - Social learning rate 0 to 1

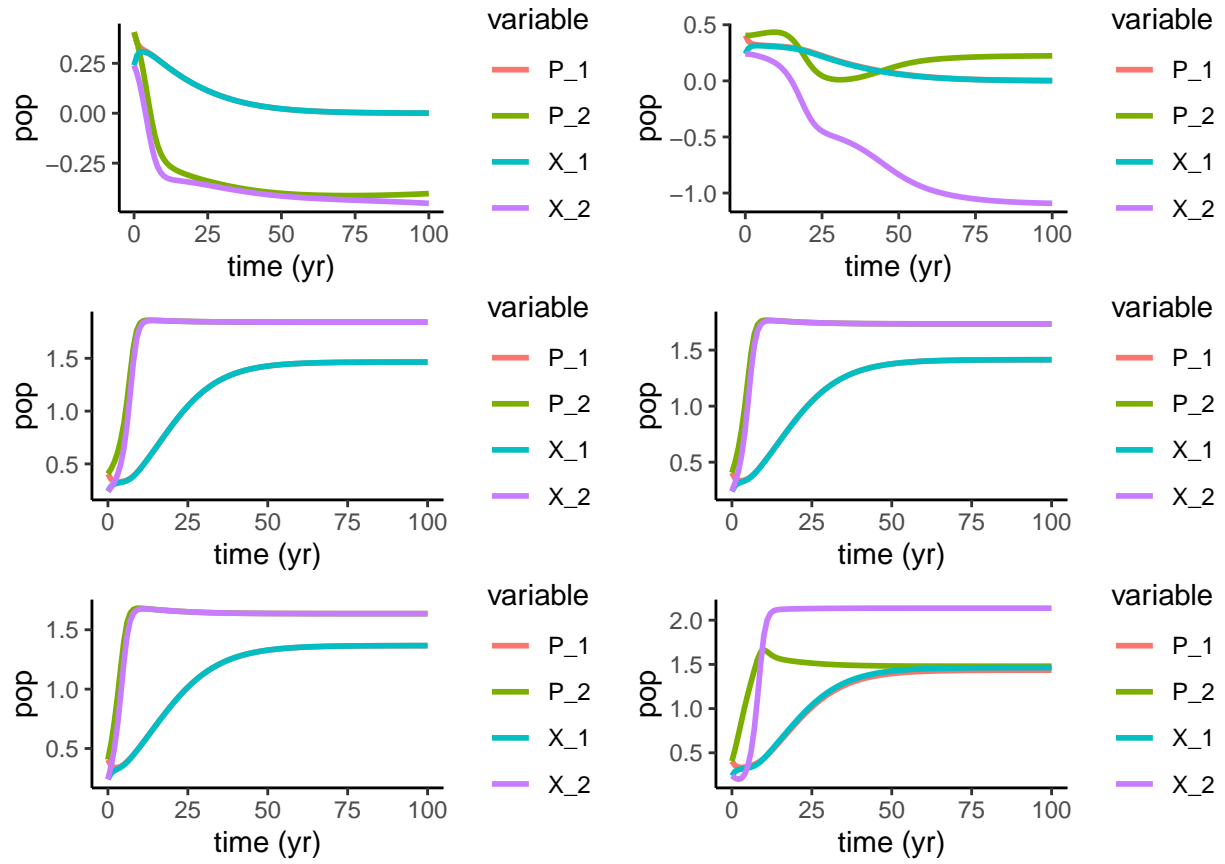


Figure 9: w - conservation costs

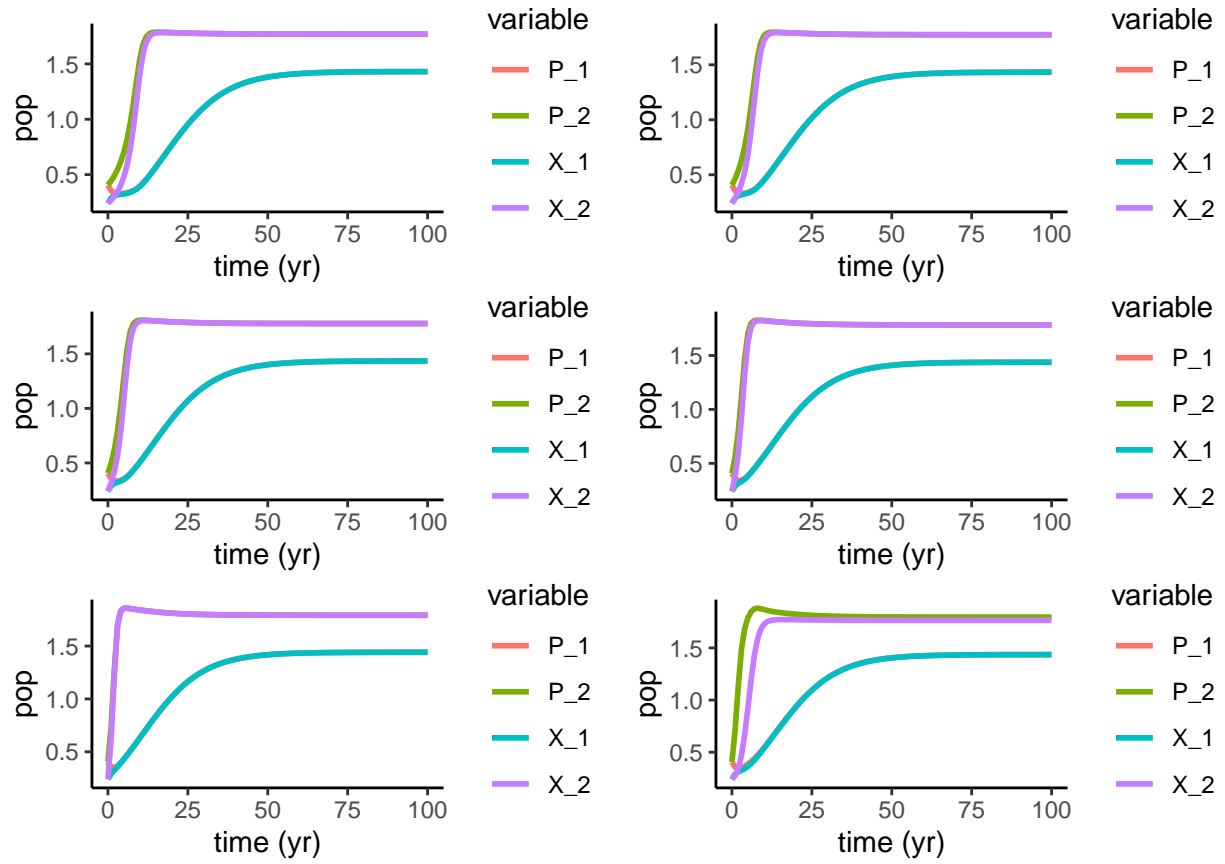


Figure 10: c - rarity valuation param

```

## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 37.5252, R2 = 3.42975e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
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## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 37.5252, R2 = 2.80636e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
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##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 37.5252, R2 = 2.29628e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
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##      such that in the machine,  $T + H = T$  on the next step
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## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 37.5252, R2 = 1.87892e-15
##
## DLSODA- Above warning has been issued I1 times.
##      It will not be issued again for this problem.
## In above message, I1 = 10
##

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## DLSODA- At current T (=R1), MXSTEP (=I1) steps
##      taken on this call before reaching TOUT
## In above message, I1 = 5000
##
## In above message, R1 = 37.5252
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.49516e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
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##      (H = step size). Solver will continue anyway.
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##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.22996e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.22996e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.22996e-15
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##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.22996e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.
## In above message, R1 = 29.2803, R2 = 1.01181e-15
##
## DLSODA- Warning..Internal T (=R1) and H (=R2) are
##      such that in the machine,  $T + H = T$  on the next step
##      (H = step size). Solver will continue anyway.

```

```

## In above message, R1 = 29.2803, R2 = 1.01181e-15
##
## DLSODA- Above warning has been issued I1 times.
##      It will not be issued again for this problem.
## In above message, I1 = 10
##
## DLSODA- At current T (=R1), MXSTEP (=I1) steps
##      taken on this call before reaching TOUT
## In above message, I1 = 5000
##
## In above message, R1 = 29.2803
##

```

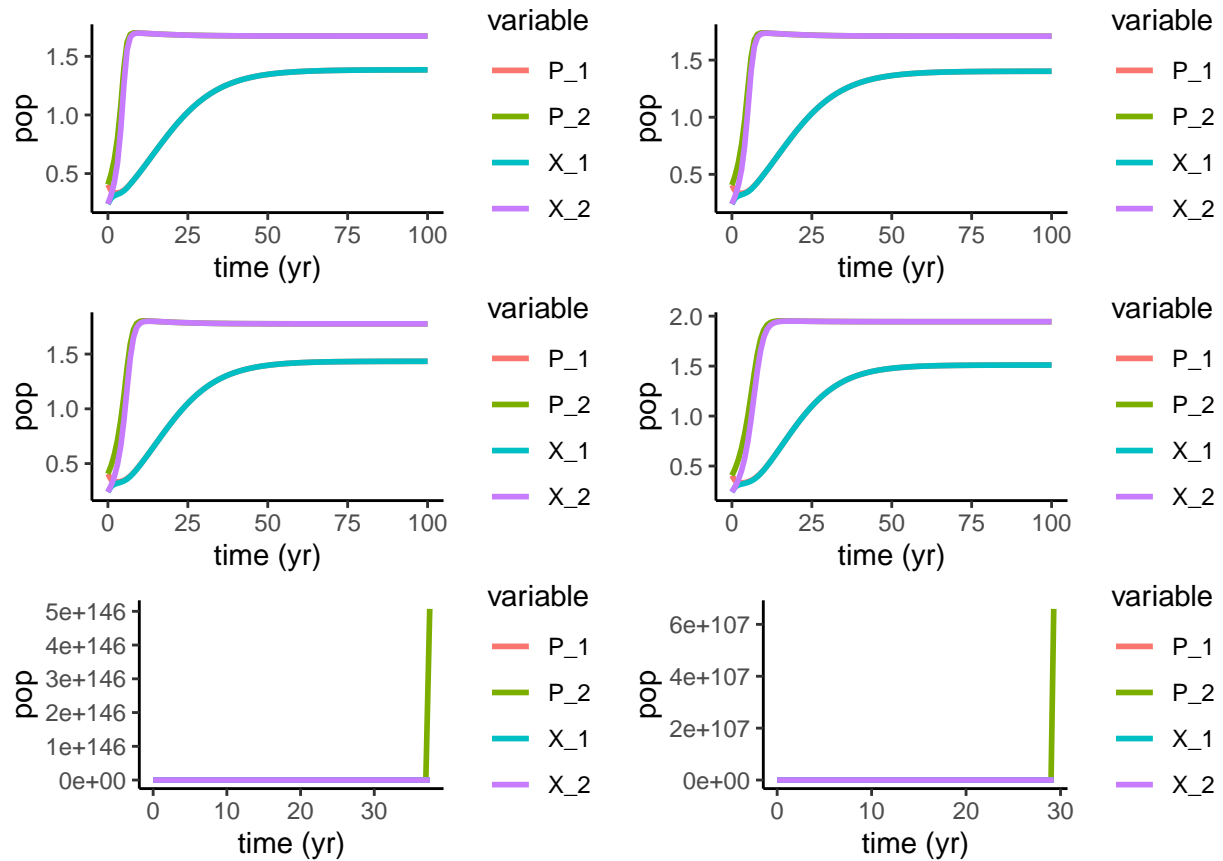


Figure 11: d - social norm strength

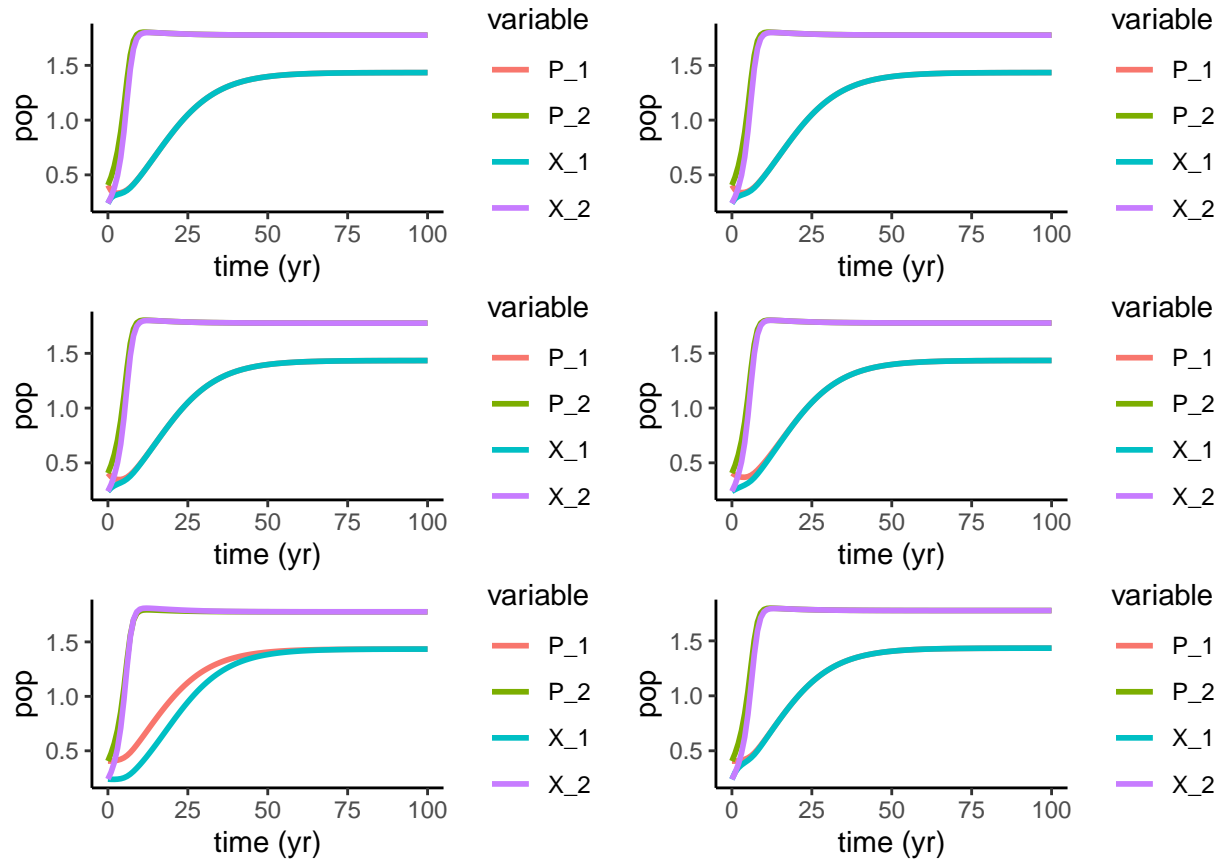


Figure 12: roh - fish diffusion

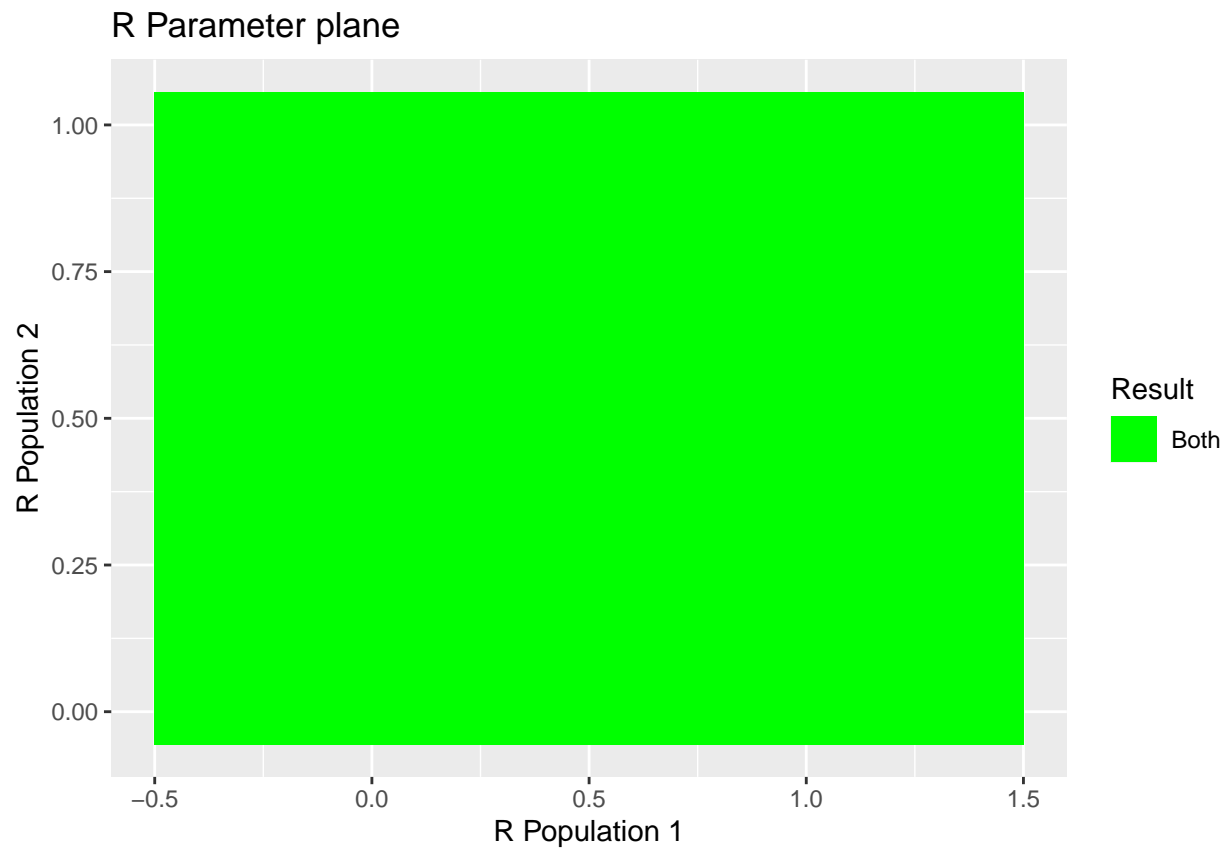


Figure 13: r population planes

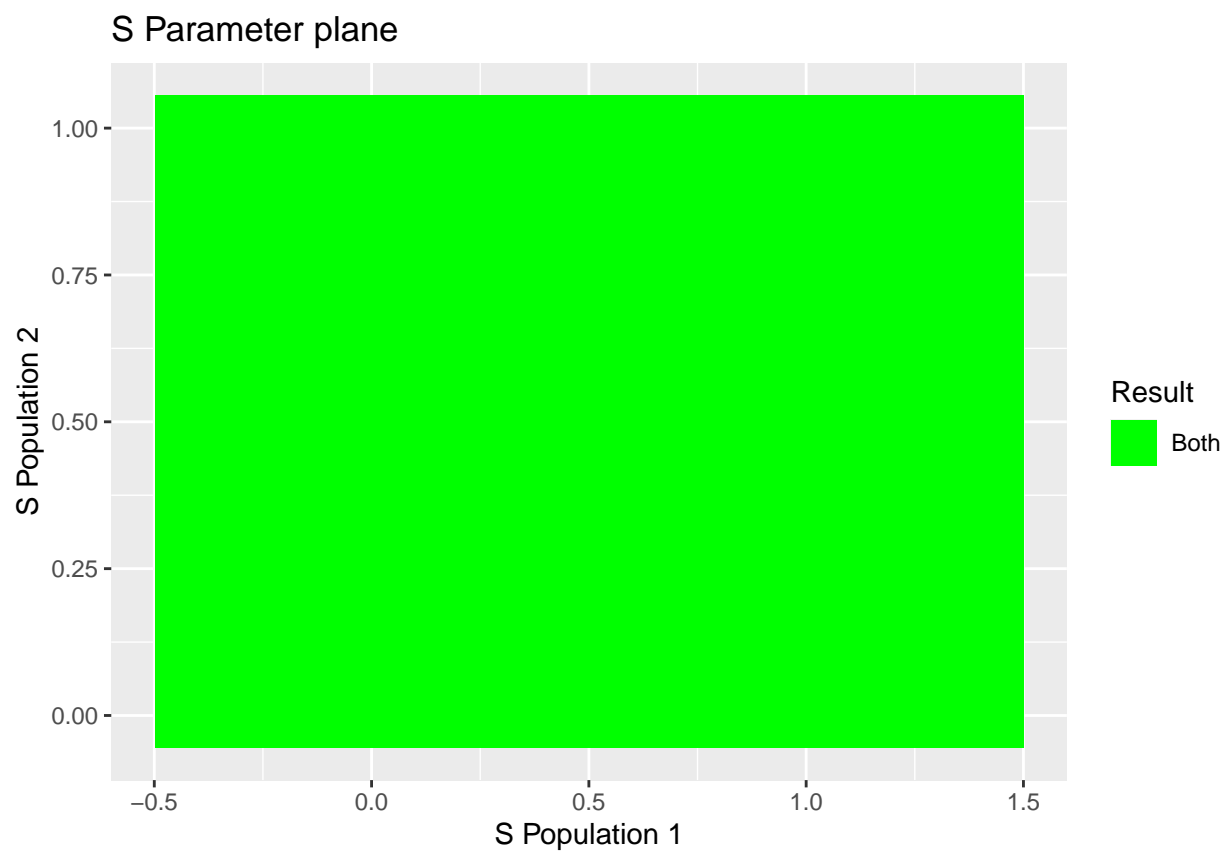


Figure 14: s population planes

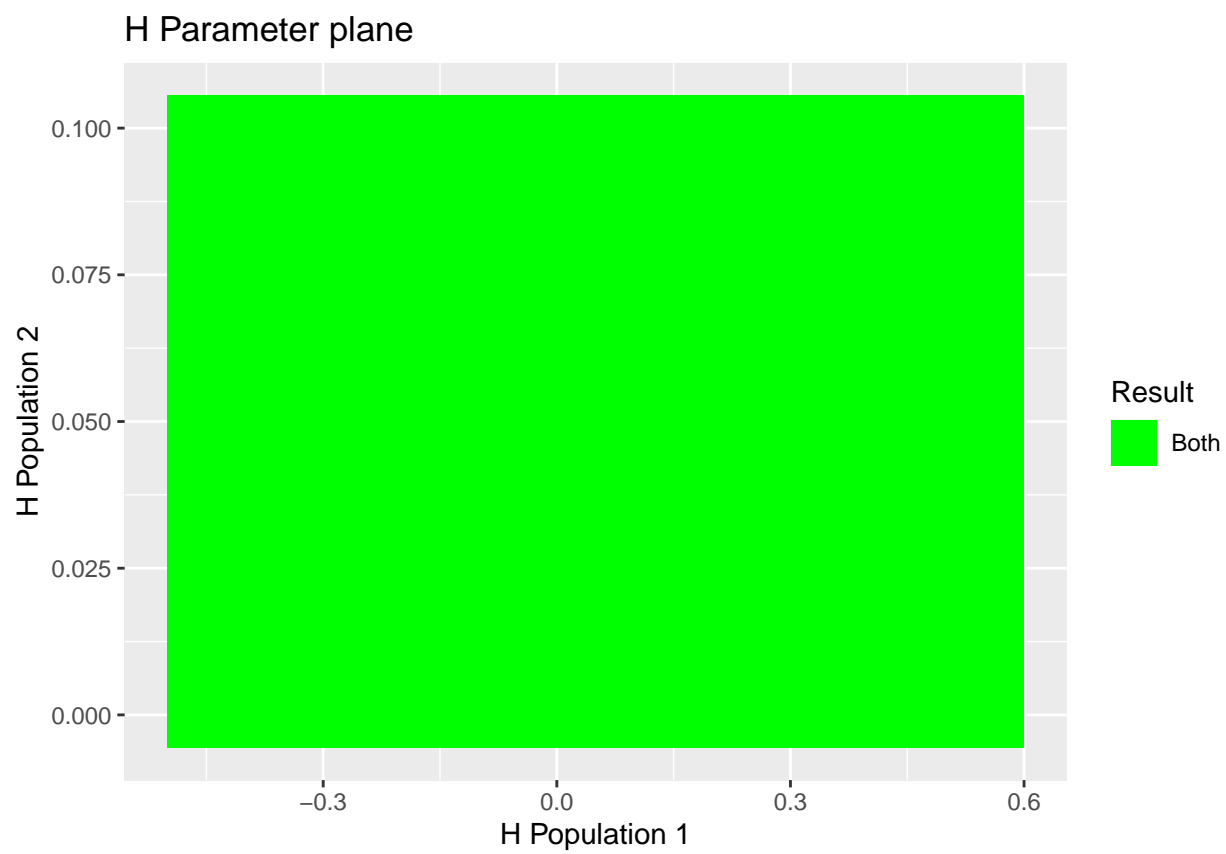


Figure 15: h population planes

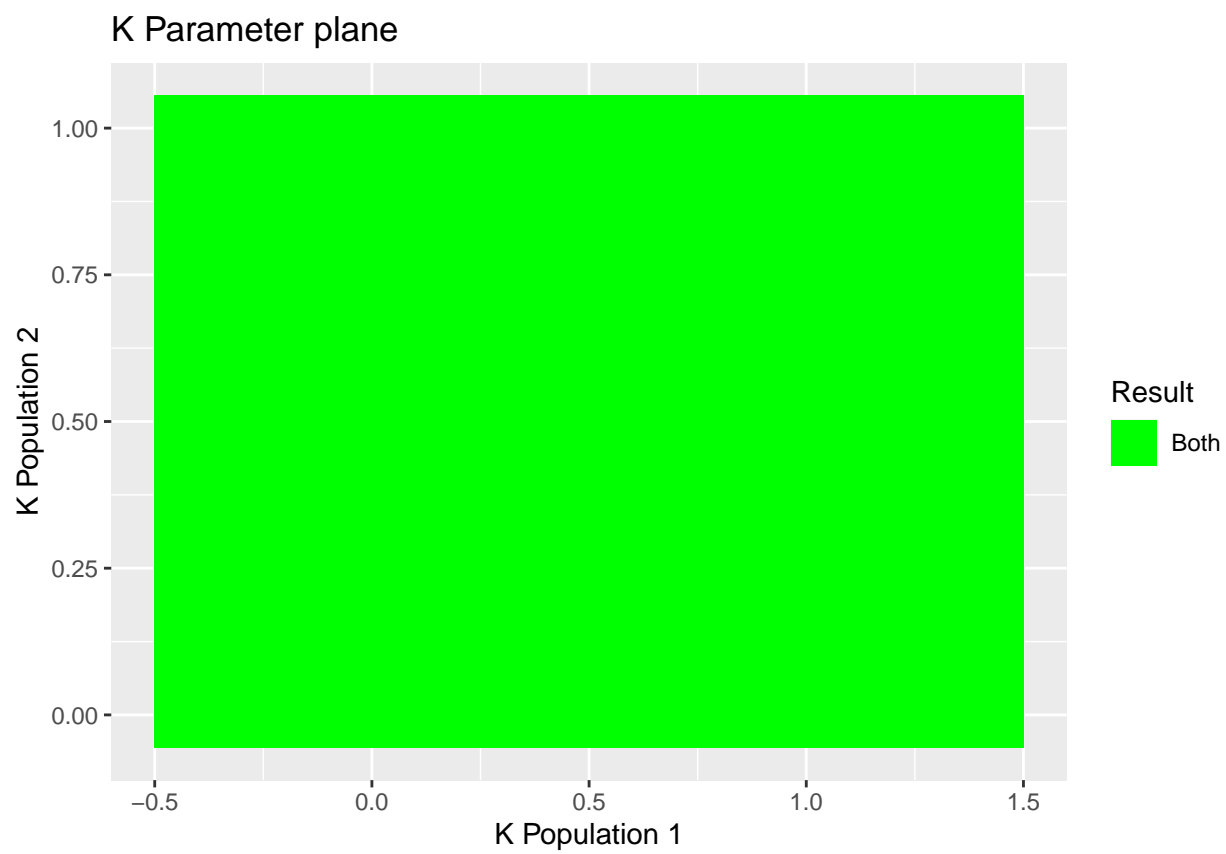


Figure 16: k population planes 0 to 1

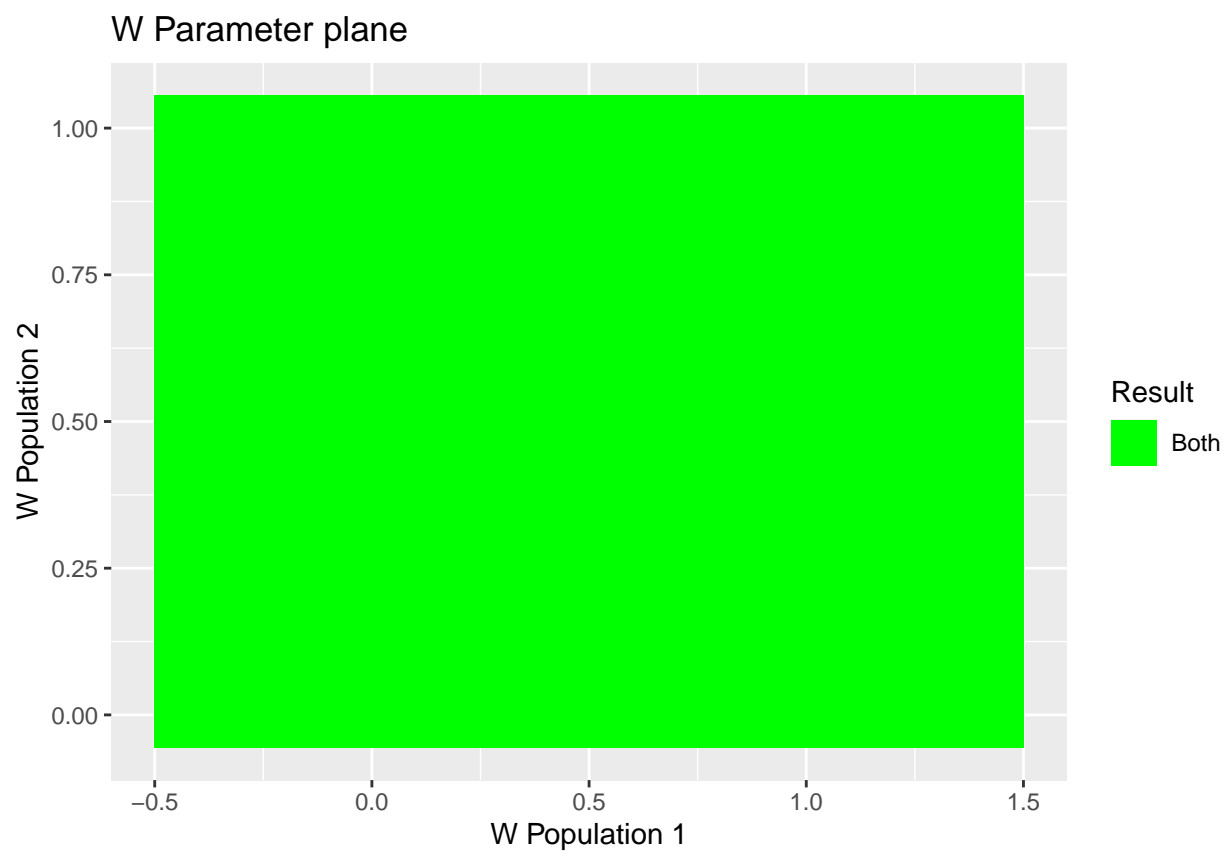


Figure 17: w population planes

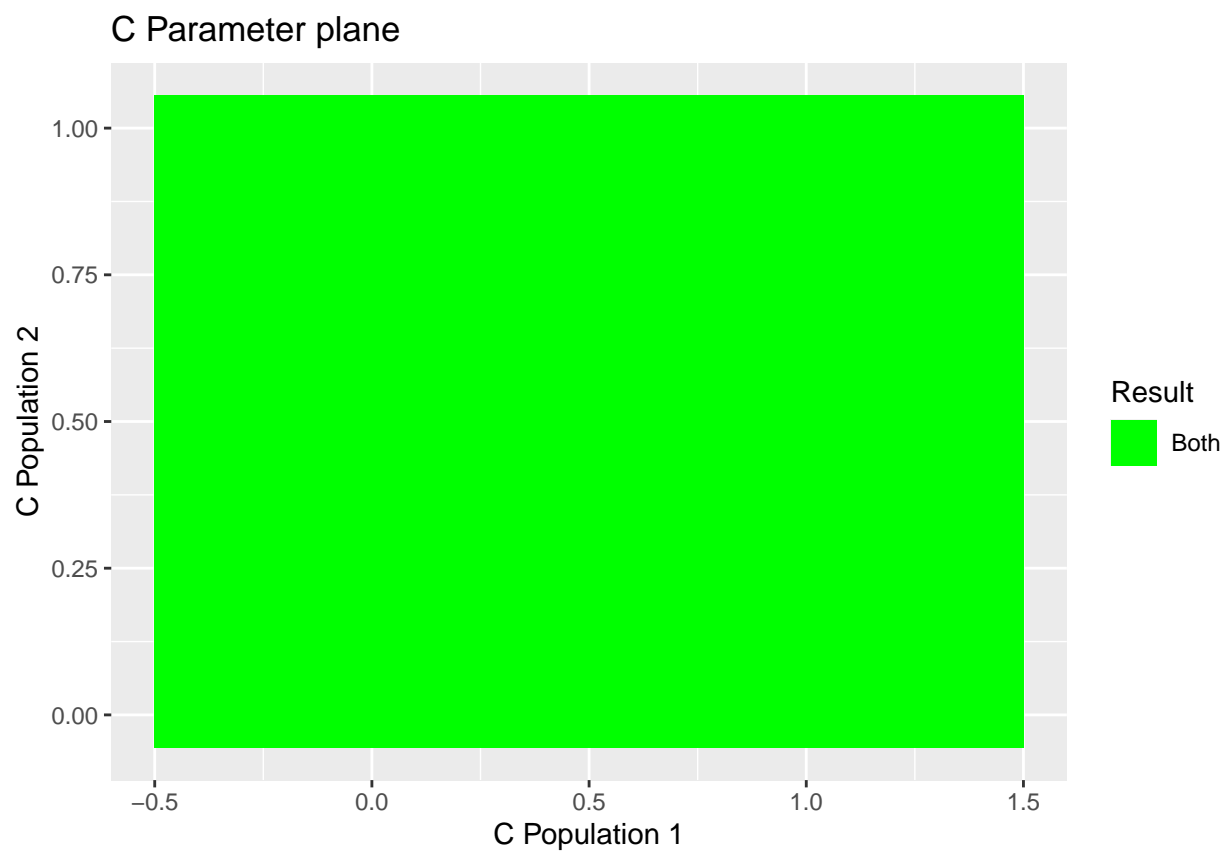


Figure 18: c population planes

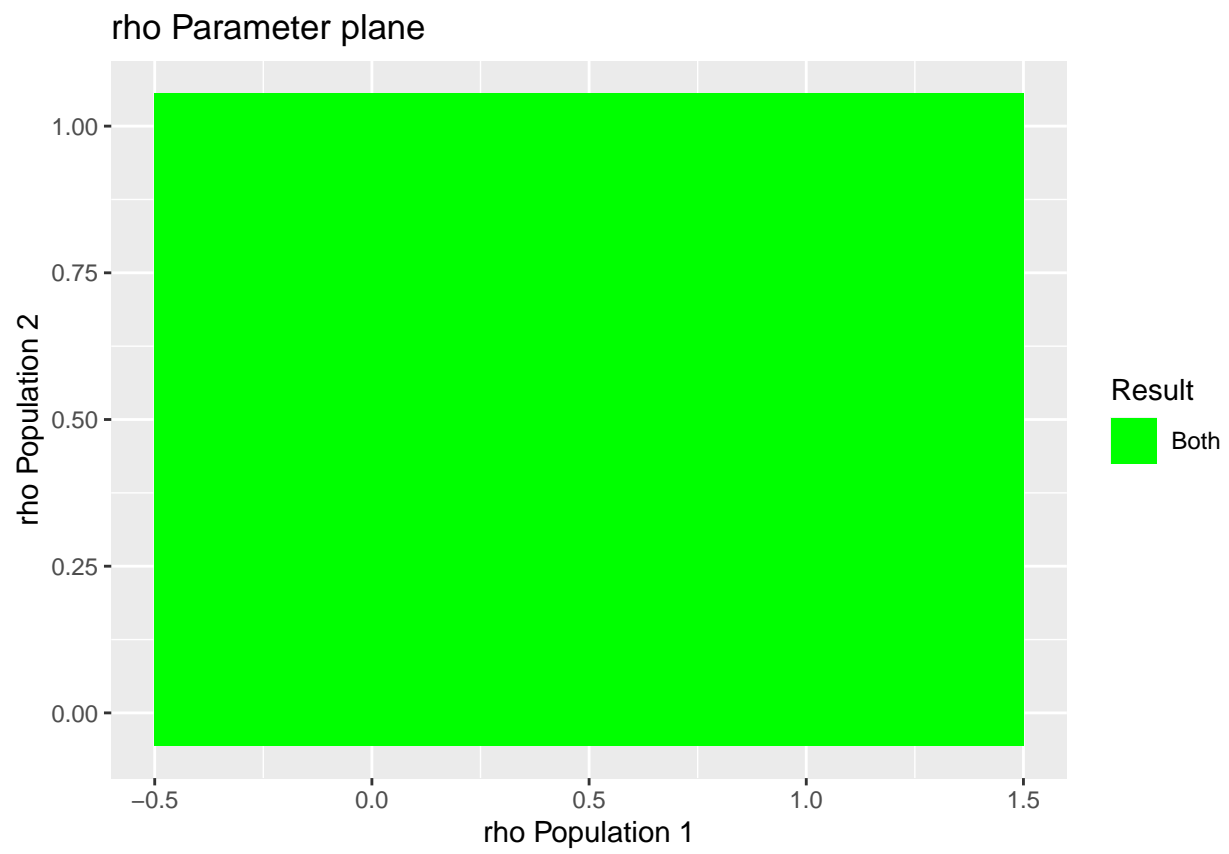


Figure 19: roh population planes