tpc_maxent

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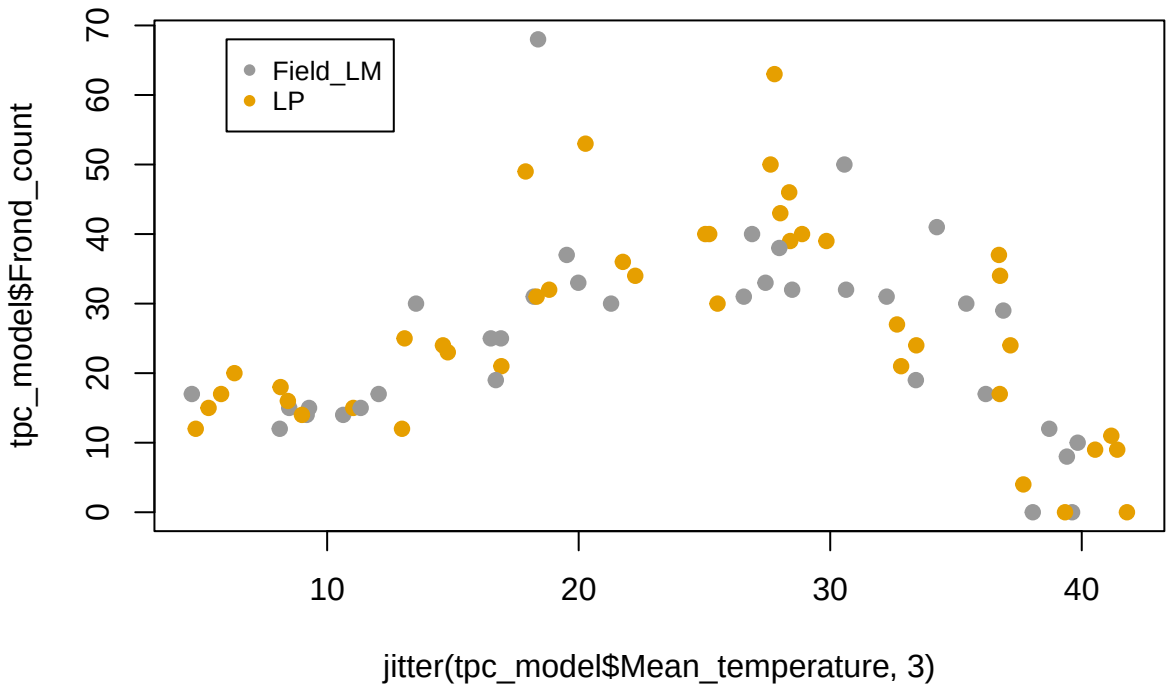
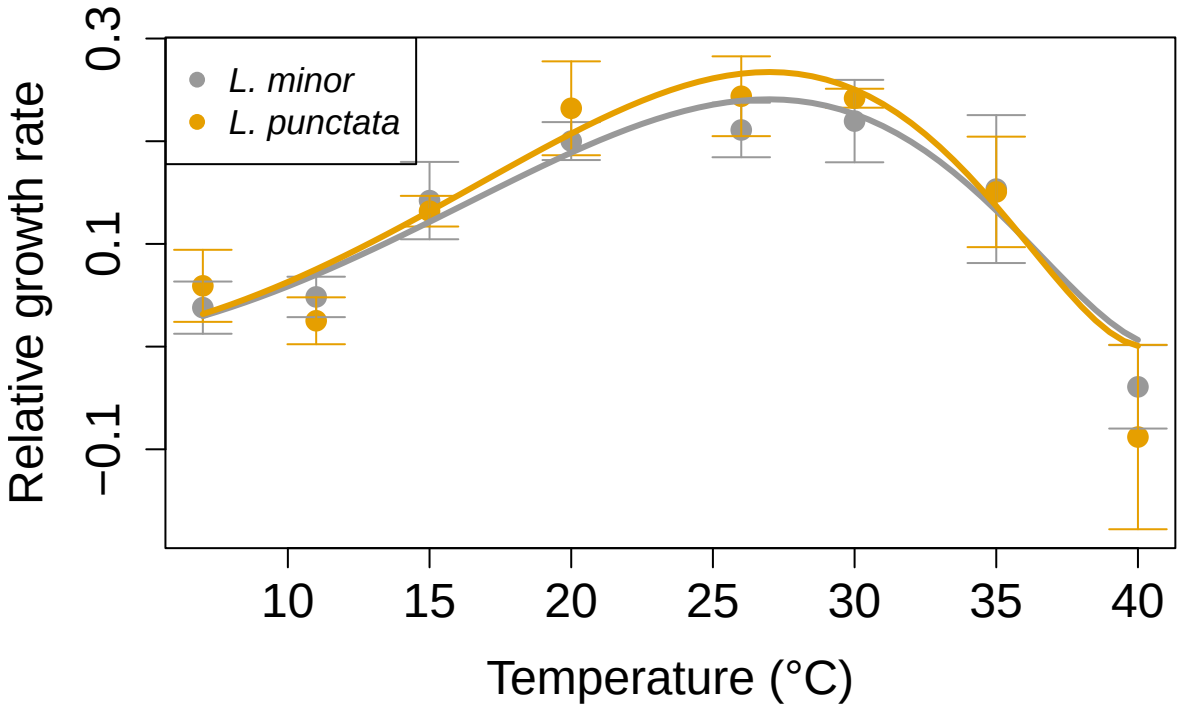
```
library(rTPC)
library(nls.multstart)

### Datasets
datin1 <- read.csv("https://raw.githubusercontent.com/Cuddington-Lab/thermal-experiments/main/dataset_au
                   header=TRUE, stringsAsFactors = TRUE, fileEncoding="UTF-8-BOM")
datin2 <- read.csv("https://raw.githubusercontent.com/Cuddington-Lab/thermal-experiments/main/dataset_au
                   header=TRUE, stringsAsFactors = TRUE, fileEncoding="UTF-8-BOM")
tpc_model <- rbind(datin1, datin2)

### Total reproductive number for each replicate (summing 3 dishes)
tpc_model$Frond_count <- tpc_model$Frond_count_1 + tpc_model$Frond_count_2 + tpc_model$Frond_count_3

### Selecting constant temperature experiments
tpc_model <- subset(tpc_model, Treatment == "constant")

### Removing failed experiments
tpc_model <- subset(tpc_model, (!Errors == "y") | is.na(Errors))

tpc_model <- subset(tpc_model, !Species == "Lab_LM")

### Plotting observations
colors <- c("#999999", "#E69F00")
plot(jitter(tpc_model$Mean_temperature, 3), tpc_model$Frond_count, pch = 19, col = colors[factor(tpc_mo
legend(6, 68, legend=c("Field_LM", "LP"), col=colors, pch=16, cex=0.8)
```




```
tpc_model <- subset(tpc_model, Frond_count != 0)
tpc_model$r <- (log(tpc_model$Frond_count) - log(12)) / 5

# Removing 2 probable data entry errors
tpc_model <- subset(tpc_model, Frond_count <= 60)

tpc <- data.frame(temp = tpc_model$Mean_temperature, frond = tpc_model$r, Species = tpc_model$Species)
tpc$temp <- as.numeric(as.character(tpc$temp))

mylist <- list()
mylist[[1]] <- subset(tpc, Species == "Field_LM")
mylist[[2]] <- subset(tpc, Species == "LP")

# choose model
mod <- "ratkowsky_1983"
new_data <- data.frame(temp = seq(min(tpc_model$Mean_temperature), max(tpc_model$Mean_temperature), 0.5)
all_results <- list()
count <- 1

for (i in mylist) {
  # get start vals
  start_vals <- get_start_vals(i[, 1], i[, 2], model_name = mod)
  # get limits
  low_lims <- get_lower_lims(i[, 1], i[, 2], model_name = mod)
  upper_lims <- get_upper_lims(i[, 1], i[, 2], model_name = mod)
  # fit model
```

```
  fit <- nls_multstart(frond ~ ratkowsky_1983(temp = temp, tmin, tmax, a, b),
                       data = i[, 1:2],
                       iter = 500,
                       start_lower = start_vals - 10,
                       start_upper = start_vals + 10,
                       lower = low_lims,
                       upper = upper_lims,
                       supp_errors = 'Y')
  result <- predict(fit, newdata = new_data)
  all_results[[count]] <- as.data.frame(result)
  count <- count + 1
}

df <- as.data.frame(do.call(cbind, all_results))
colnames(df) <- c("tpc_fieldLM", "tpc_LP")
df$temp <- new_data$temp

# Summary stats using base R
m <- aggregate(frond ~ temp + Species, tpc, mean, na.rm = TRUE)
s <- aggregate(frond ~ temp + Species, tpc, sd, na.rm = TRUE)
tpc.summary <- merge(s, m, by = c("temp", "Species"))
names(tpc.summary)[3:4] <- c("sd", "frond")

# Plotting with error bars and model lines
plot(tpc.summary$temp, tpc.summary$frond,
     ylim = range(c(tpc.summary$frond - tpc.summary$sd, tpc.summary$frond + tpc.summary$sd)),
     pch = 16, col = c("#999999", "#E69F00"), xlab = "Temperature (\u00B0C)", ylab = "Relative growth ra
     cex = 1.5, cex.lab = 1.5, cex.axis = 1.5, cex.main = 1.5, cex.sub = 1.5)

# Error bars
arrows(x0 = tpc.summary$temp, y0 = tpc.summary$frond - tpc.summary$sd,
       x1 = tpc.summary$temp, y1 = tpc.summary$frond + tpc.summary$sd,
       length = 0.15, code = 3, angle = 90, col = c("#999999", "#E69F00"))

legend("topleft", legend = c("L. minor", "L. punctata"), text.font = c(3, 3),
       col = c("#999999", "#E69F00"), pch = 16, cex = 1.1)

lines(df$temp, df$tpc_fieldLM, col = "#999999", lwd = 3)
lines(df$temp, df$tpc_LP, col = "#E69F00", lwd = 3)
```


Relative growth rate
0.3
0.1
−0.1
L. minor
L. punctata
10
15
20
25
30
35
40
Temperature (°C)