Seasonal scenarios for Insecticide Resistance Management game. v1

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This document demonstrates seasonal scenarios for vector populations and resistance to be used in the game. It follows on from IRM-prototype-game-scenarios4.

The game will modify input parameters to generate reasonable scenarios. The input parameters are simply a means to generate reasonable scenarios.

In the following plots time in days is represented on the x axis, the top panel shows insecticide use, the middle panel shows vector population and the lower panel shows resistance (phenotypic).

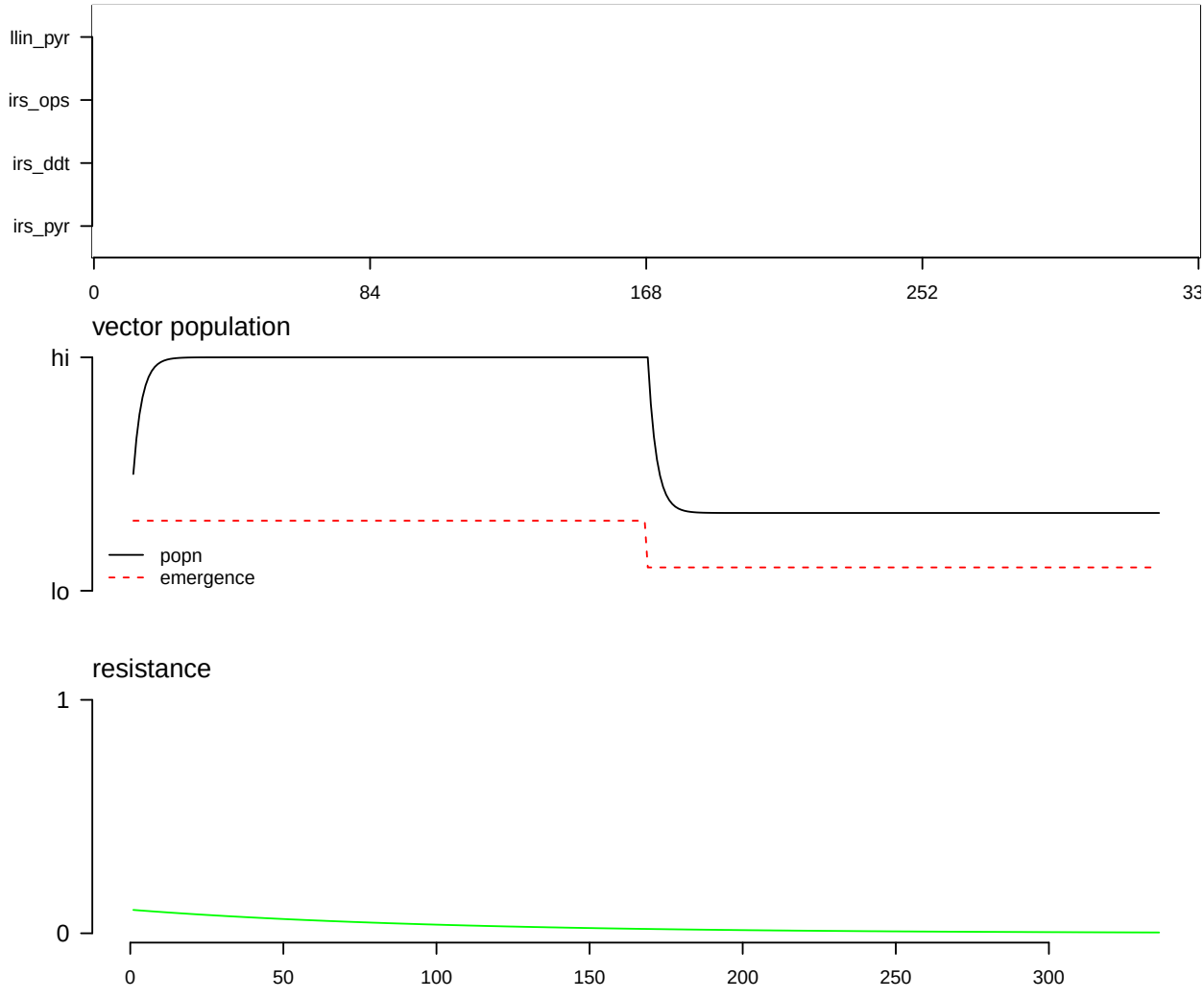
The code included is there merely to show us as developers how the scenarios were generated.

For an interactive version of the equations used to generate these plots see https://andysouth.shinyapps.io/shinyGame4.

Remember that years are 336 days (7days * 4weeks * 12months), half=168.

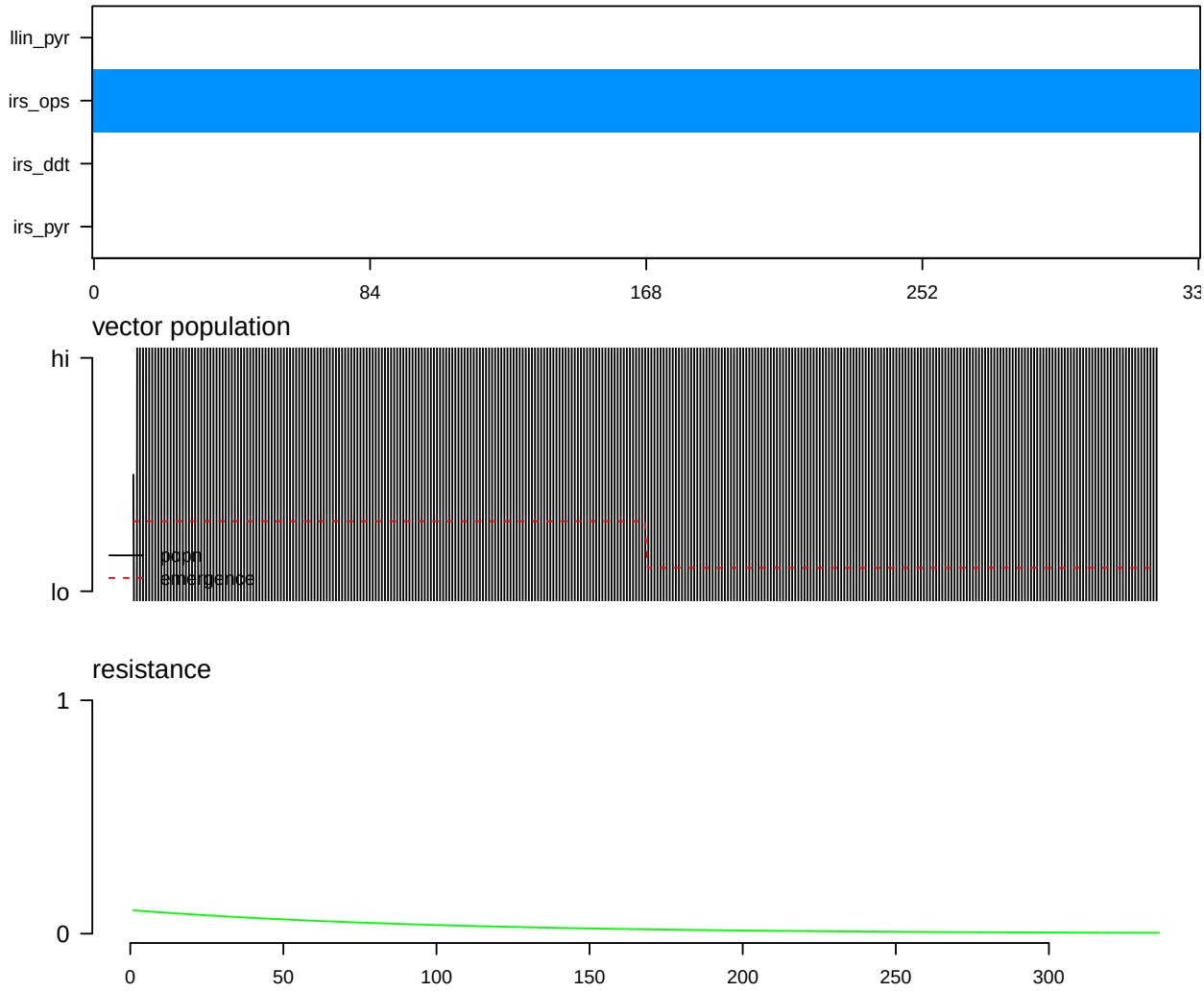
seasonal scenario 1 : 6 months high, 6 months low

```
emergence <- expand_season(season_string="6:0.3;6:0.1")
plot_sim( run_sim(num_tsteps=336, emergence=emergence, survival=0.7,
                  resist_incr=0.02, resist_decr = 0.01),
                  plot_emergence=TRUE )
```



seasonal scenario 2 : as previous, with constant control no resistance

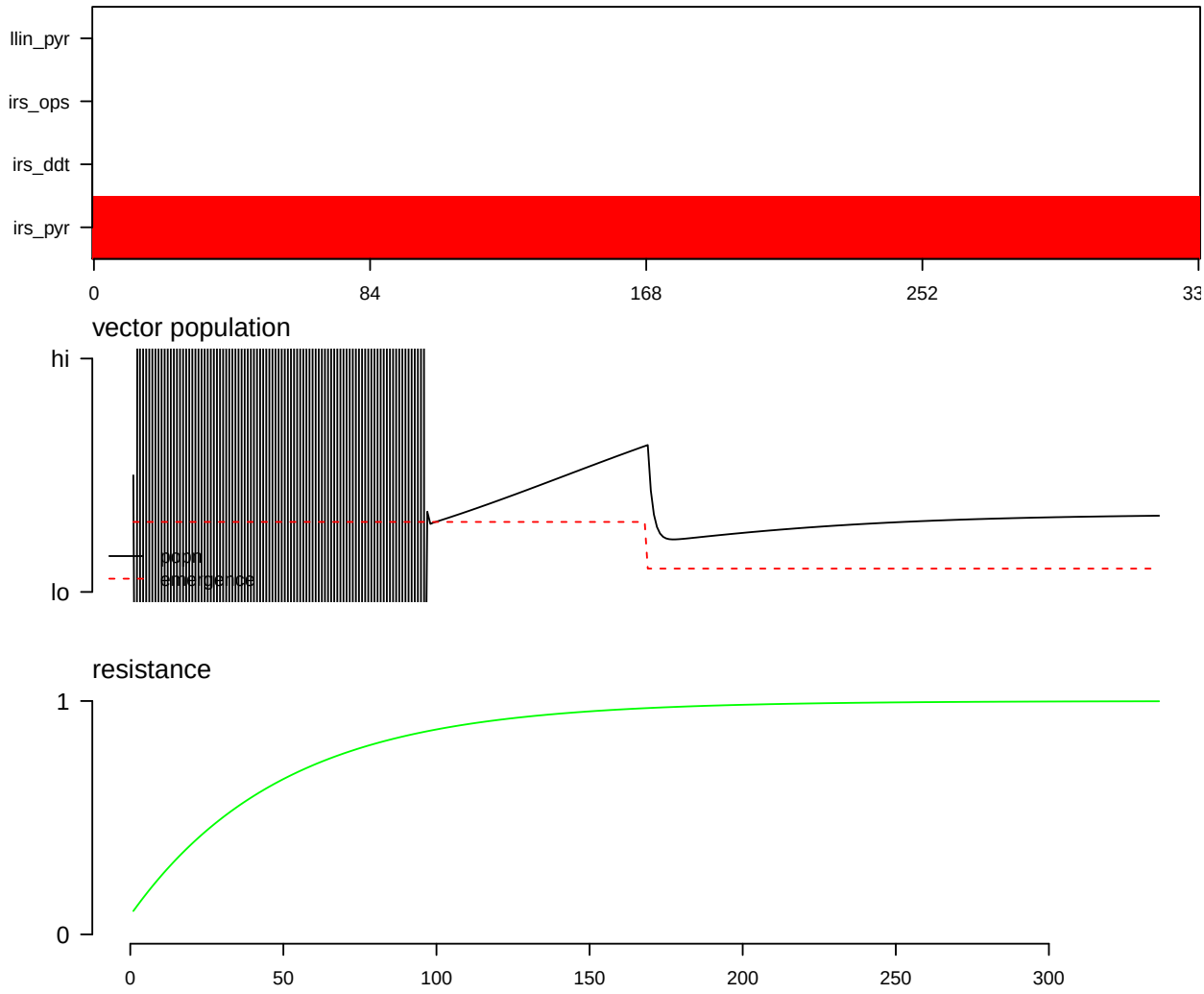
```
emergence <- expand_season(season_string="6:0.3;6:0.1")
l_config2 <- config_plan(l_config, t_strt=c(1), t_stop=c(336),
                         control_id=c('irs_ops'))
plot_sim( run_sim(l_config=l_config2,
                  num_tsteps=336, emergence=emergence, survival=0.7,
                  resist_incr=0.02, resist_decr = 0.01),
                  plot_emergence=TRUE )
```



seasonal scenario 2 : as previous, with constant control with resistance

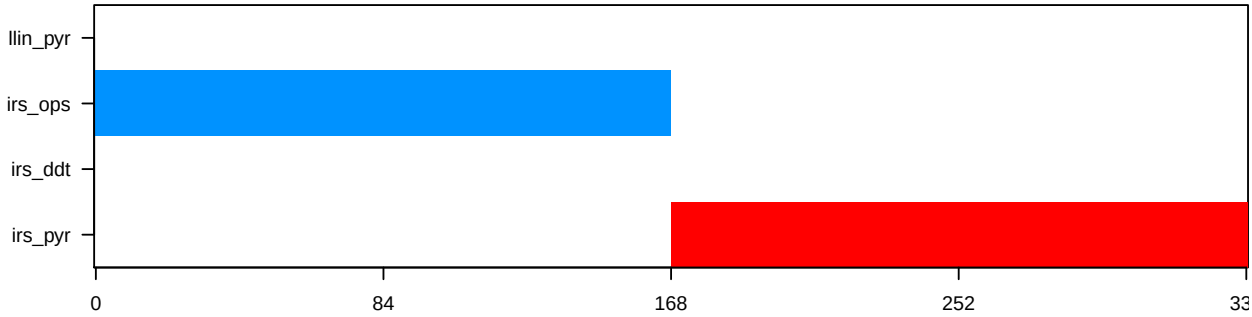
```
emergence <- expand_season(season_string="6:0.3;6:0.1")
l_config2 <- config_plan(l_config, t_strt=c(1), t_stop=c(336),
                         control_id=c('irs_pyr'))
plot_sim( run_sim(l_config=l_config2,
```

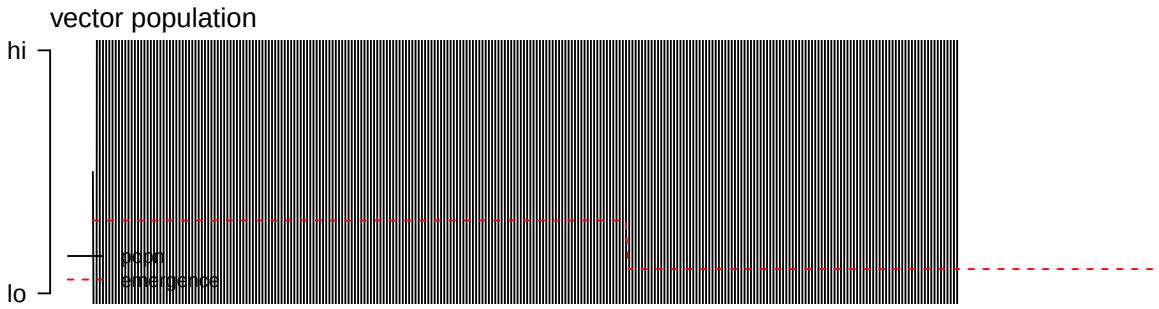
```
                  num_tsteps=336, emergence=emergence, survival=0.7,
                  resist_incr=0.02, resist_decr = 0.01),
                  plot_emergence=TRUE )
```

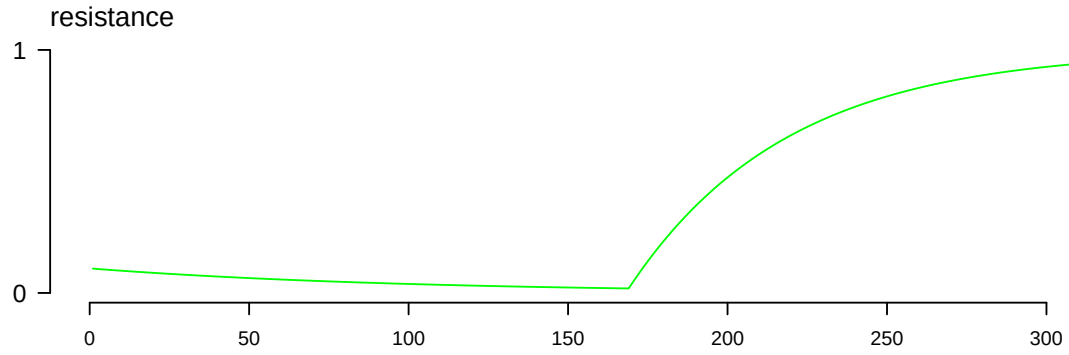


seasonal scenario 3 : as previous, with changing control

```
emergence <- expand_season(season_string="6:0.3;6:0.1")
l_config2 <- config_plan(l_config, t_strt=c(1,169), t_stop=c(168,336),
                         control_id=c('irs_ops','irs_pyr'))
plot_sim( run_sim(l_config=l_config2,
                  num_tsteps=336, emergence=emergence, survival=0.7,
                  resist_incr=0.02, resist_decr = 0.01),
                  plot_emergence=TRUE )
```


llin_pyr
irs_ops
irs_ddt
irs_pyr
0
84
168
252
33


vector population
hi
lo
pcpn
emergence


resistance
1
0
0
50
100
150
200
250
300

How controls and resistance mechanisms can be specified.

Our generic approach allows us to specify any combination of controls and resistance mechanisms. The controls cause a specified kill rate(s) on specified vector(s). The resistance mechanisms specify which controls they apply to and how fast resistance increases and decreases in the presence and absence respectively of that control. Cross resistance can be specified simply by specifiying multiple controls for one resistance mechanism.

The relationships between vectors, controls and resistance mechanisms are specified in simple configuration files. Here is a simple example of a collection of such configuration files :

places.csv

```
##   place_id place_name            place_desc vector_id   emergence
## 1     dry1         NA vectors only when wet   an_gamb 6:0.1;6:0.9
## 2   swamp1         NA      vectors all year   an_gamb           1
```

vectors.csv

```
##   vector_id        vector_name vector_desc vector_survival
## 1   an_gamb  Anopheles gambiae          NA             0.7
```

controls.csv

```
##   control_id         control_name control_desc vector_id control_kill_rate
## 1    irs_pyr       IRS pyrethroid           NA   an_gamb               0.4
## 2    irs_ddt             IRS ddt            NA   an_gamb               0.5
## 3    irs_ops IRS organophosphates           NA   an_gamb               0.3
## 4   llin_pyr    pyrethroid bednet           NA   an_gamb               0.2
```

resistances.csv

```
##   resistance_id              resistance_name control_id
## 1   met_pyr_ddt metabolic pyrethroids and ddt    irs_pyr
## 2   met_pyr_ddt metabolic pyrethroids and ddt   llin_pyr
## 3   met_pyr_ddt metabolic pyrethroids and ddt    irs_ddt
##   resistance_strength resistance_incr resistance_decr
## 1                 1.0            0.20             0.1
## 2                 1.0            0.05             0.1
## 3                 0.9            0.20             0.1
```

control_plan.csv

```
##   t_strt t_stop control_id
## 1      1     10    irs_pyr
## 2     11     20    irs_ops
```