

Appendix 3 - Example ectotherm models

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Introduction

Parameters and running the model

```
library(NicheMapR)
```

Set parameters and ...

```
#####  
# Physiology  
  
## preferred temperatures  
tpref <- read.table('./data/Gvozdk_Kristin_TP.txt',  
                    header=T, sep='\t')  
m_tpref <- mean(tpref$MeanTp[tpref$Treatment == 'Food'])  
lbt <- mean(tpref$LBTP[tpref$Treatment == 'Food'])  
ubt <- mean(tpref$UBTP[tpref$Treatment == 'Food'])  
  
## metabolic rates  
mrs <- read.table('./data/Gvozdk_Kristin_AS.txt',  
                  header=T, sep='\t')  
colnames(mrs) <- c('temp', 'sex', 'mass', 'smr', 'mmr', 'scope', 'fscope')  
smr_model <- nls(smr ~ exp(a + b * temp), data = mrs, start = list(a = 0, b = 0))  
  
#####  
# Ectotherm model  
  
load('./results/micro_Jihlava.Rda') # load microclimate  
  
# full sun (0% shade)  
maxshades <- micro$minshade + 1 # increase a bit to avoid convergence problems  
minshades <- micro$minshade  
shdburrow <- 2  
# # or deep shade (90% shade)  
# maxshades <- micro$maxshade  
# minshades <- micro$maxshade  
# shdburrow <- 0  
  
# movement restriction  
maxdepth <- 10 # up to 2 m  
# maxdepth <- 8 # up to 50 cm
```

```

# morphology
Ww_g = 3.5,
shape = 3,
pct_wet = 90,

# Physiology
T_F_min = 4,
T_F_max = ubt,
T_pref = m_tpref,
T_B_min = 4,
T_RB_min = 4,
CT_max = 36,
CT_min = -2,

# general behaviour
burrow=1,
diurn = 0,
nocturn = 1,
crepus = 1,
shade_seek = 0,

# set behavioral strategy
behav <- 1 # 1 = cold shelters; 2 = warm shelters; 3 = passive
bwater <- 1 # following moist shelters (0 = no, 1 = yes)

ecto <- ectotherm(burrowtmp = behav, burrowwtr = bwater,
                  Ww_g = Ww_g, shape = shape, burrow=burrow,
                  T_F_min = T_F_min, T_F_max = ubt, T_pref = m_tpref,
                  T_B_min = T_B_min, T_RB_min = T_RB_min,
                  CT_max = CT_max, CT_min = CT_min,
                  diurn = diurn, nocturn = nocturn, crepus = crepus,
                  shade_seek = shade_seek, maxdepth = maxdepth,
                  pct_wet = pct_wet,
                  maxshade=maxshades, minshade=minshades, shdburrow = shdburrow)

```

Models can be run in a loop as in the 2_ectotherm_model.R script, with the different behavioral options [...]. Once results are stored, they can be loaded to inspect them.

```

load('./results/micro_Jihlava.Rda')

ecto_current_sun_files <- list.files(path='./results', pattern='*200cm_sun.Rda', full.names=T)
ecto_current_shd_files <- list.files(path='./results', pattern='*200cm_shade.Rda', full.names=T)

a <- 1
for(ec in ecto_current_sun_files){
  load(ec)
  ecto$enviro$dates <- micro$dates
  ecto$enviro$model <- strsplit(strsplit(ec, '/')[[1]][3], '.R')[[1]][1]
  if(a==1){envs_current_sun <- ecto$enviro}
  else{envs_current_sun <- rbind(envs_current_sun, ecto$enviro)}
  a = a+1
}
str(envs_current_sun)

```

```
## 'data.frame': 473328 obs. of 32 variables:
## $ DOY : num 213 213 213 213 213 213 213 213 213 213 ...
## $ YEAR : num 1 1 1 1 1 1 1 1 1 1 ...
## $ DAY : num 1 1 1 1 1 1 1 1 1 1 ...
## $ TIME : num 0 1 2 3 4 5 6 7 8 9 ...
## $ TC : num 13.7 13.4 13.1 13 13.5 ...
## $ SHADE : num 0 0 0 0 0 0 0 0 0 0 ...
## $ SOLAR : num 0 0 0 0 0 0 0 0 0 0 ...
## $ DEP : num 0 0 0 0 -20 -20 -15 -20 -20 -20 ...
## $ ACT : num 2 2 2 2 0 0 0 0 0 0 ...
## $ TA : num 15.6 14.8 14.1 13.9 13.4 ...
## $ TSUB : num 16 15 14.3 14.1 13.4 ...
## $ TSKY : num 6.97 5.66 4.39 3.48 13.43 ...
## $ VEL : num 0.183 0.209 0.216 0.223 0.01 ...
## $ RELHUM : num 83.9 88.8 93.1 95 100 ...
## $ ZEN : num 90 90 90 90 84 ...
## $ CONDEP : num 0 0 0 0 0 0 0 0 0 0 ...
## $ WATERTEMP: num 0 0 0 0 0 0 0 0 0 0 ...
## $ DAYLENGTH: num 15.4 15.4 15.4 15.4 15.4 ...
## $ WINGANGLE: num 179 179 179 179 179 179 179 179 179 179 ...
## $ WINGTEMP : num 0 0 0 0 0 0 0 0 0 0 ...
## $ FLYING : num 0 0 0 0 0 0 0 0 0 0 ...
## $ FLYTIME : num 0 0 0 0 0 0 0 0 0 0 ...
## $ PO2WATER : num 5.27e-316 5.27e-316 5.27e-316 5.27e-316 5.27e-316 ...
## $ SALWATER : num 1.98e-323 1.98e-323 1.98e-323 1.98e-323 1.98e-323 ...
## $ ABSAN : num 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85 0.85 ...
## $ PTCOND : num 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 ...
## $ POSTURE : num 0 0 0 0 0 0 0 0 0 0 ...
## $ PANT : num 1 1 1 1 1 1 1 1 1 1 ...
## $ SMR : num 0.125 0.122 0.119 0.118 0.122 ...
## $ SMR_acc : num 0.0872 0.0851 0.0834 0.0829 0.0857 ...
## $ dates : POSIXct, format: "2009-08-01 00:00:00" "2009-08-01 01:00:00" ...
## $ model : chr "ecto_b1w0_200cm_sun" "ecto_b1w0_200cm_sun" "ecto_b1w0_200cm_sun" "ecto_b1w0_200cm_sun" ...

unique(envs_current_sun$model)

## [1] "ecto_b1w0_200cm_sun" "ecto_b1w1_200cm_sun" "ecto_b2w0_200cm_sun"
## [4] "ecto_b2w1_200cm_sun" "ecto_b3w0_200cm_sun" "ecto_b3w1_200cm_sun"

with(envs_current_sun[envs_current_sun$model == "ecto_b1w0_200cm_sun",],
plot(dates, TC, type='l'))
```

