pi_curves_nls

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```
## install packages if you dont already have them in your library
if ("devtools" %in% rownames(installed.packages()) == 'FALSE') install.packages('devtools')
if ("segmented" %in% rownames(installed.packages()) == 'FALSE') install.packages('segmented')
if ("plotrix" %in% rownames(installed.packages()) == 'FALSE') install.packages('plotrix')
if ("gridExtra" %in% rownames(installed.packages()) == 'FALSE') install.packages('gridExtra')
if ("LoLinR" %in% rownames(installed.packages()) == 'FALSE') install_github('colin-olito/LoLinR')
if ("lubridate" %in% rownames(installed.packages()) == 'FALSE') install.packages('lubridate')
if ("chron" %in% rownames(installed.packages()) == 'FALSE') install.packages('chron')
if ("plyr" %in% rownames(installed.packages()) == 'FALSE') install.packages('plyr')
if ("dplyr" %in% rownames(installed.packages()) == 'FALSE') install.packages('dplyr')
if ("phytotools" %in% rownames(installed.packages()) == 'FALSE') install.packages('phytotools')
if ("tidyverse" %in% rownames(installed.packages()) == 'FALSE') install.packages('tidyverse')
if ("broom" %in% rownames(installed.packages()) == 'FALSE') install.packages('broom')

#Read in required libraries

library("devtools")
library("ggplot2")
library("segmented")
library("plotrix")
library("gridExtra")
library("LoLinR")
library("lubridate")
library("chron")
library('plyr')
library('dplyr')
library('phytotools')
library("tidyverse")
library("broom")
```

Import data

```
Data <- read.csv(file = 'output/1_pi_curve_rates.csv')
#Data <- Data[1:40,]
```

Define data

```
#specify data
Data$PAR <- as.numeric(Data$Light_Value)
Data$Pc <- as.numeric(Data$micromol.cm2.h)
```

Define PI curve function as a nonlinear Least Squares regression of a quadratic fit, test nls fit

Aquatic Photosynthesis, Falkowski
Pmax = max photosynthesis (AKA Am from Bayesian script)
alpha = quantum yeild (AKA AQY from Bayesian script)
I/E = irradiance (AKA PAR from Bayesian script)
Rd = dark respiration

Run models

Using fixed initial values (keeping for reference):

```
#nls_data <- Data %>%
   #filter(colony_id==c("ACR-140"))%>%
   #group_by(colony_id) %>%
   #nest(-colony_id) %>%
   #mutate(model1 = map(data, ~
                        # nls(Pc ~ (Am*((AQY*PAR)/(sqrt(Am^2 + (AQY*PAR)^2)))-Rd), data=., start=list(A
                             # tidy %>%
                             # dplyr::select(term, estimate) %>%
                             # spread(term, estimate))) %>%
  #unnest(model1) %>%
  #unnest(data) %>%
  #group_by(colony_id)%>%
  #summarise(Am=mean(Am), AQY=mean(AQY), Rd=mean(Rd))%>%
  #mutate(timepoint="timepoint1")%>%
  #write_csv(., "output/1_pi_curve_pars_NLS_fixed_inis.csv")
```

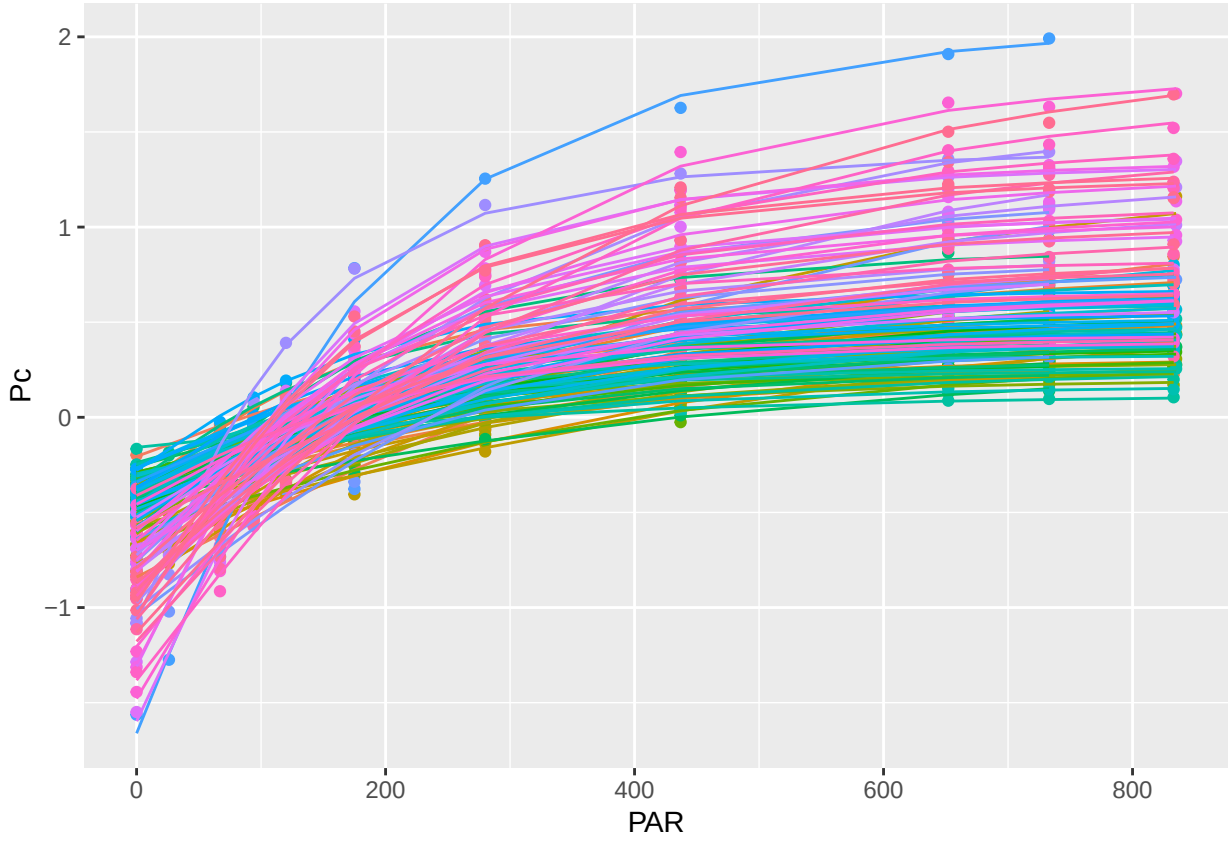
Using flexible initial values based on input data:

```
nls_data <- Data %>%
   #filter(colony_id==c("ACR-140"))%>%
   group_by(colony_id) %>%
   nest(-colony_id) %>%
   mutate(model1 = map(data, ~
                        nls(Pc ~ (Am*((AQY*PAR)/(sqrt(Am^2 + (AQY*PAR)^2)))-Rd), data=., start=list(Am=
                             tidy %>%
                             dplyr::select(term, estimate) %>%
                             spread(term, estimate))) %>%
  unnest(model1) %>%
  unnest(data) %>%
  group_by(colony_id)%>%
  summarise(Am=mean(Am), AQY=mean(AQY), Rd=mean(Rd))%>%
  mutate(timepoint="timepoint1")%>%
  write_csv(., "output/1_pi_curve_pars_NLS.csv")
```

Plot curve over data points.

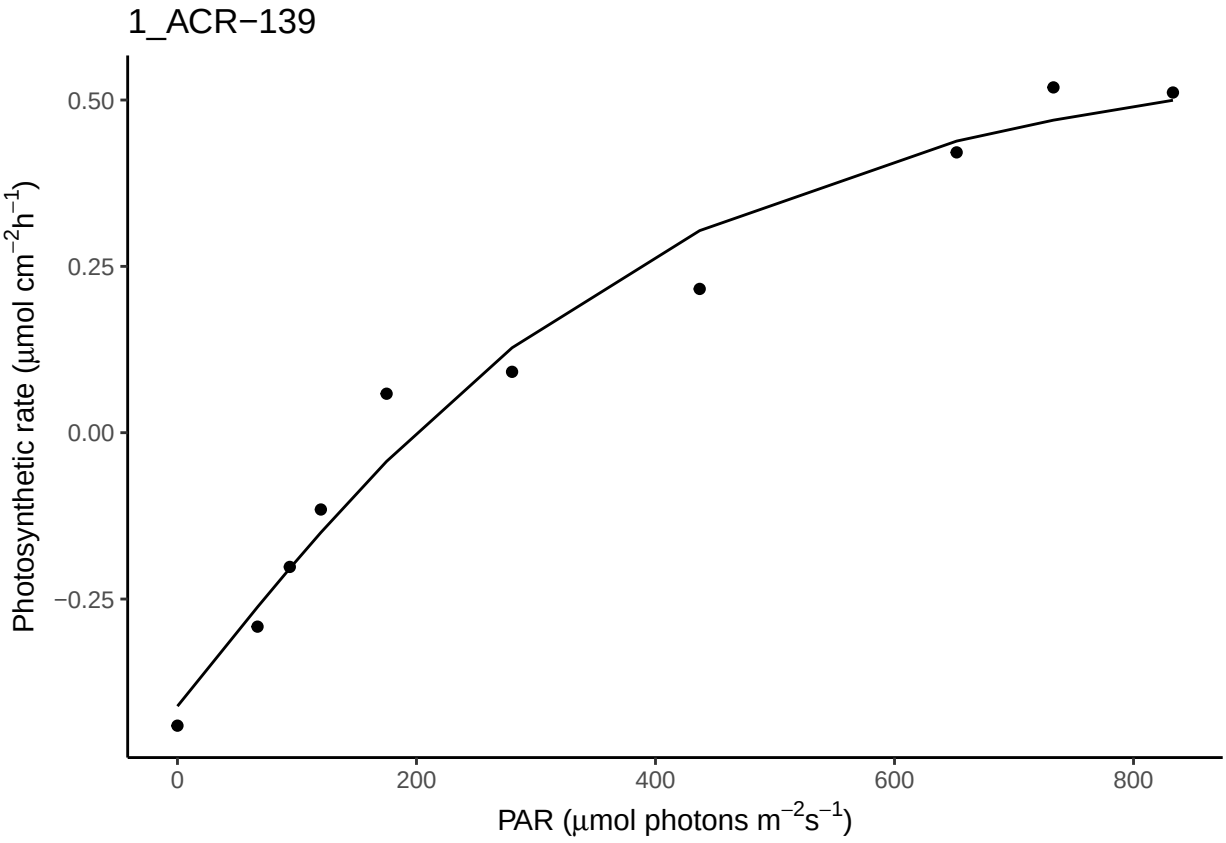
```
augmented <- Data %>%
  nest(-colony_id) %>%
  mutate(
    fit = map(data, ~ nls(Pc ~ (Am*((AQY*PAR)/(sqrt(Am^2 + (AQY*PAR)^2)))-Rd), data=., start=list(Am=0.
    augmented = map(fit, augment),
  ) %>%
  unnest(augmented)


#all colonies together
augmented %>%
  group_by(colony_id)%>%
  qplot(PAR, Pc, data = ., geom = 'point', colour = colony_id) +
  geom_line(aes(y=.fitted))+
  theme(legend.position="none")
```

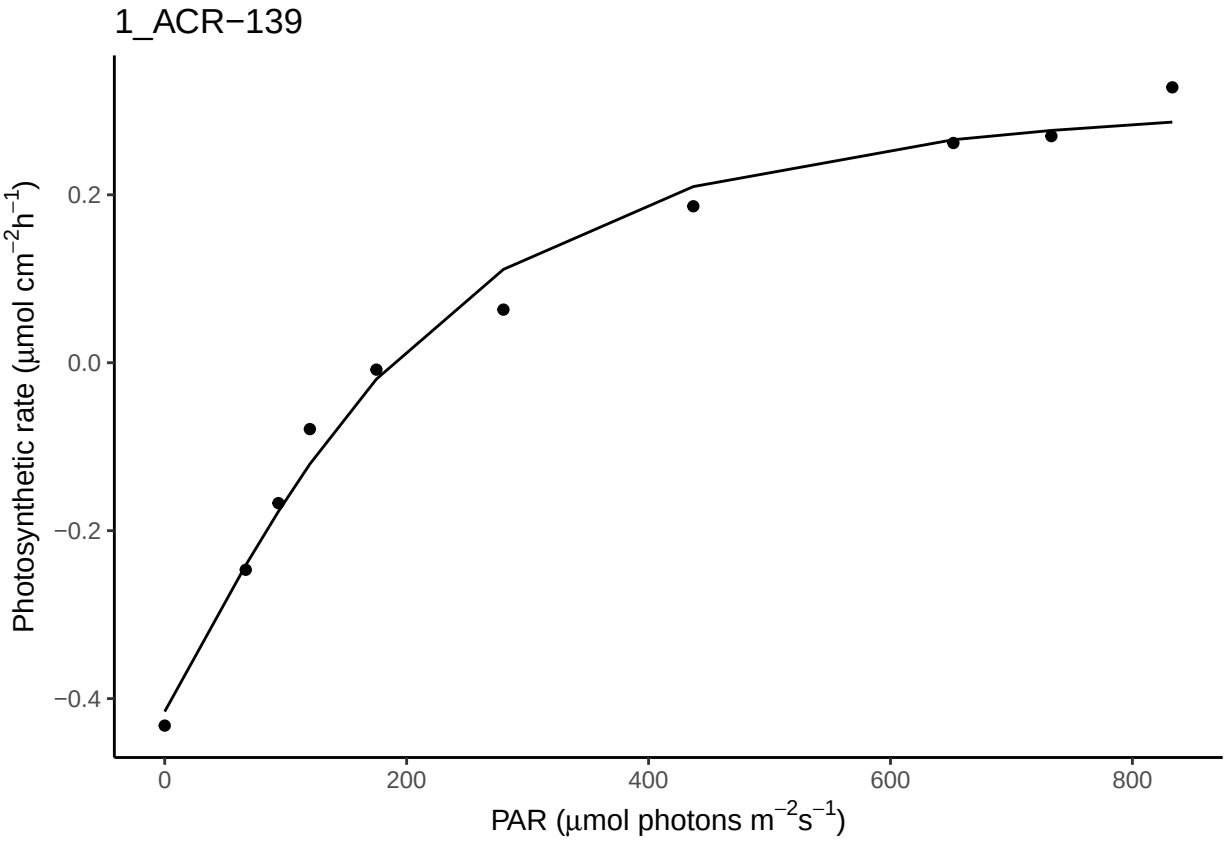



```
#view individual plots
by(augmented,augmented$colony_id, function(i) {
  ggplot(i) +
          geom_point(aes(PAR, Pc, group=colony_id)) +
          geom_line(aes(y=.fitted, x=PAR)) +
          theme_classic()+
          labs(x = expression(paste('PAR (', mu, "mol photons m"^-2, 's'^-1,")")),
               y = expression(paste('Photosynthetic rate (', mu, "mol cm"^-2, 'h'^-1,")")),
               title = paste0("1_", augmented$colony_id))
})
```

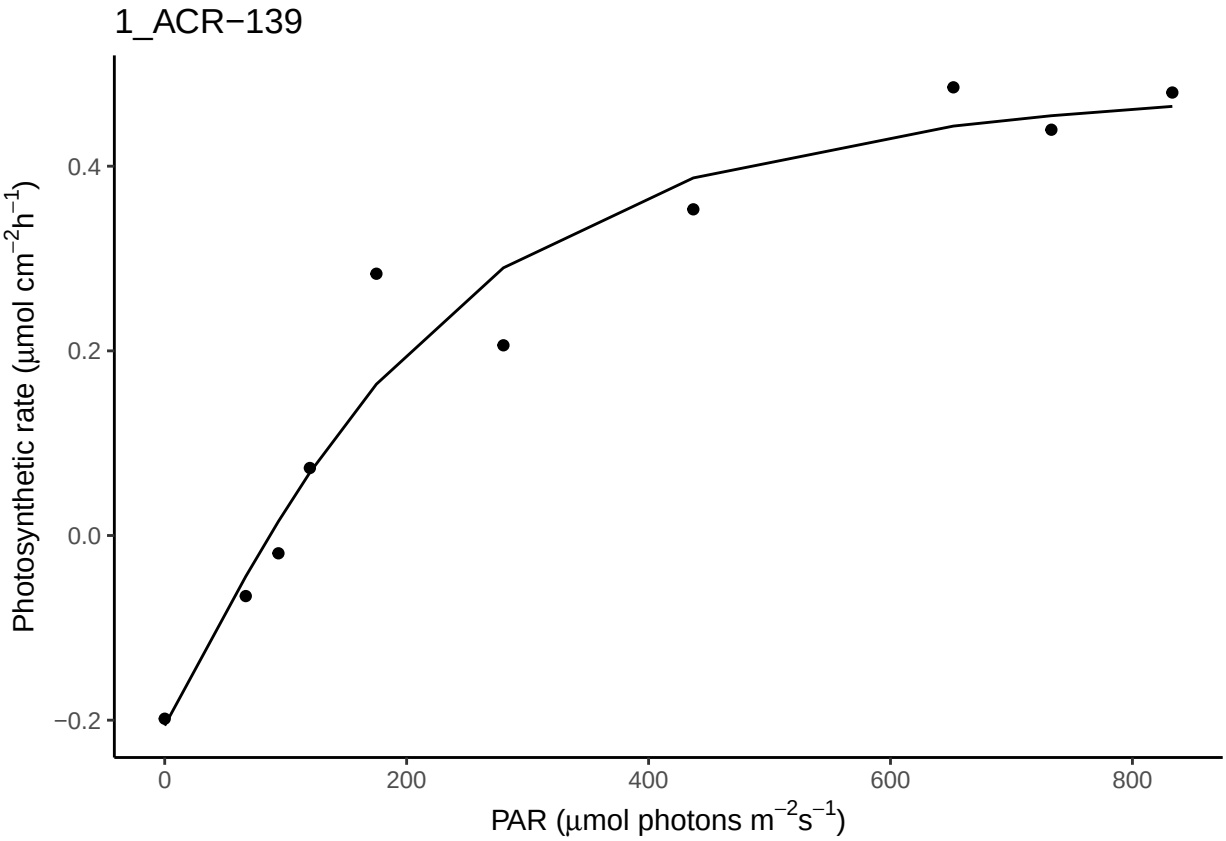
```
## augmented$colony_id: ACR-139
```



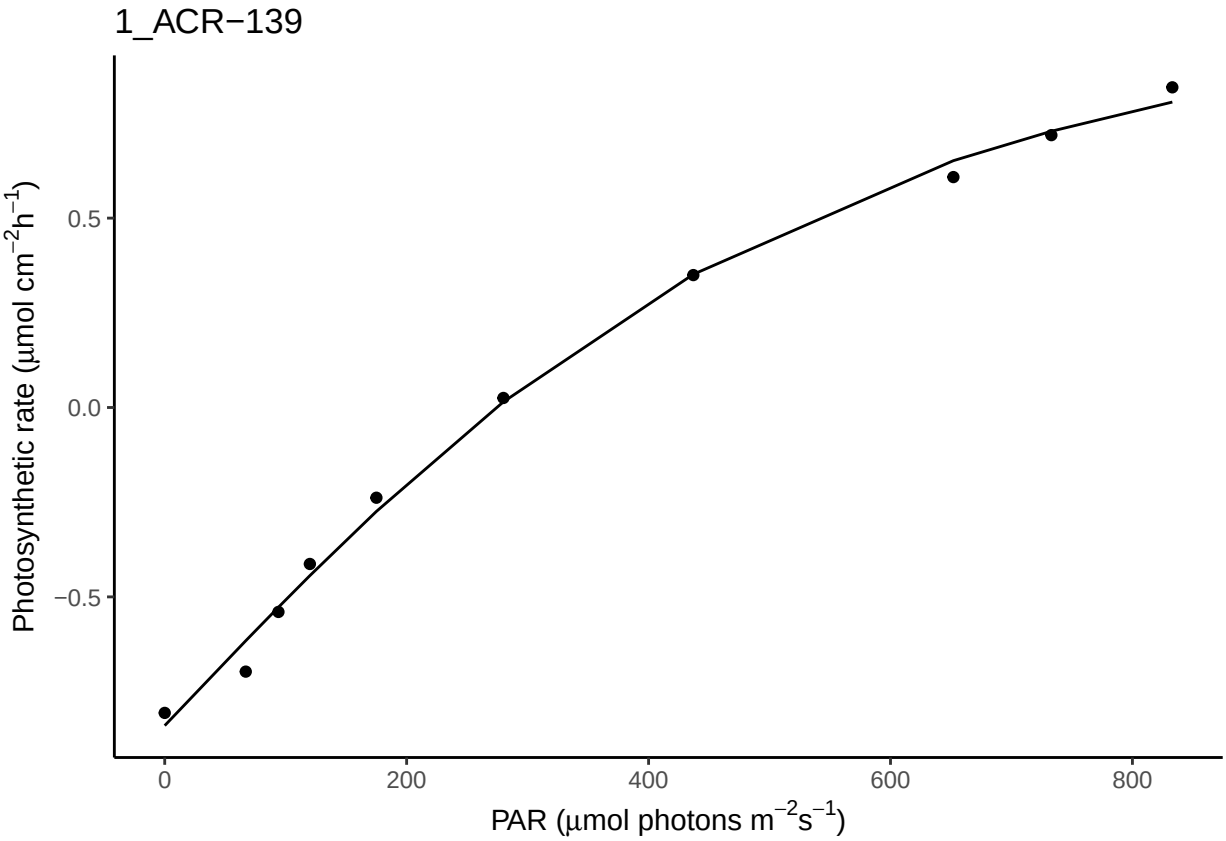

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-140
```



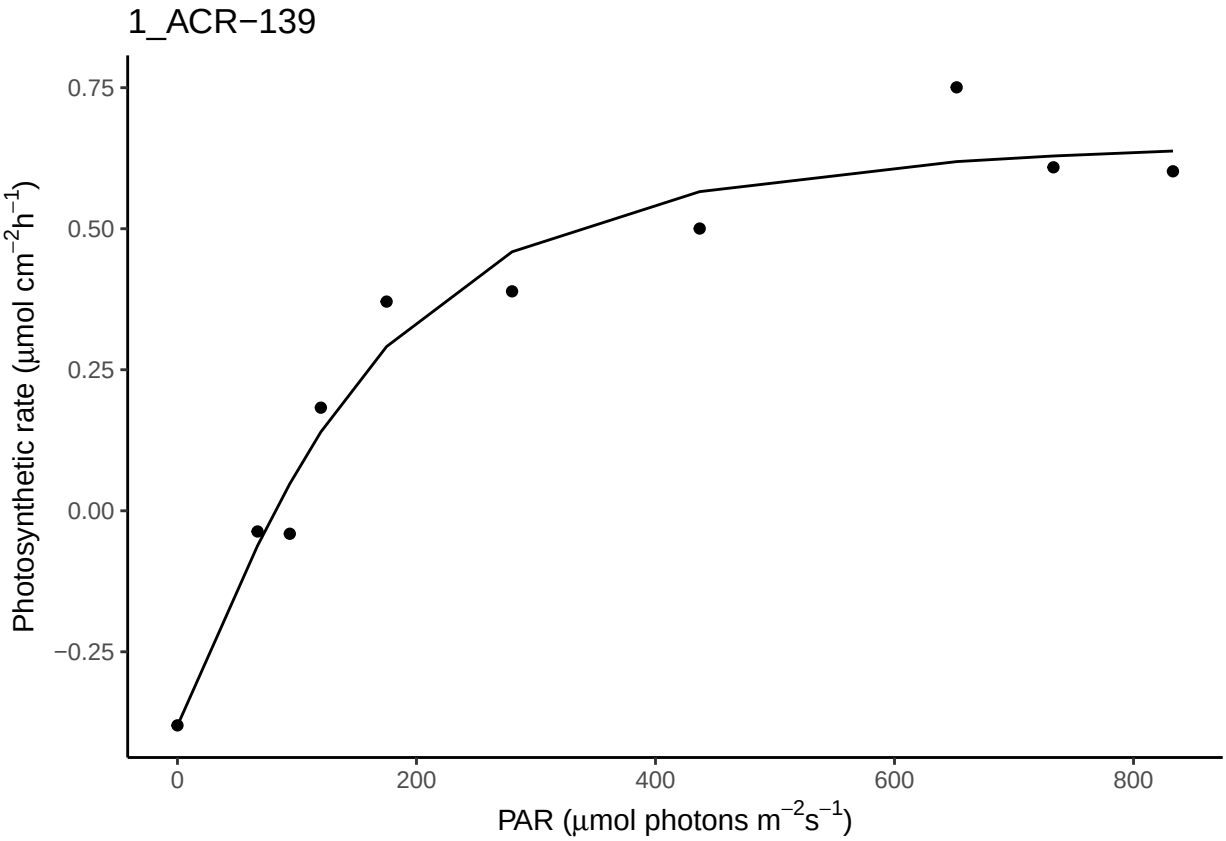

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-145
```



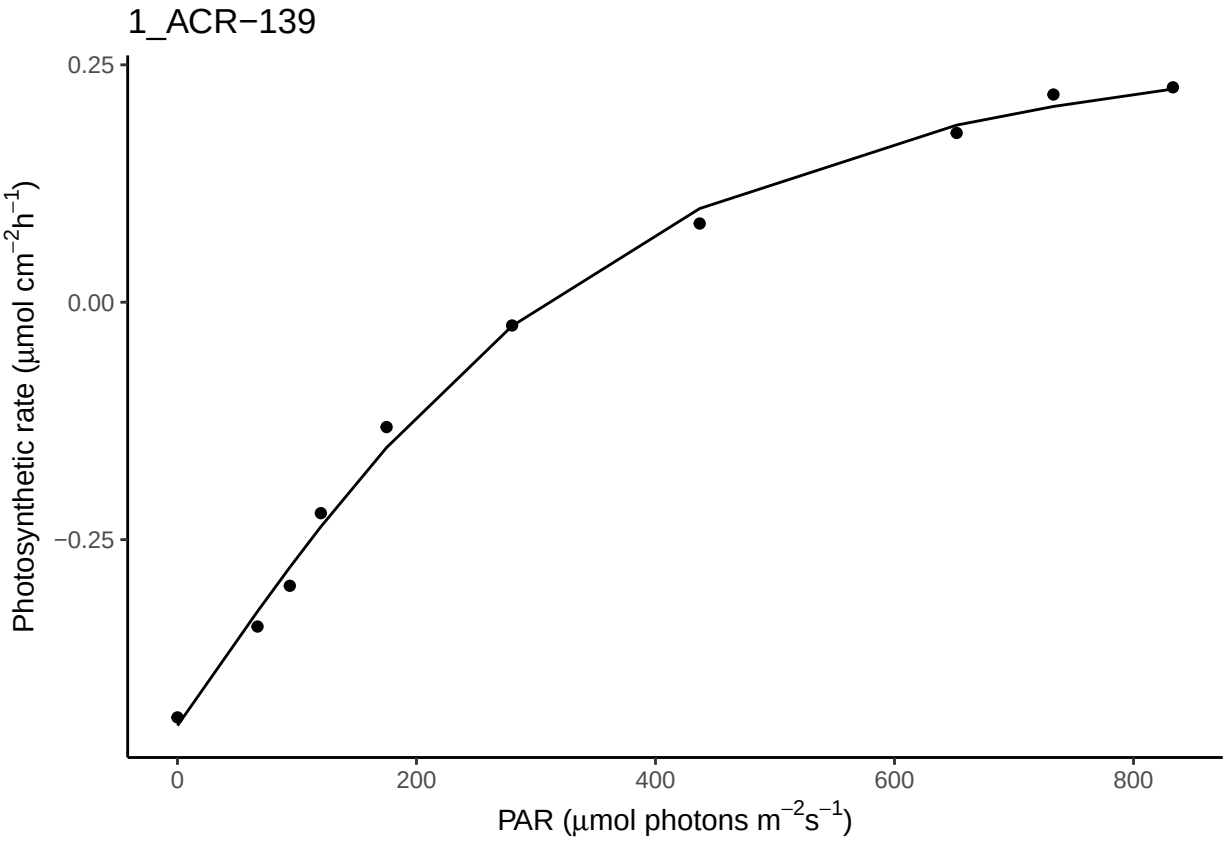

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-150
```



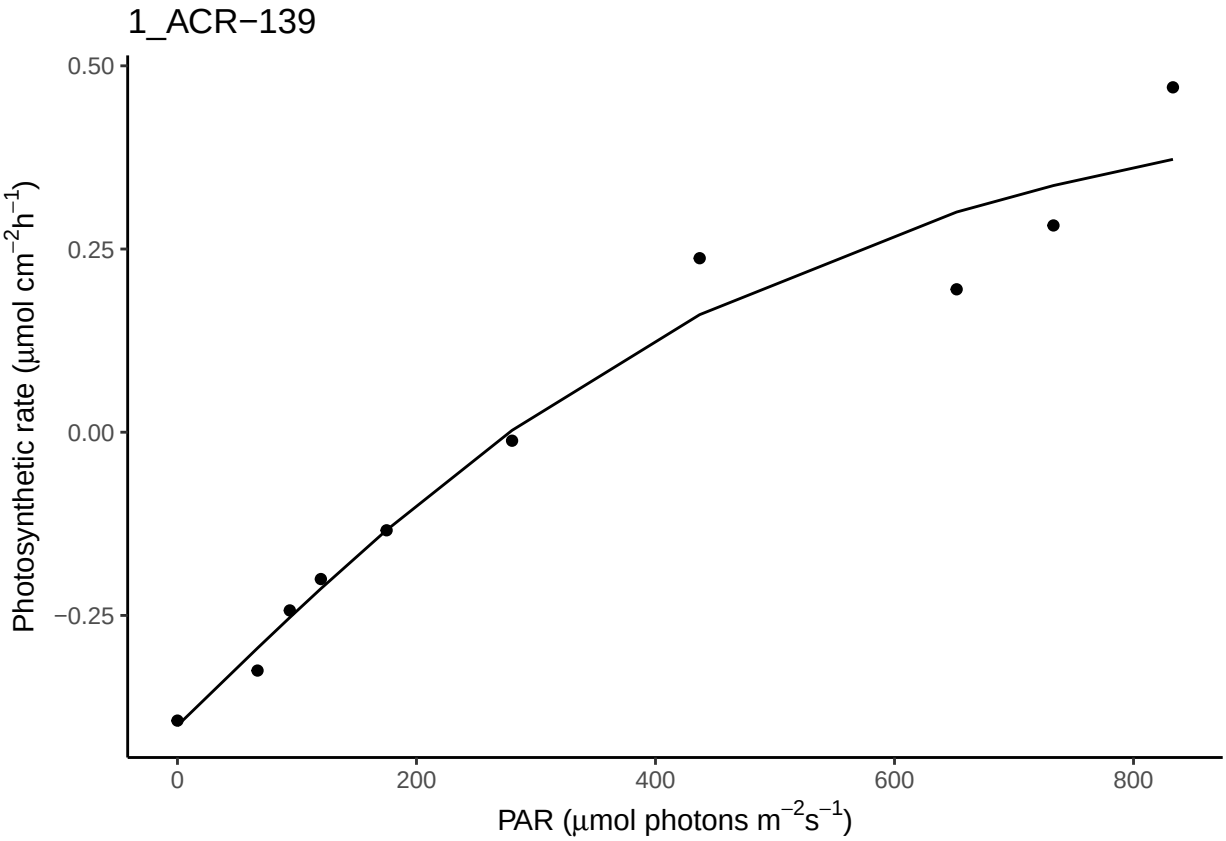

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-165
```



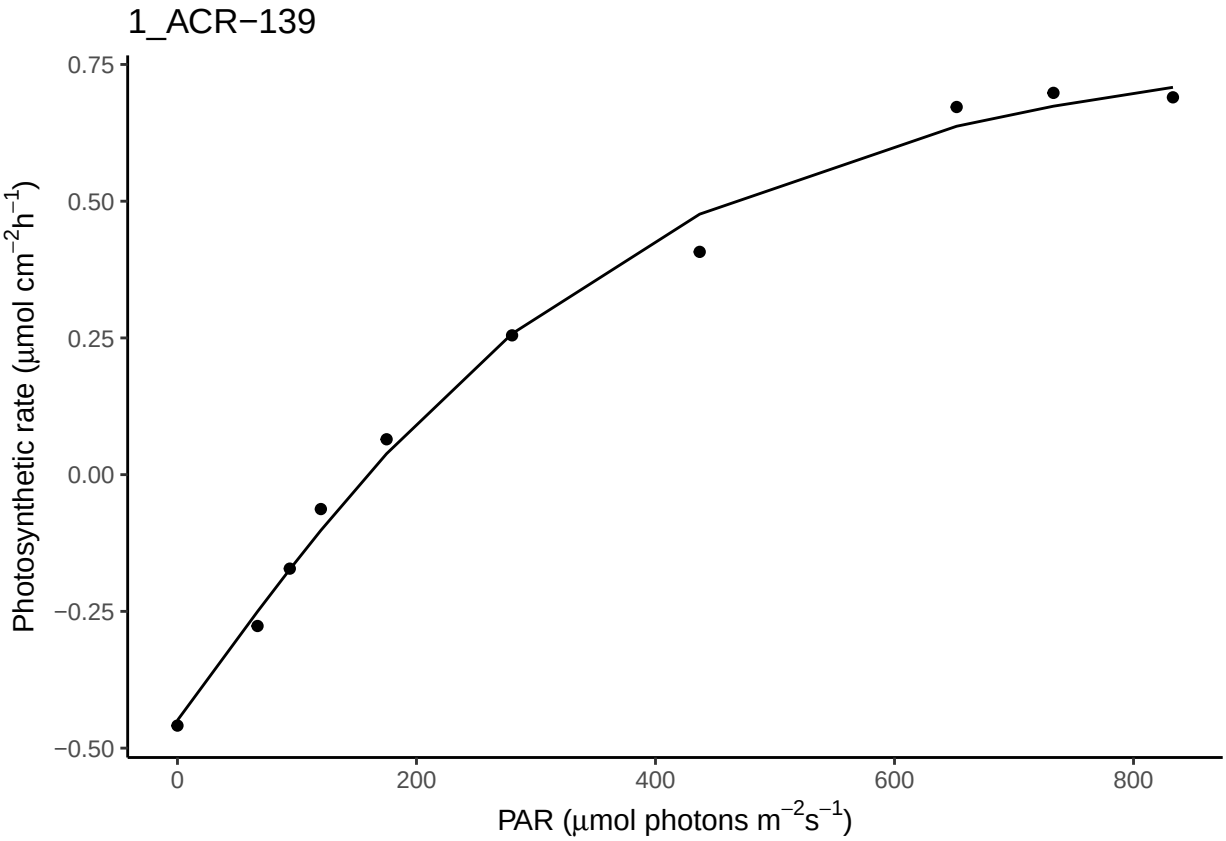

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-173
```



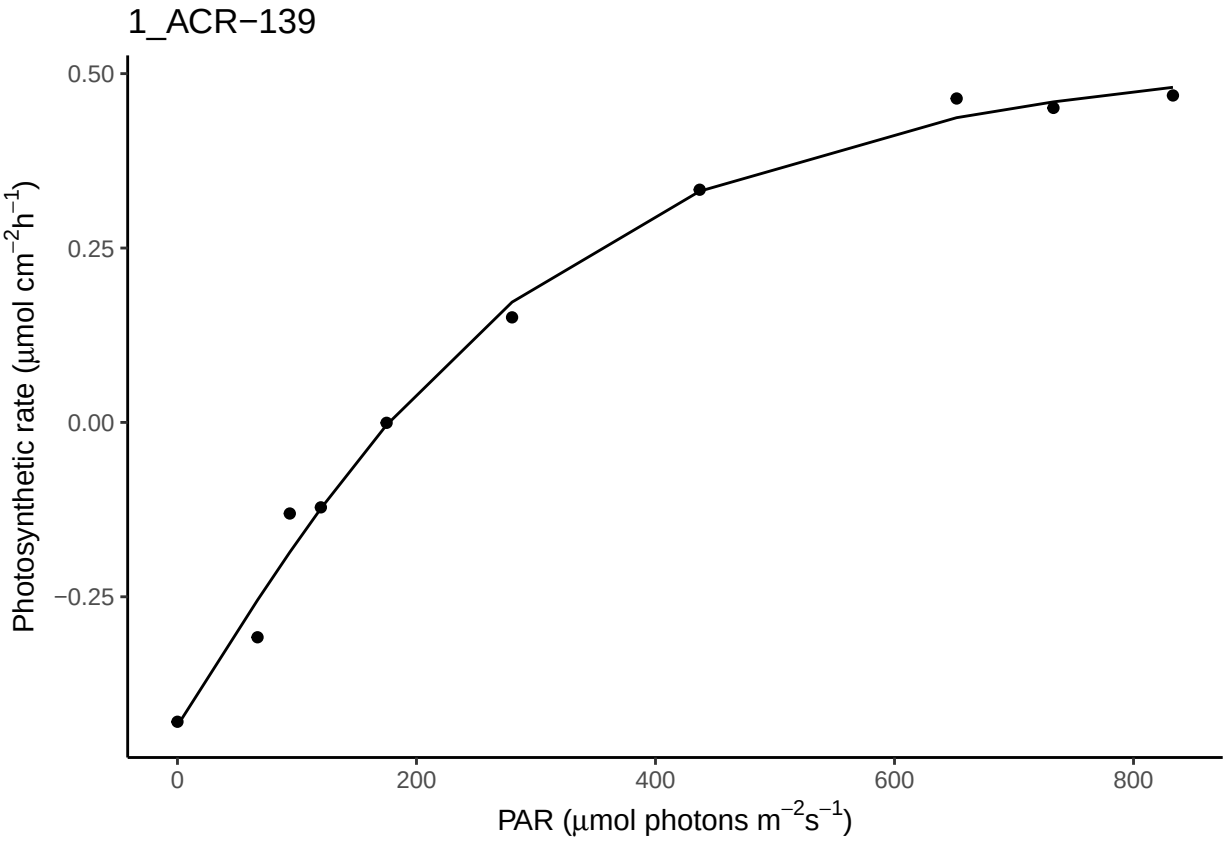

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-175
```



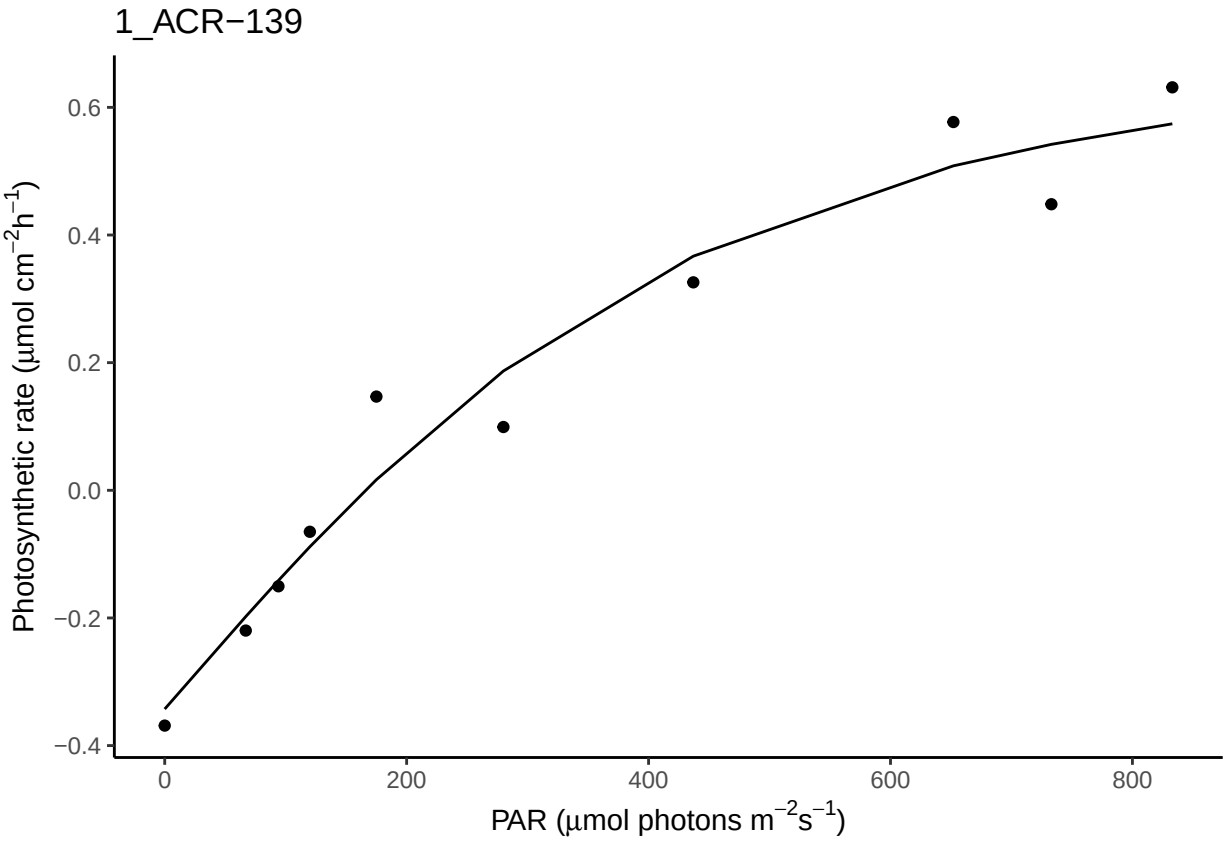

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-176
```



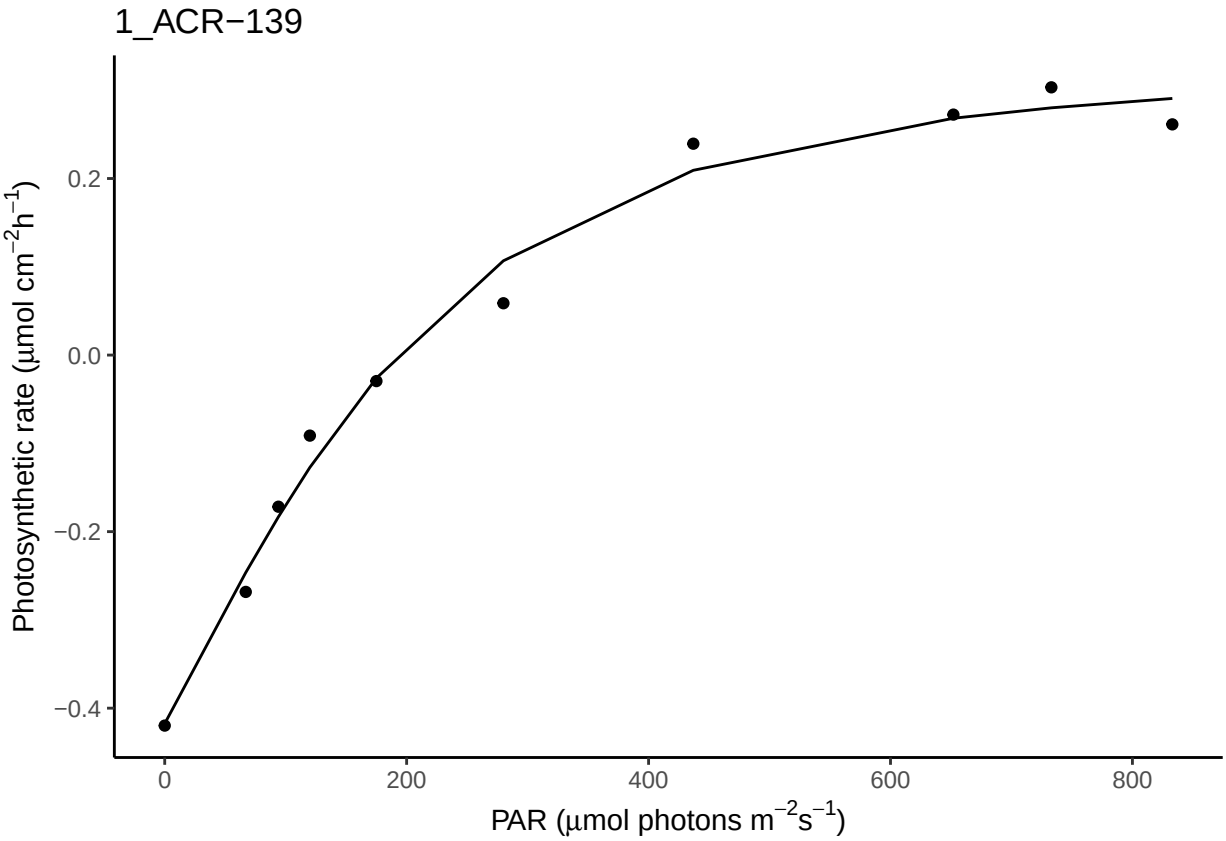

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-180
```



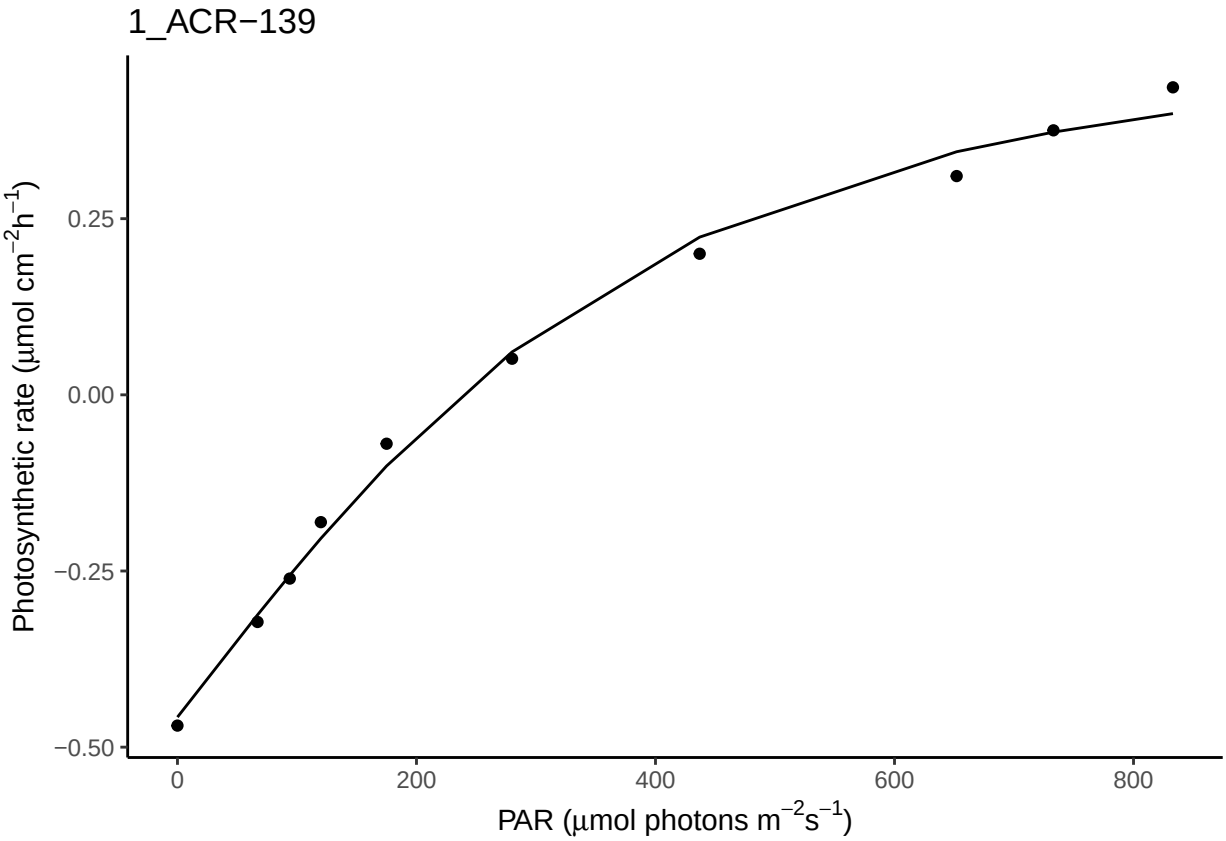

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-185
```



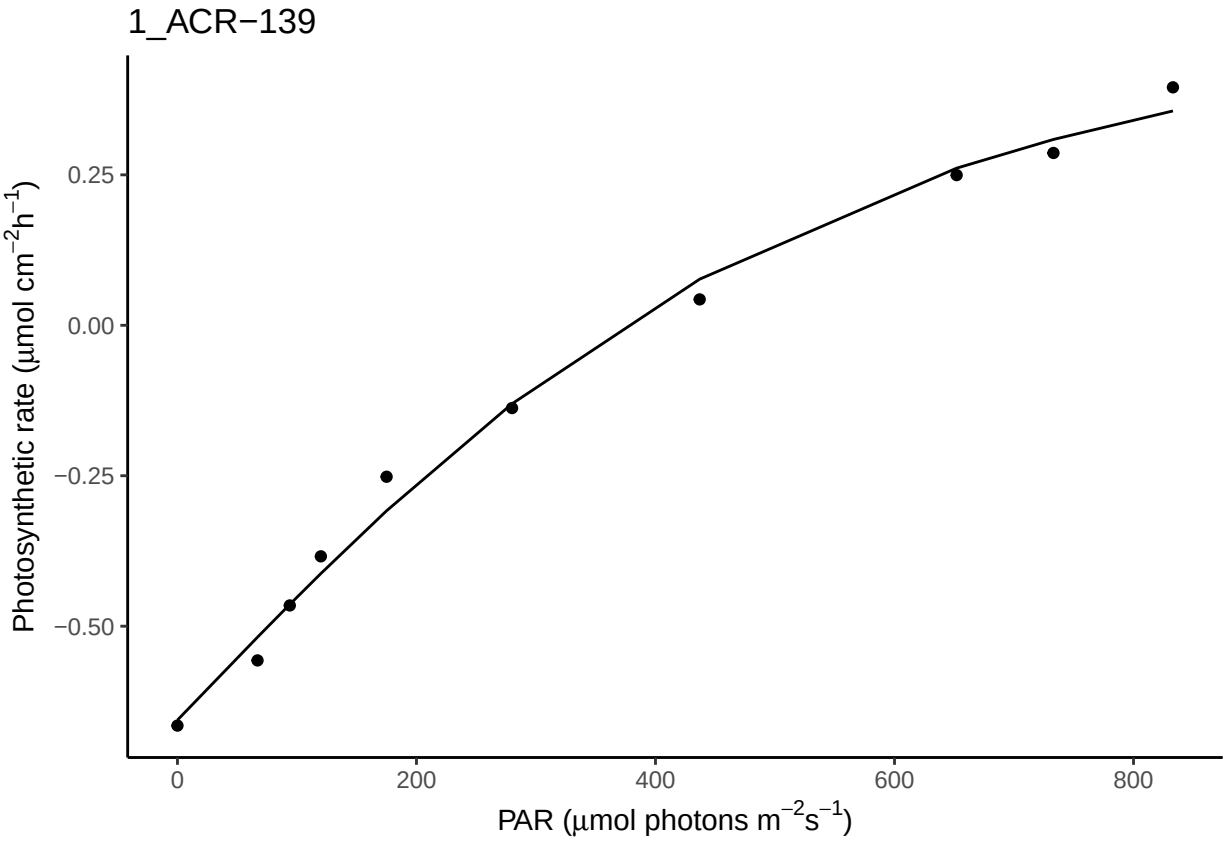

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-186
```



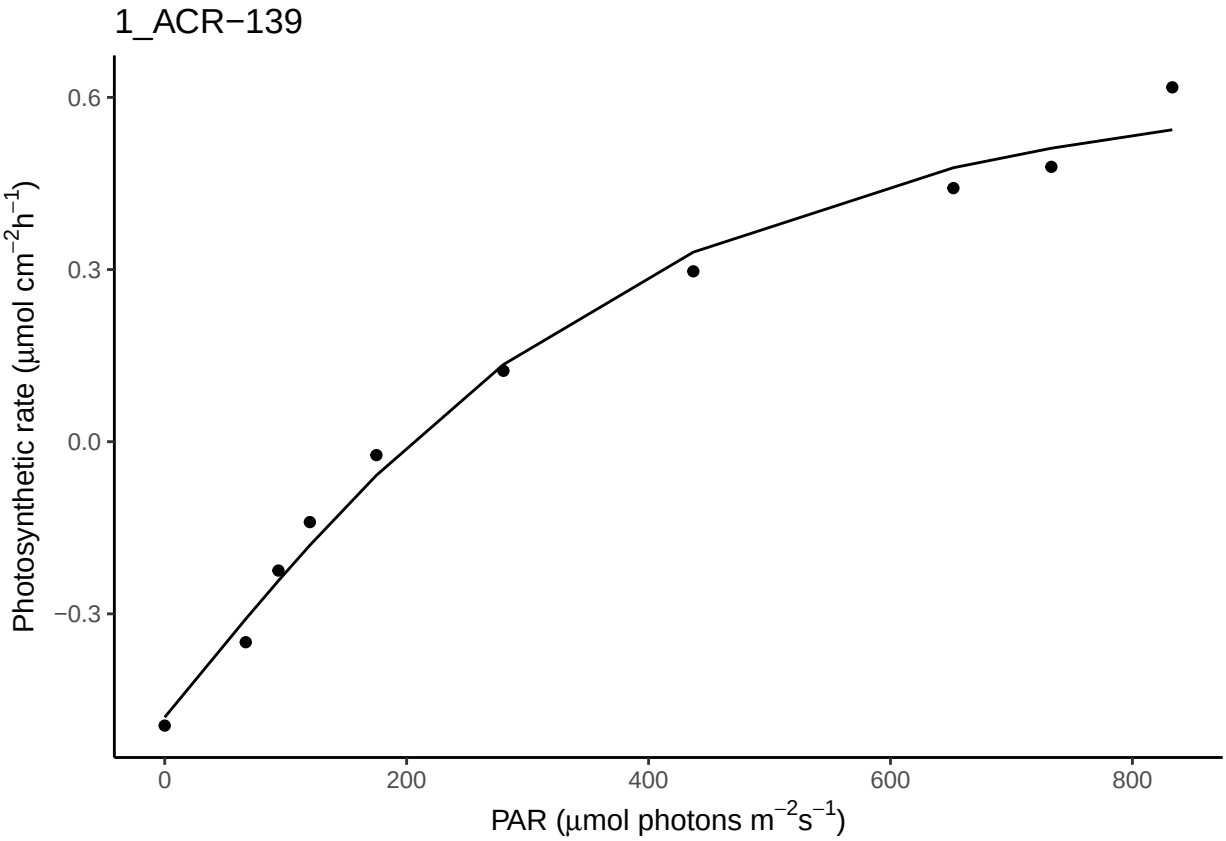

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-187
```



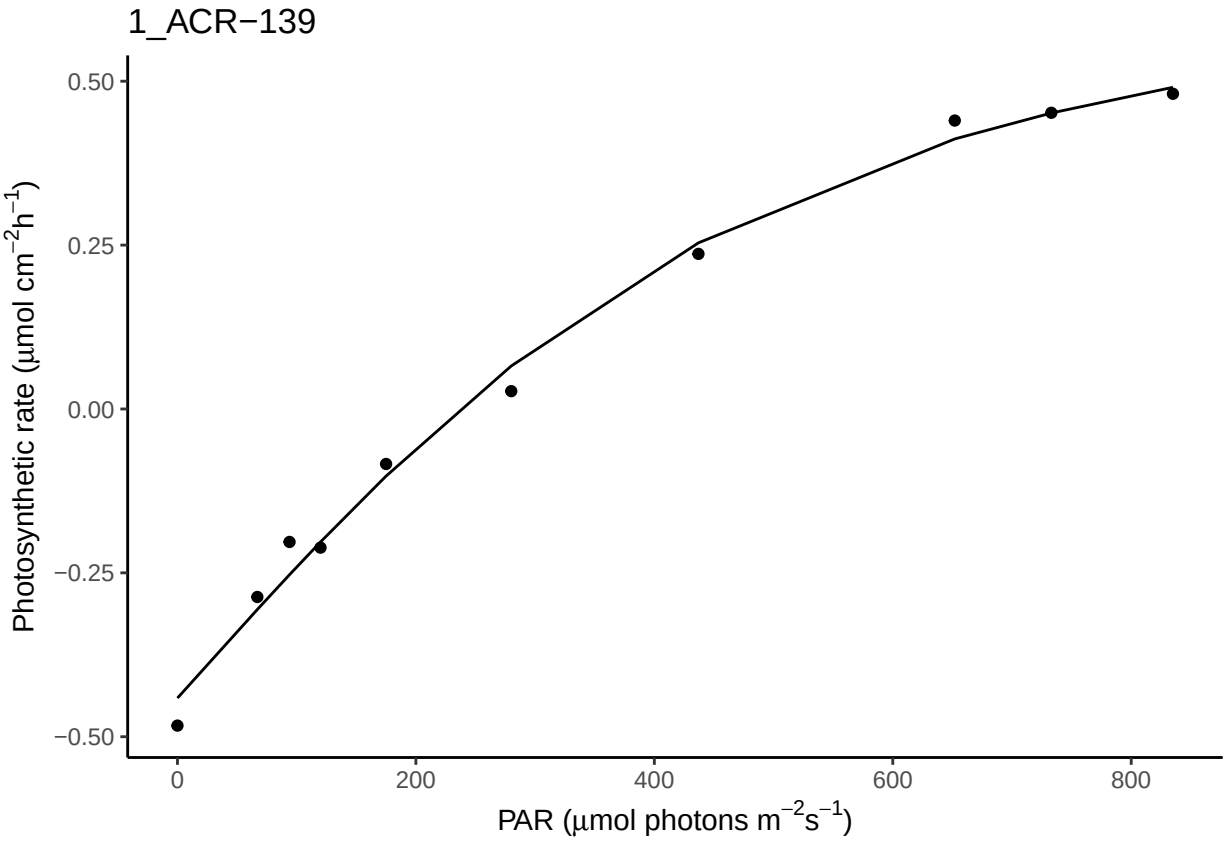

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-190
```



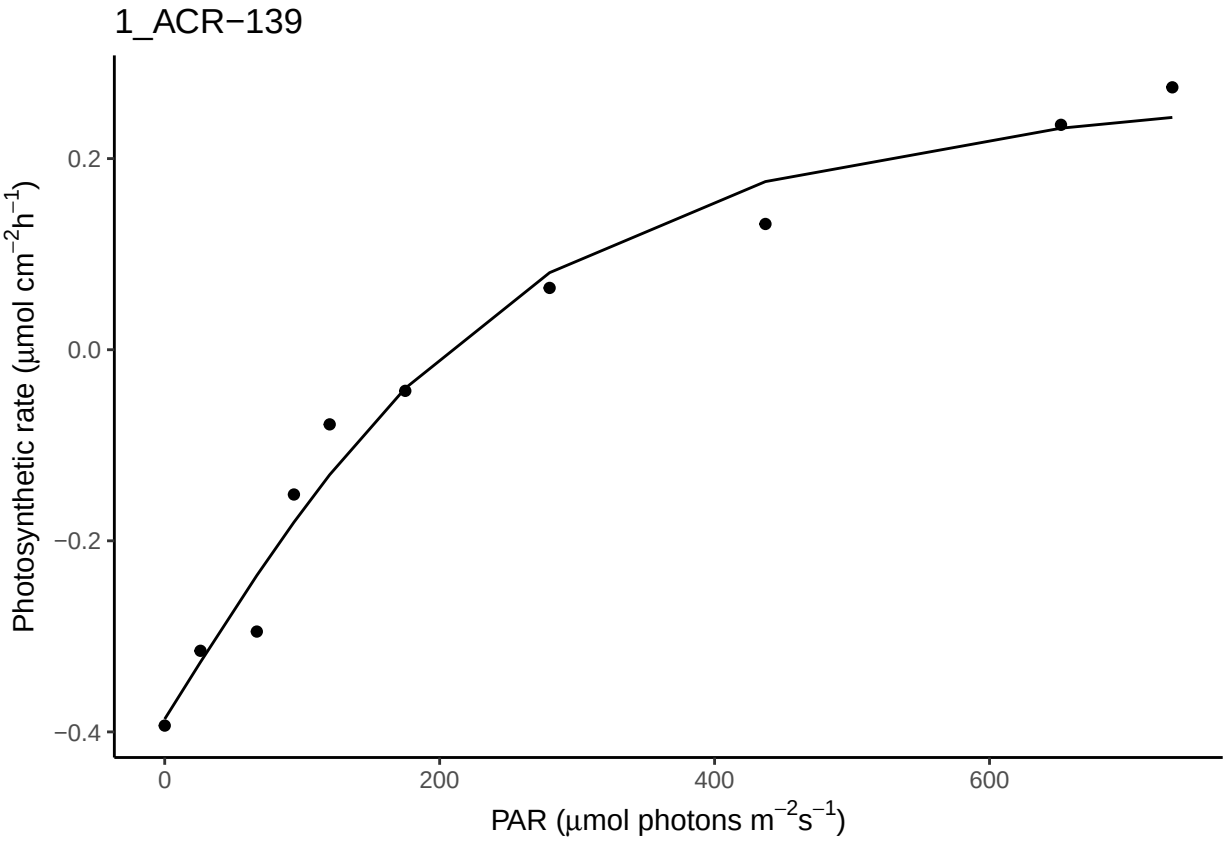

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-193
```



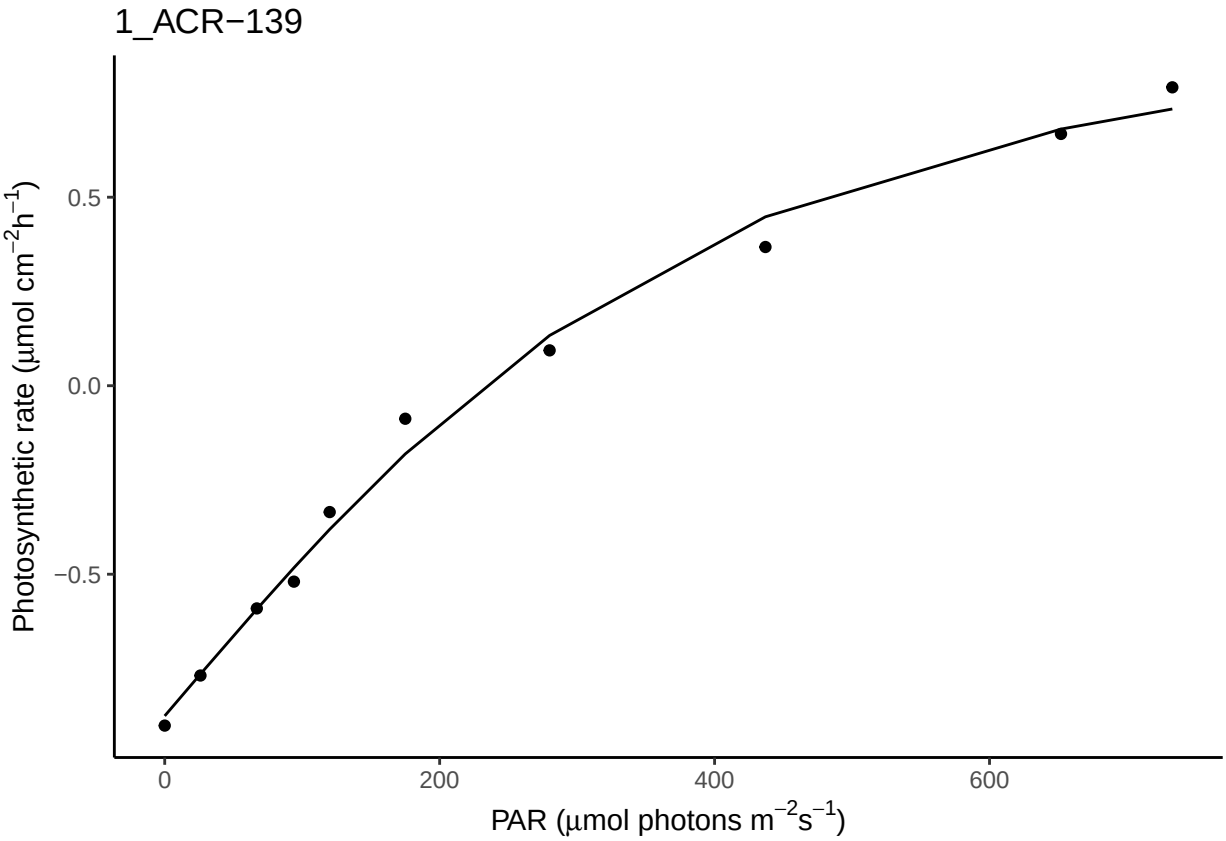

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-225
```



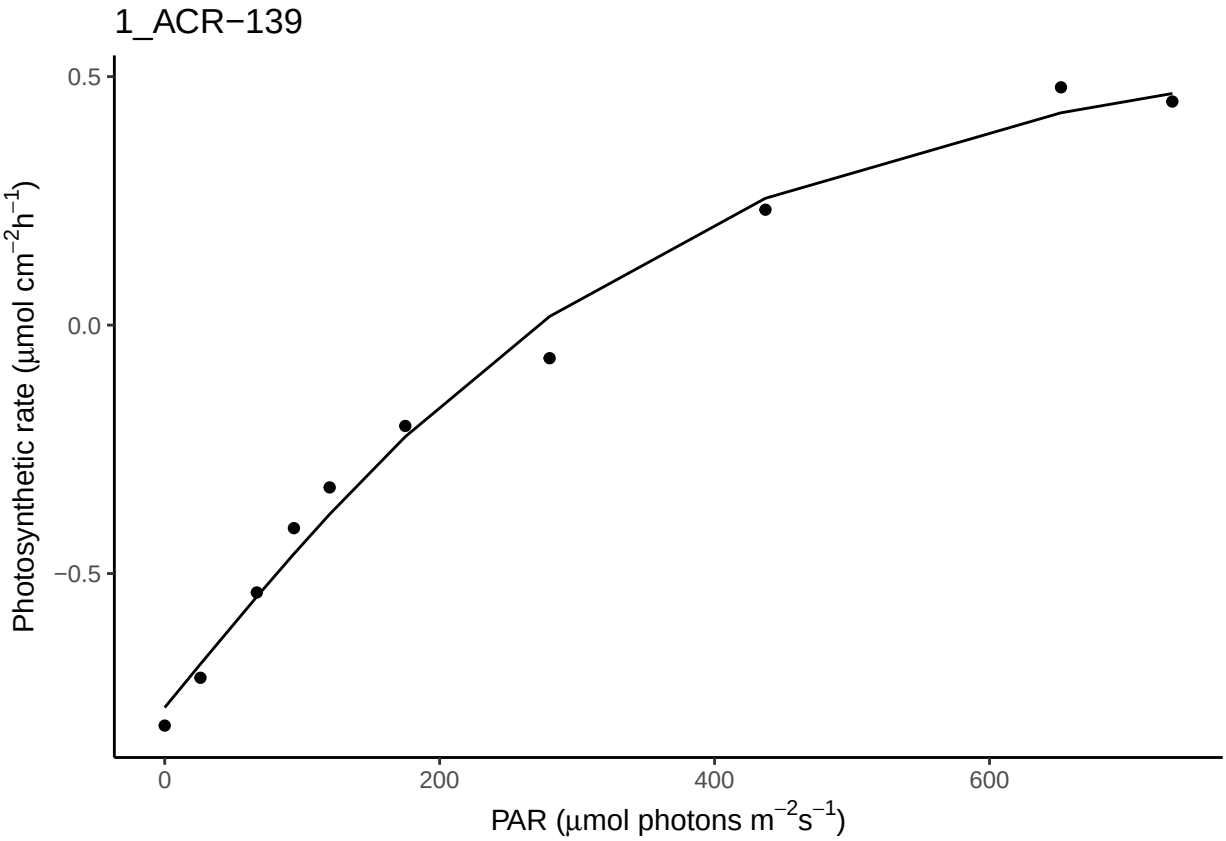

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-228
```



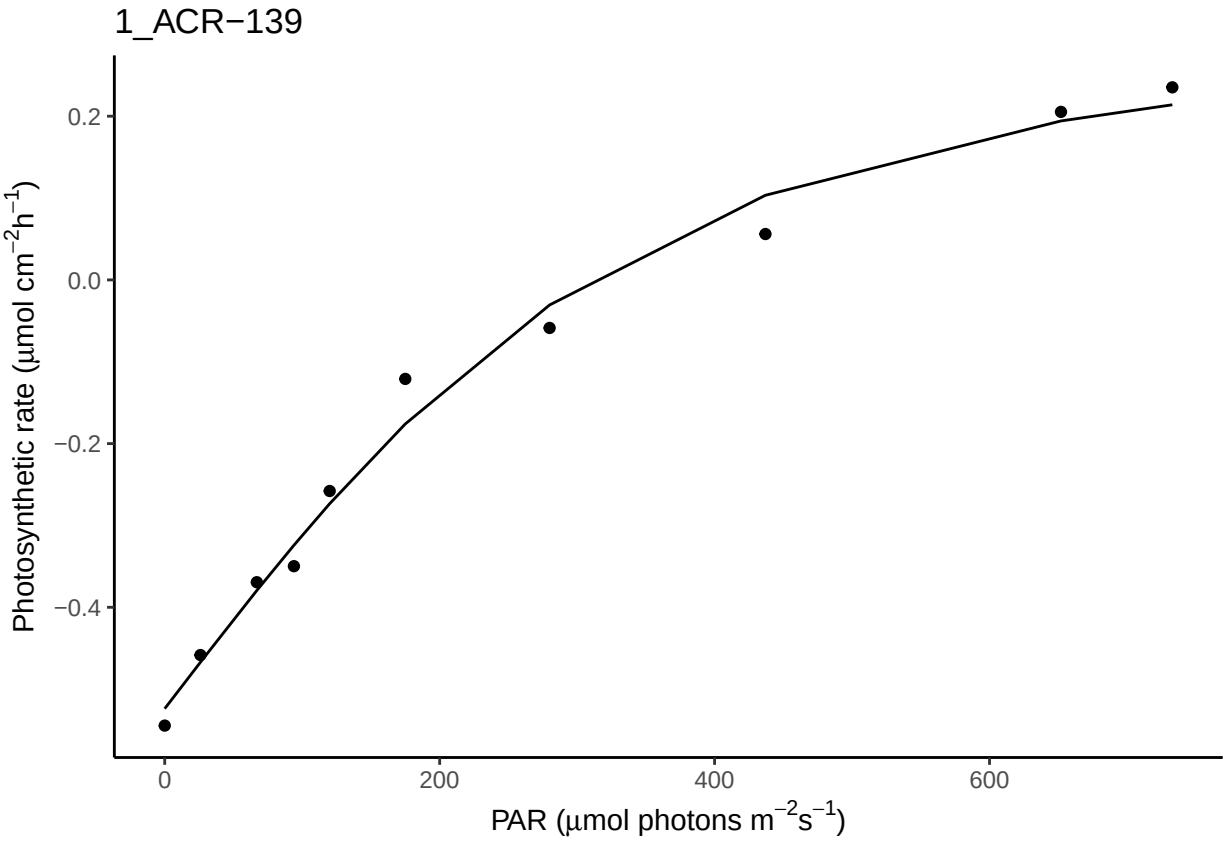

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-229
```



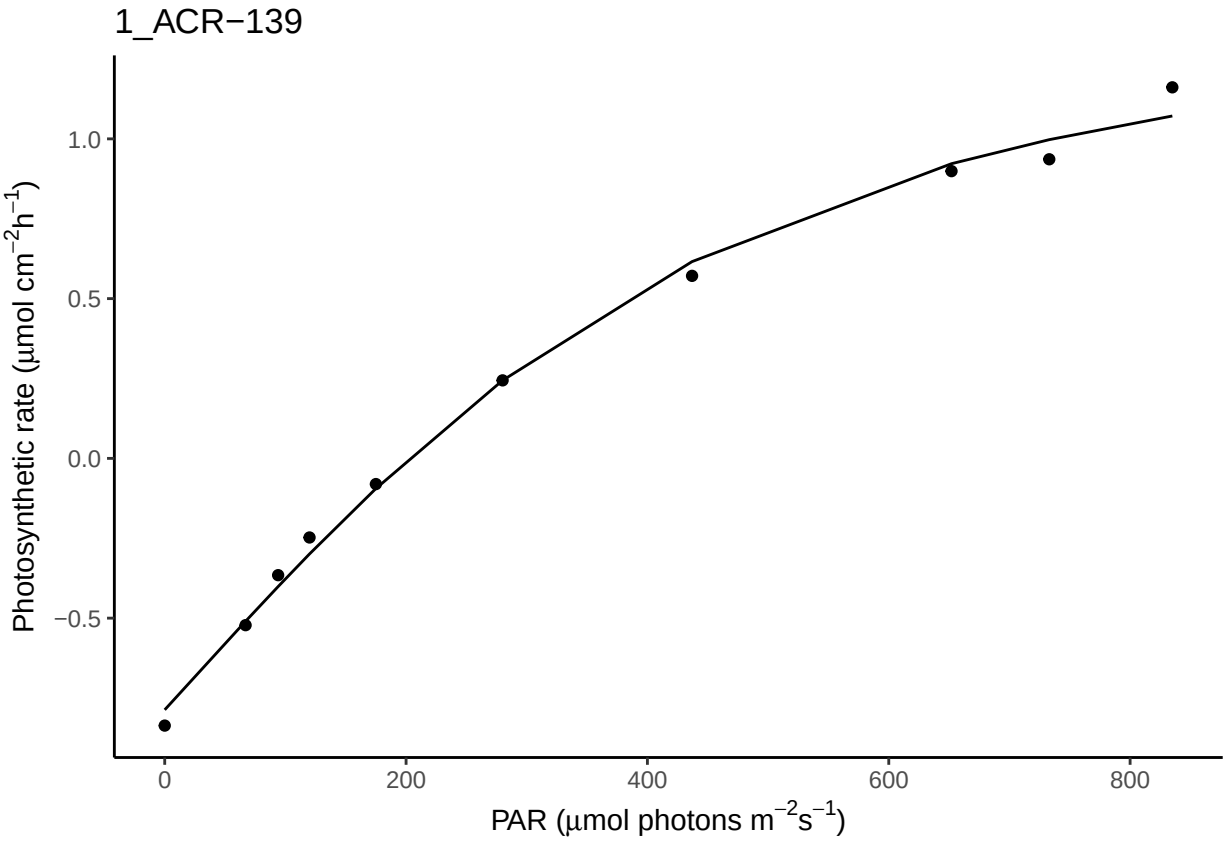

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-231
```



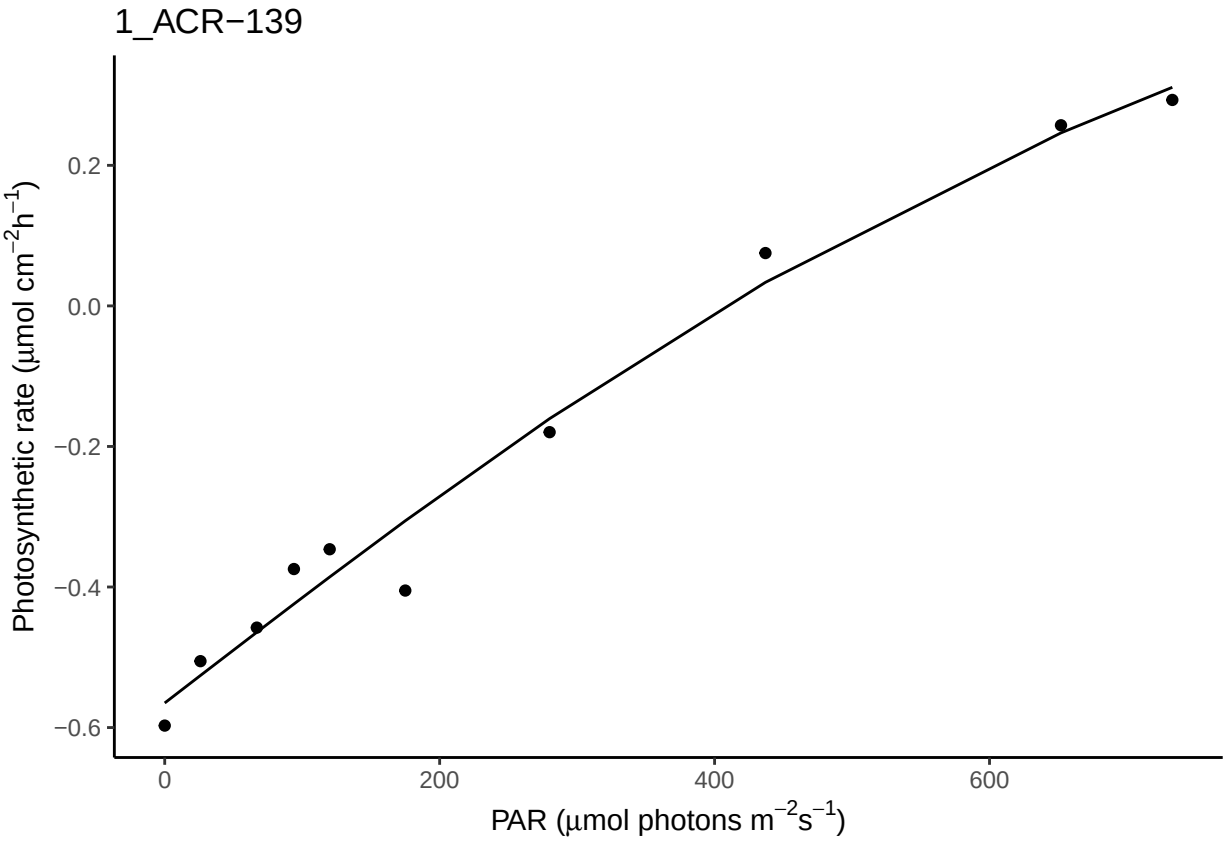

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-234
```



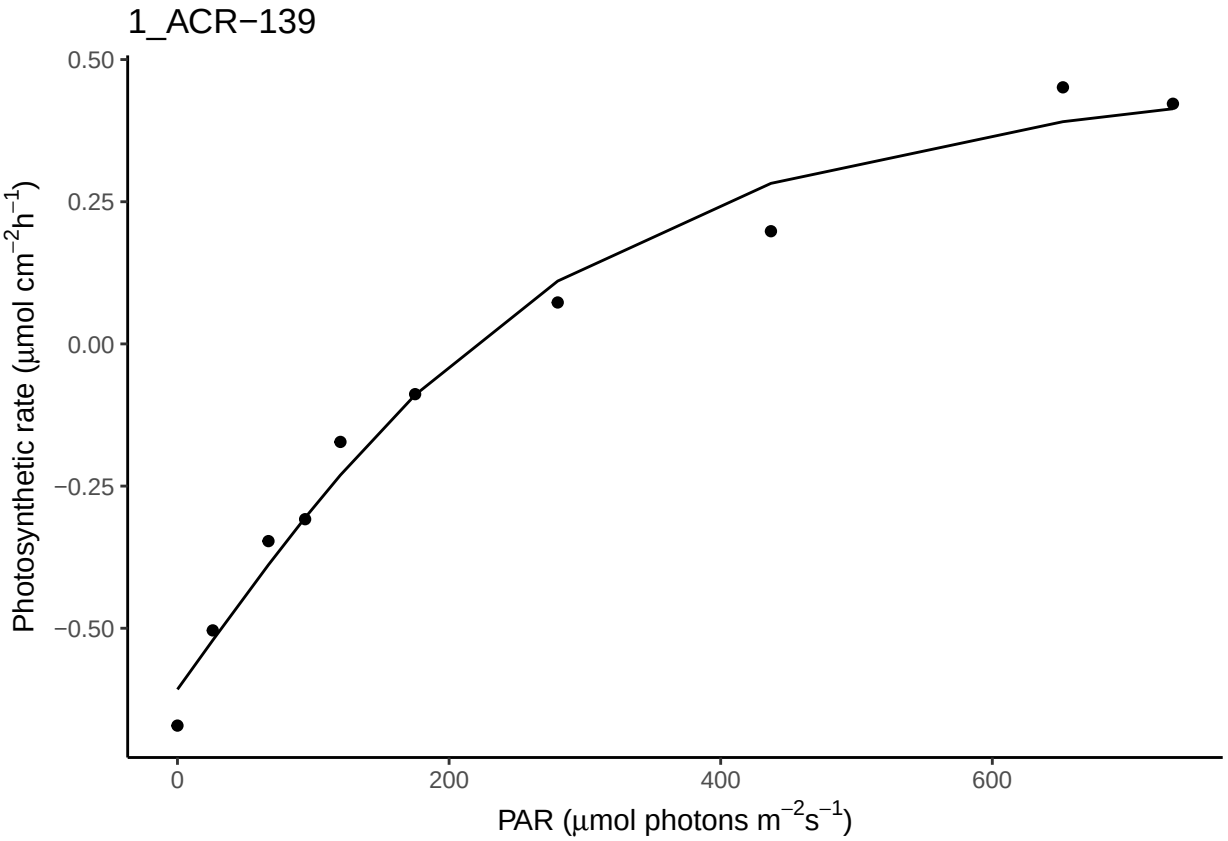

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-237
```



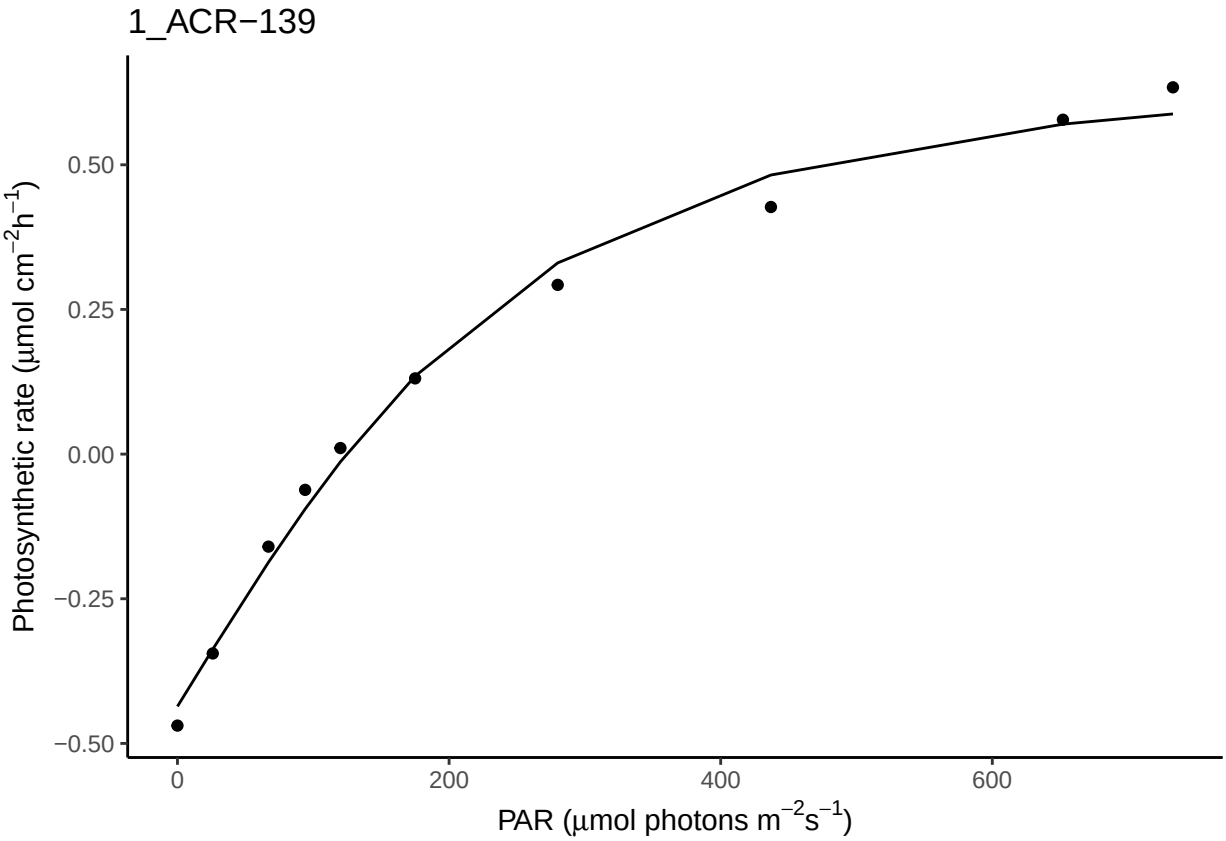

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-243
```



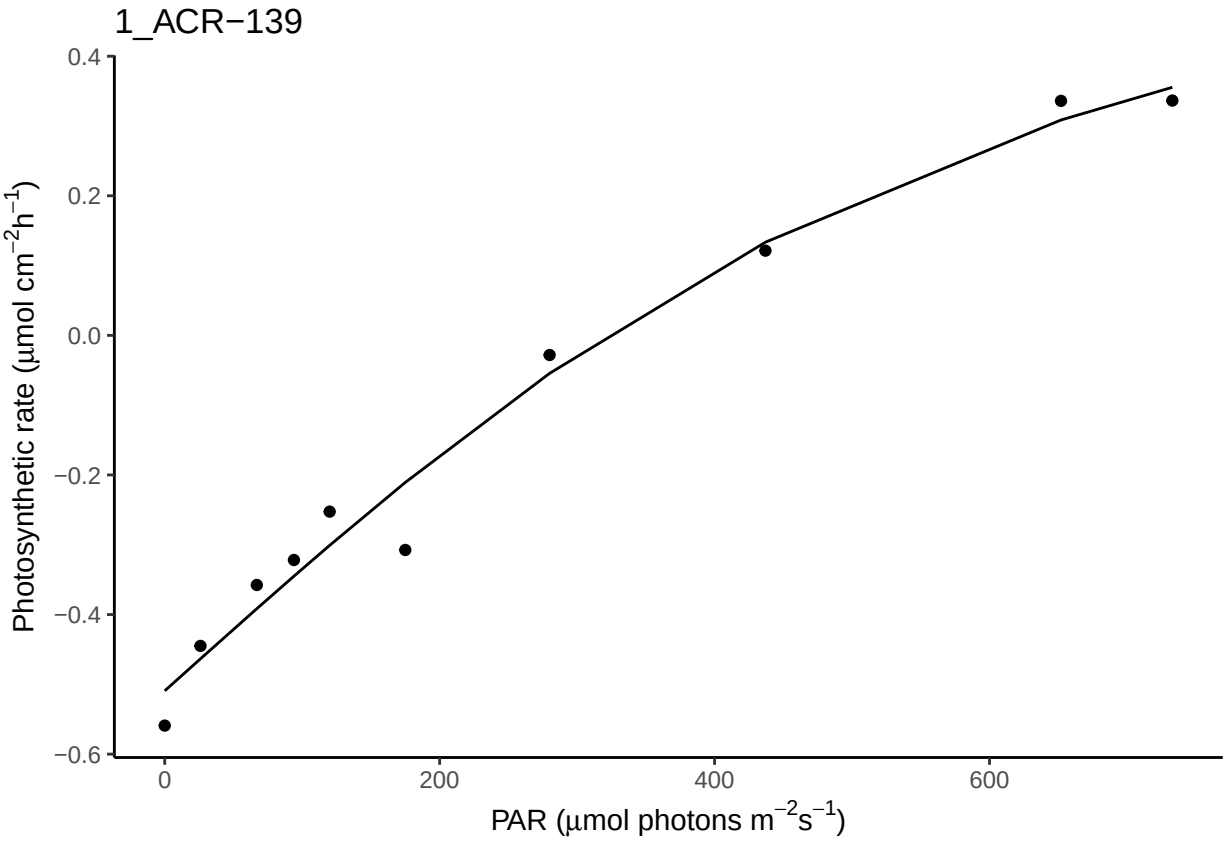

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-244
```



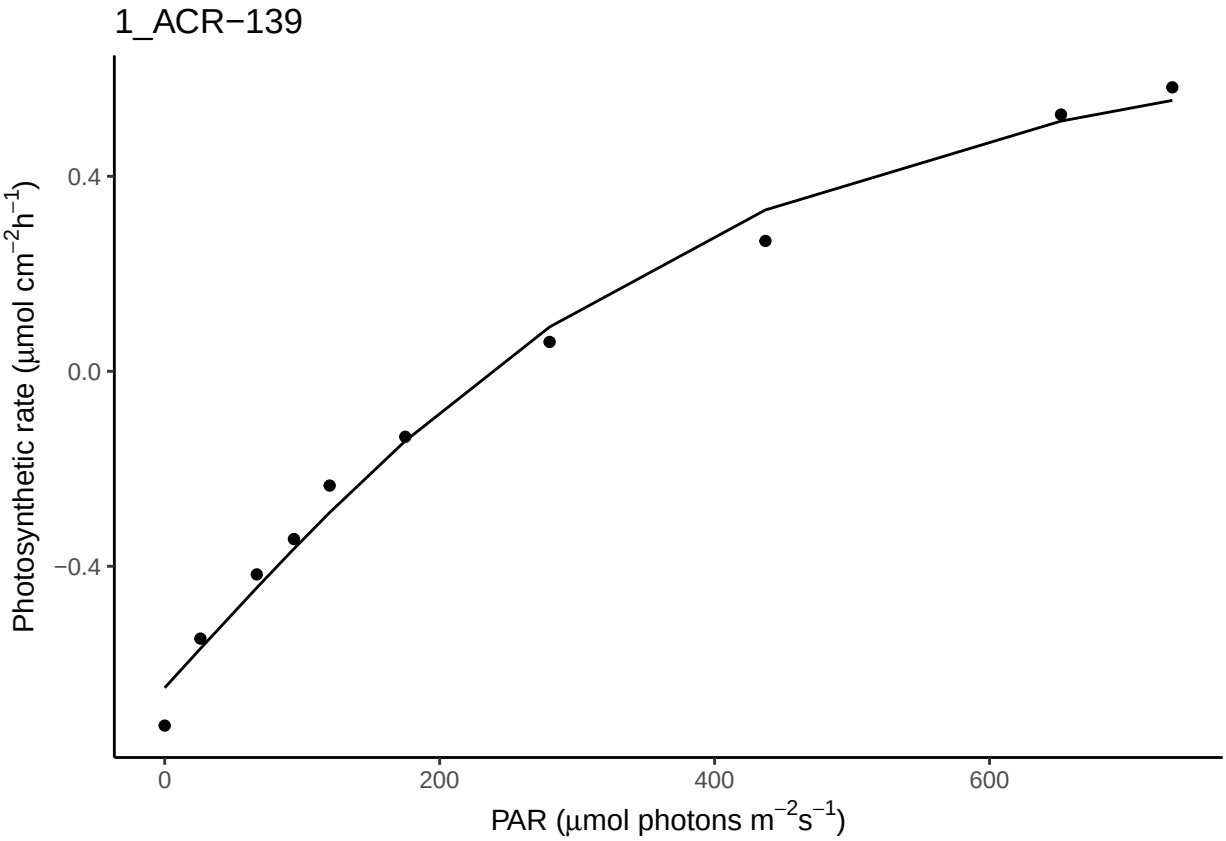

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-246
```



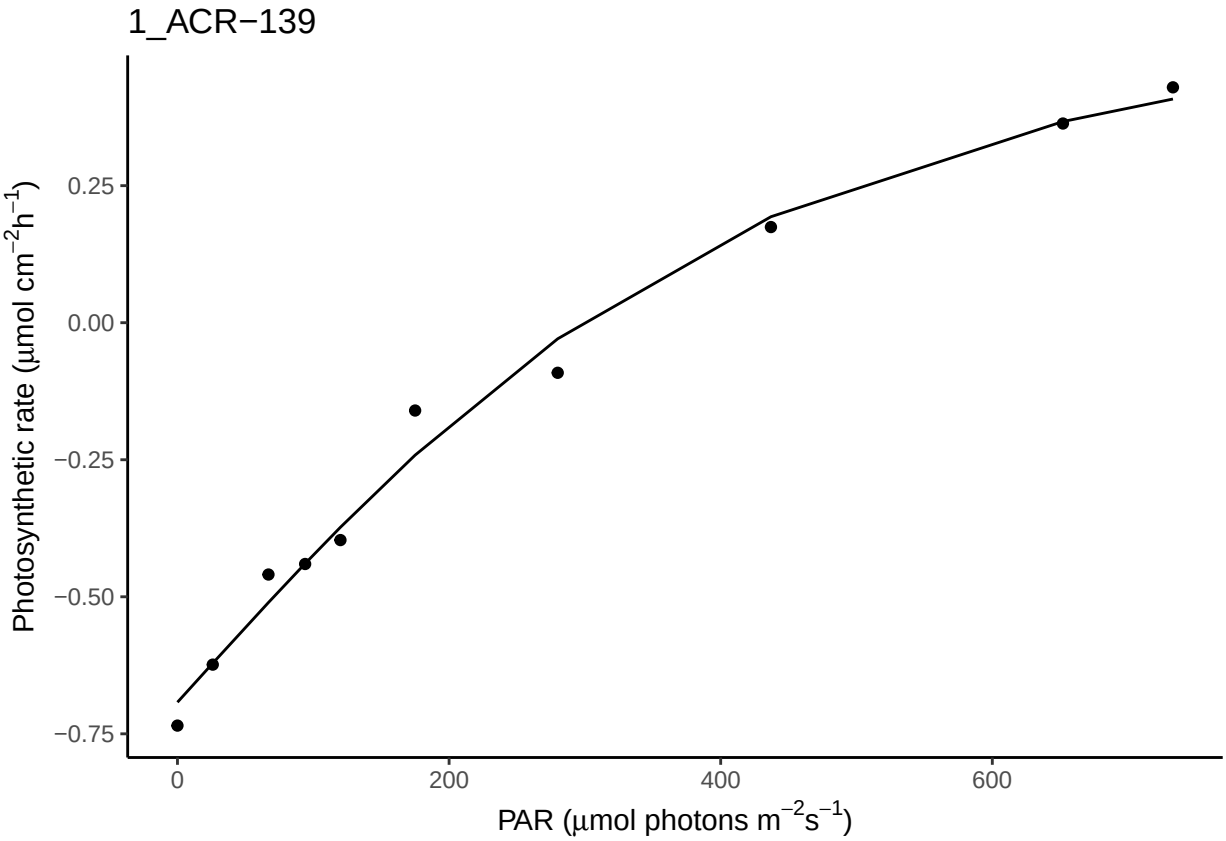

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-247
```



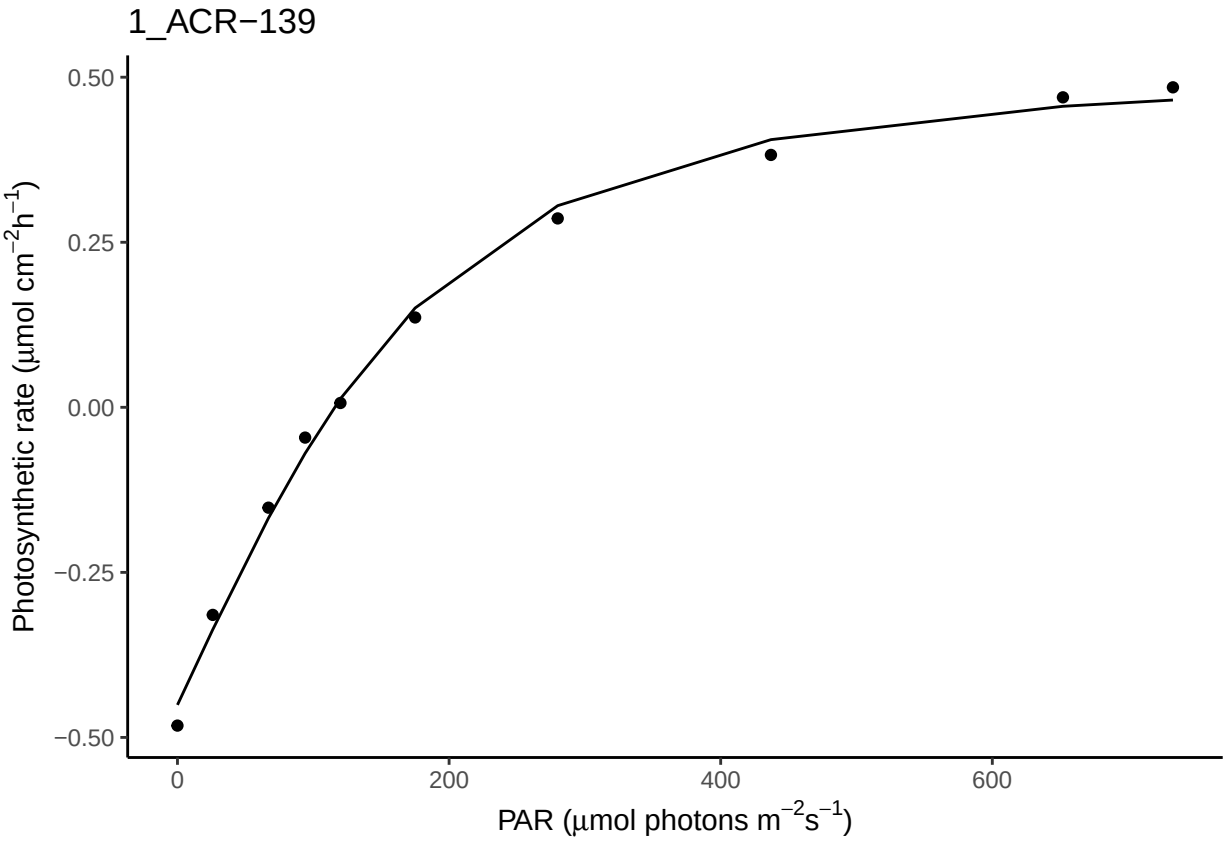

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-256
```



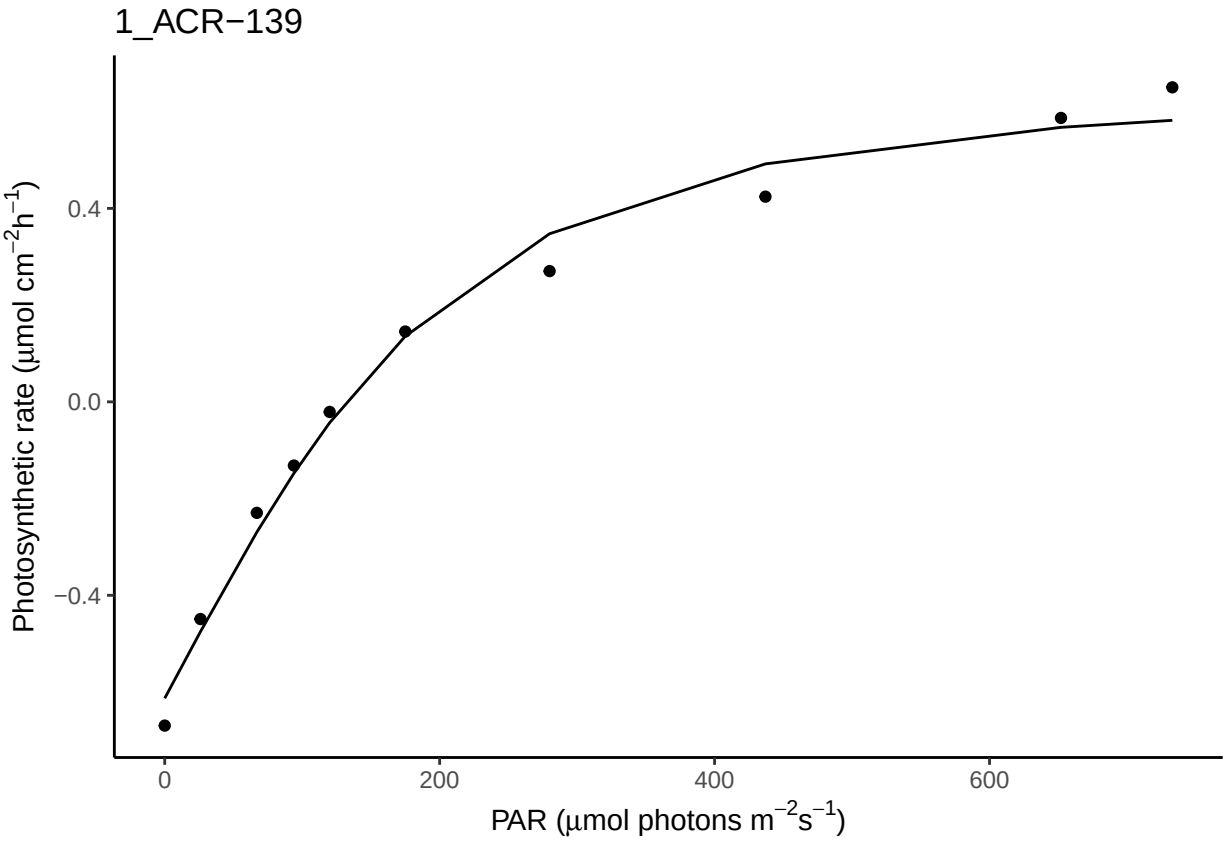

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-258
```



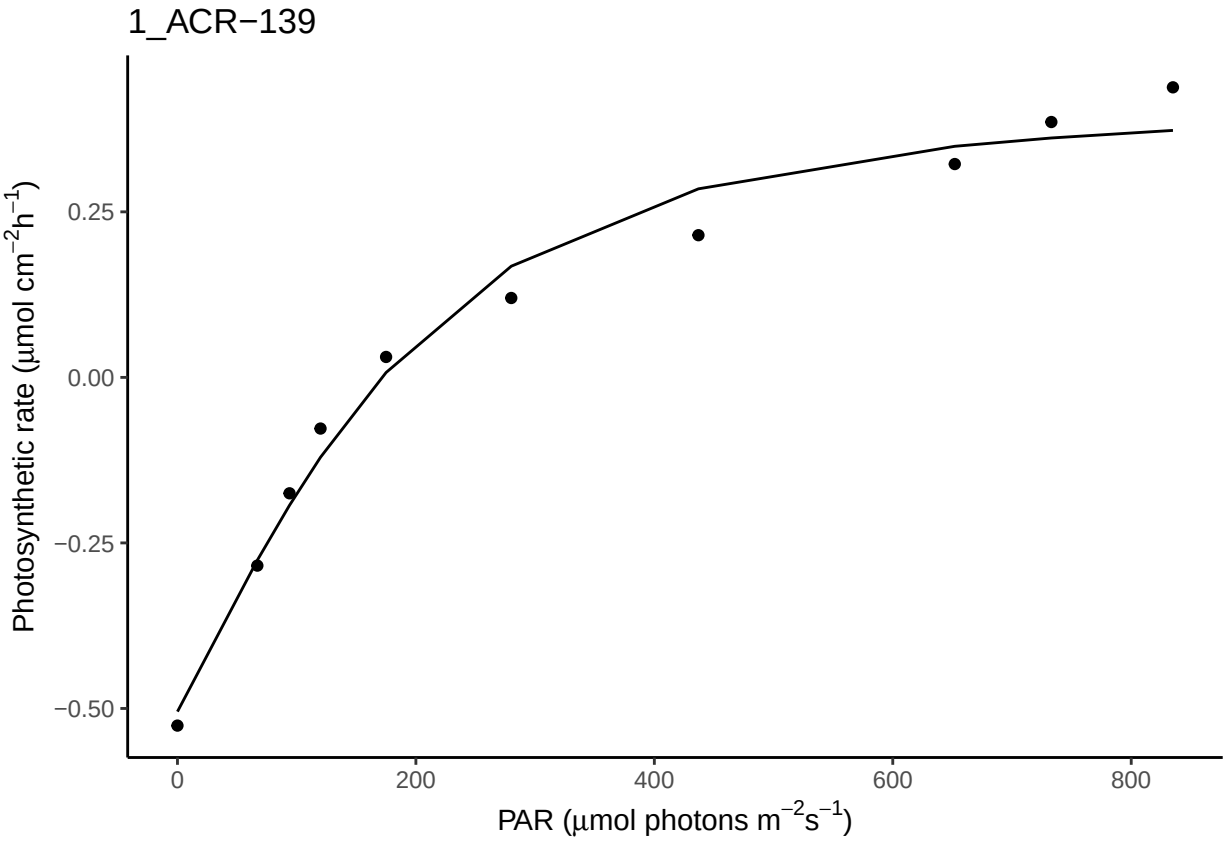

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-265
```



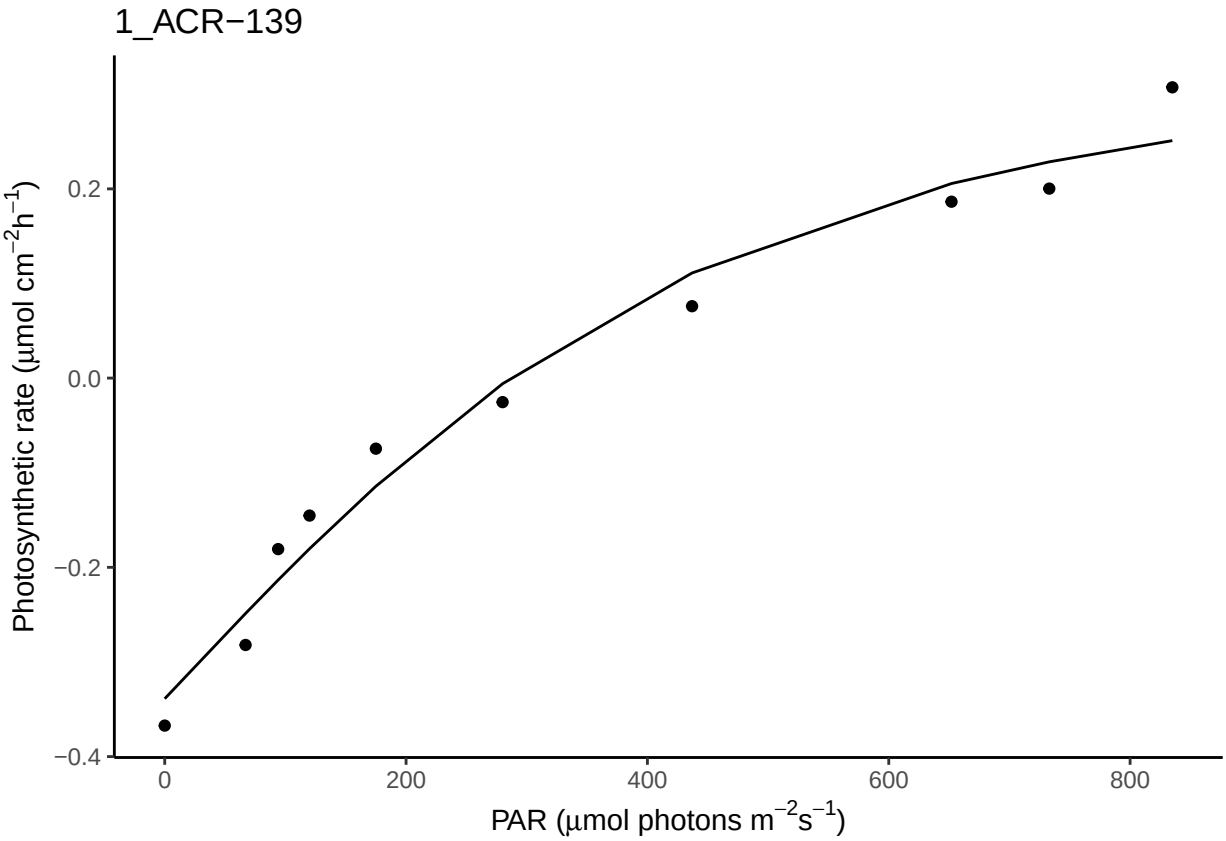

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-267
```



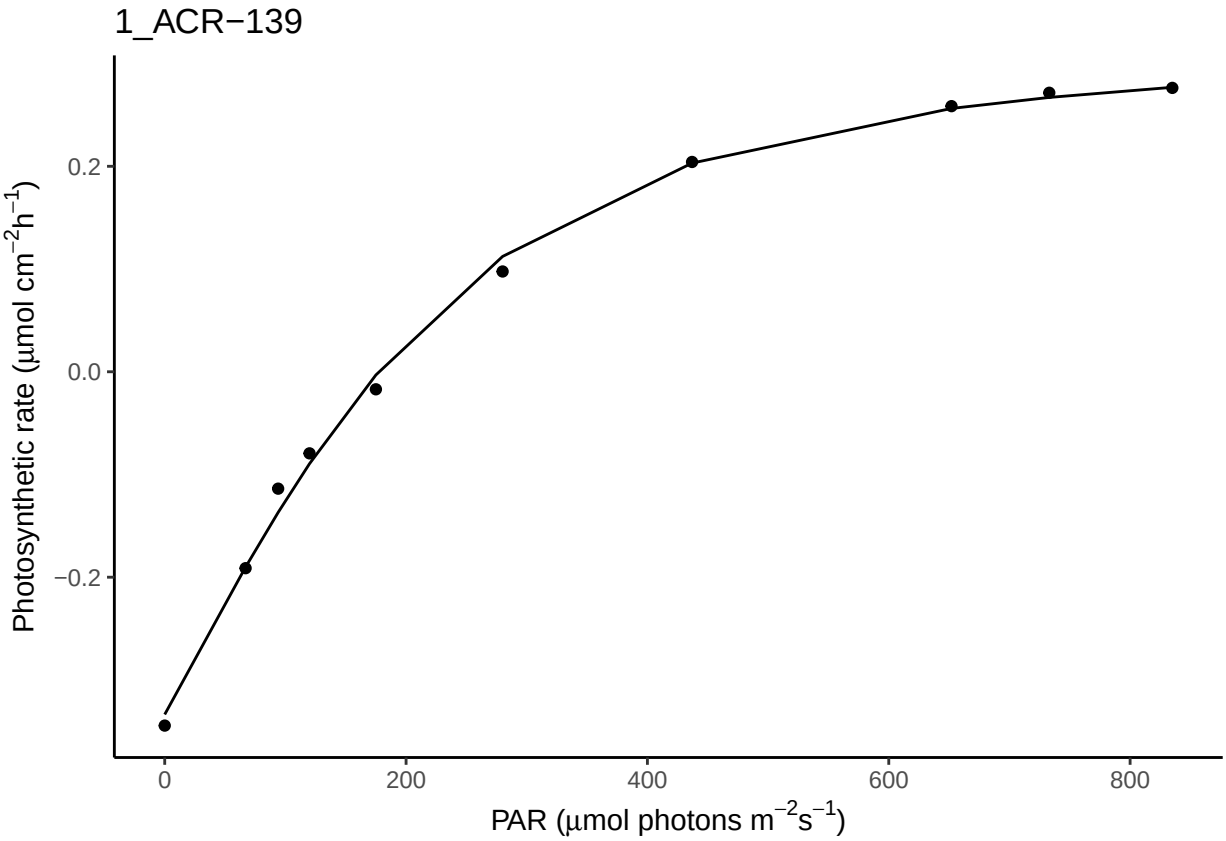

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-343
```



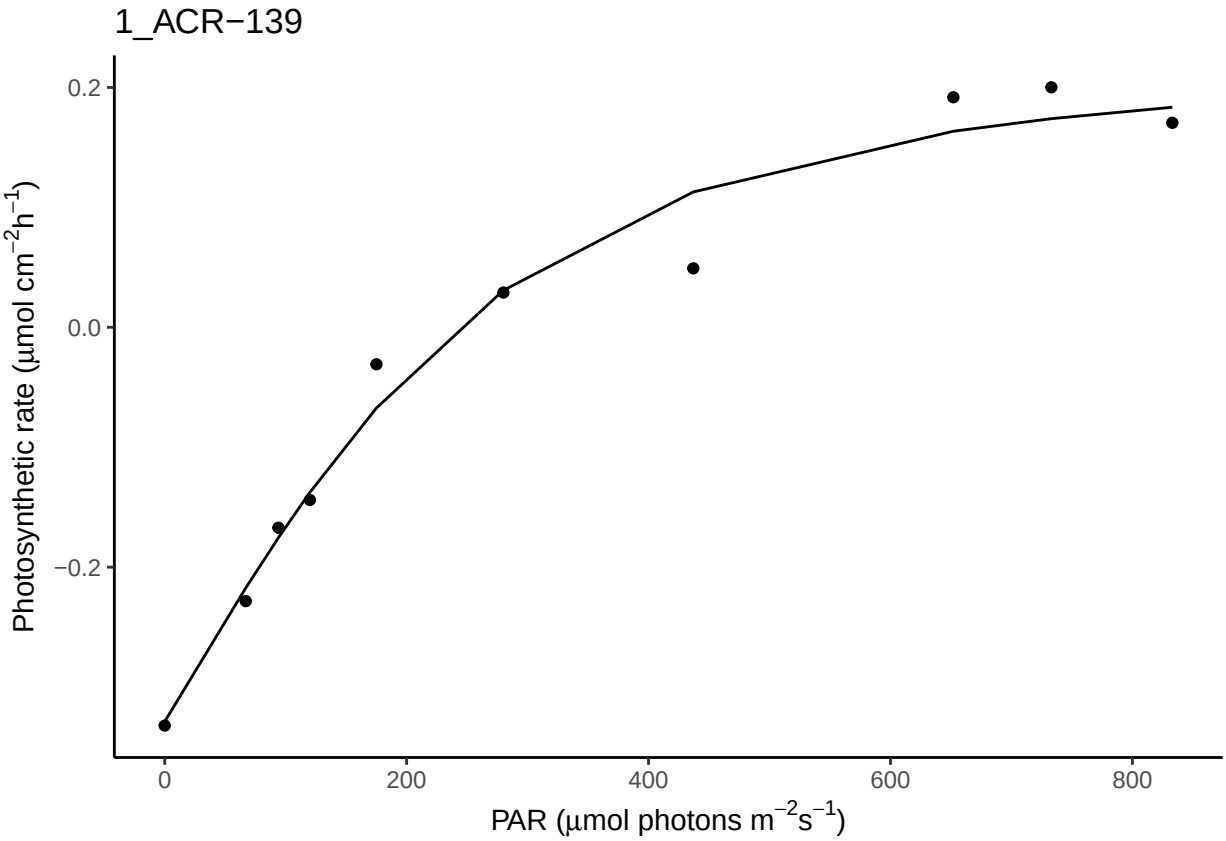

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-345
```



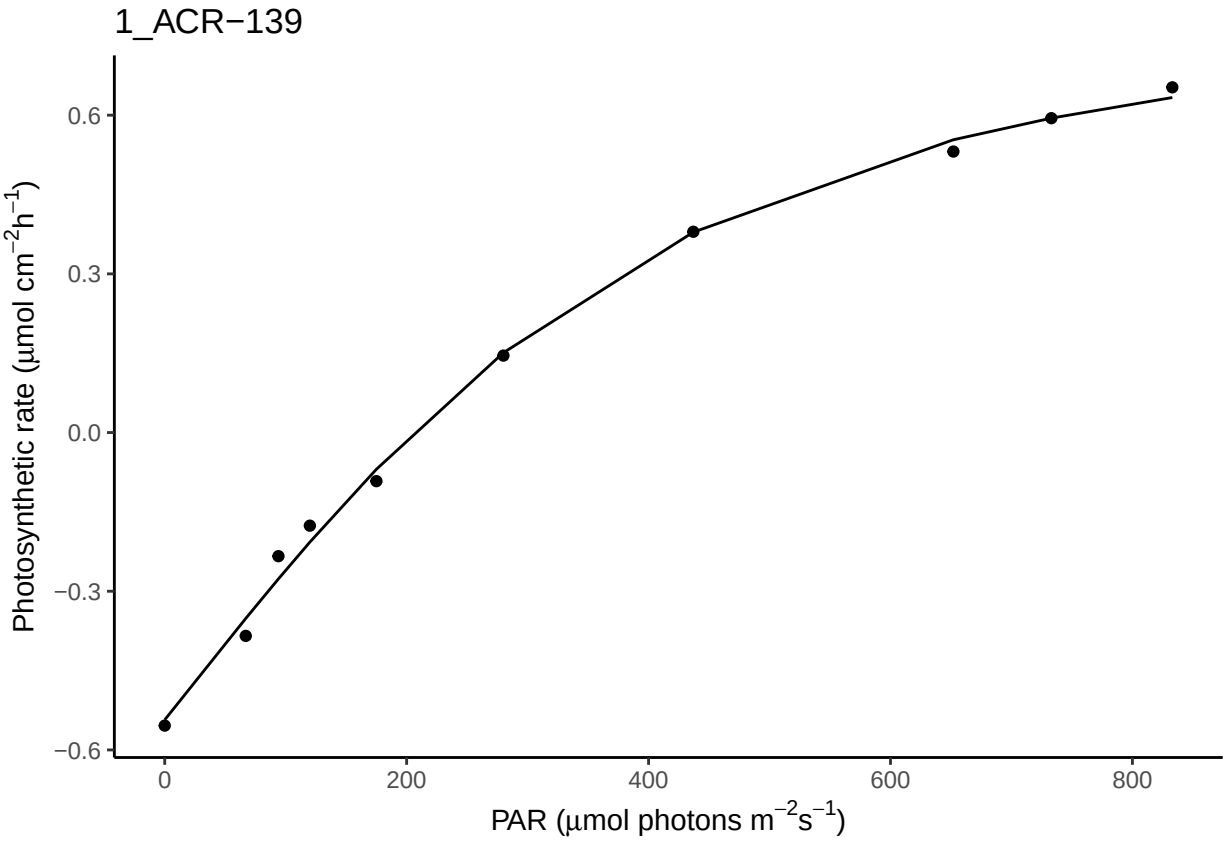

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-350
```



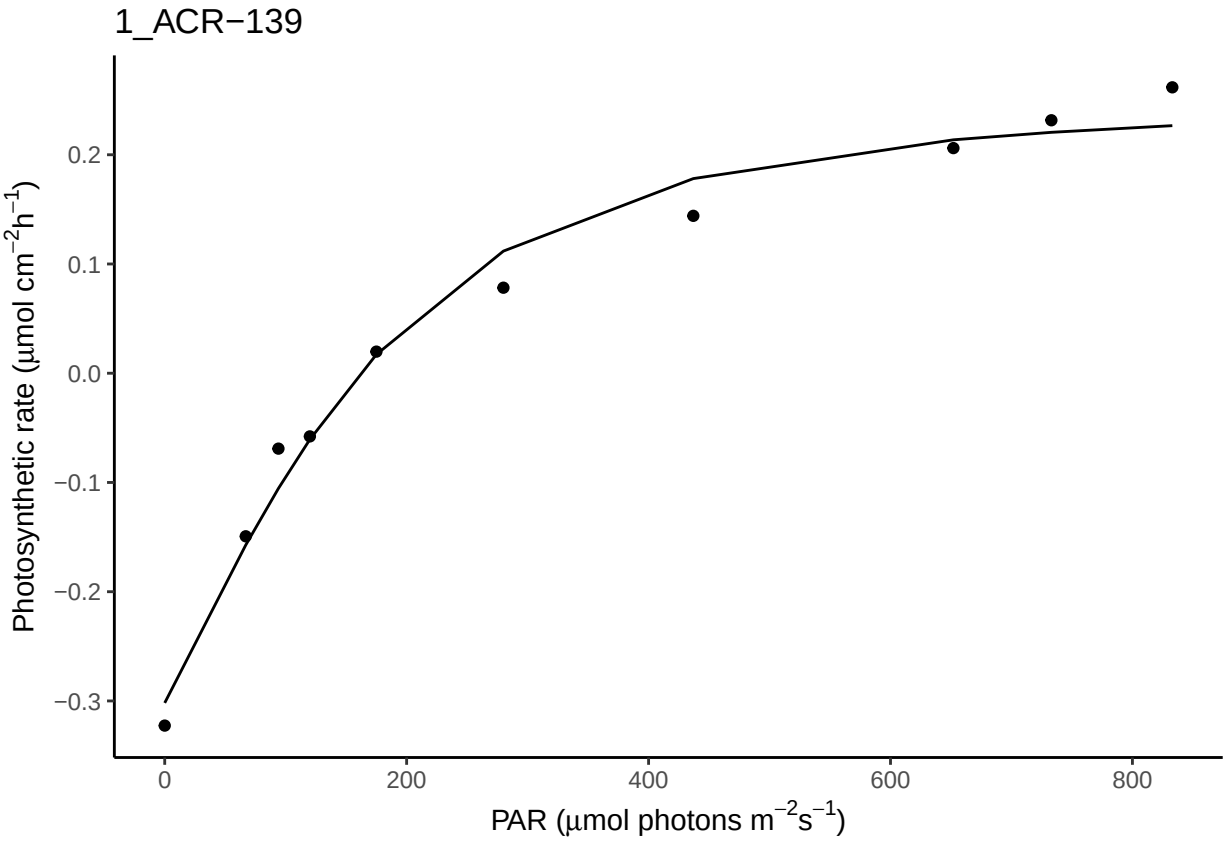

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-351
```



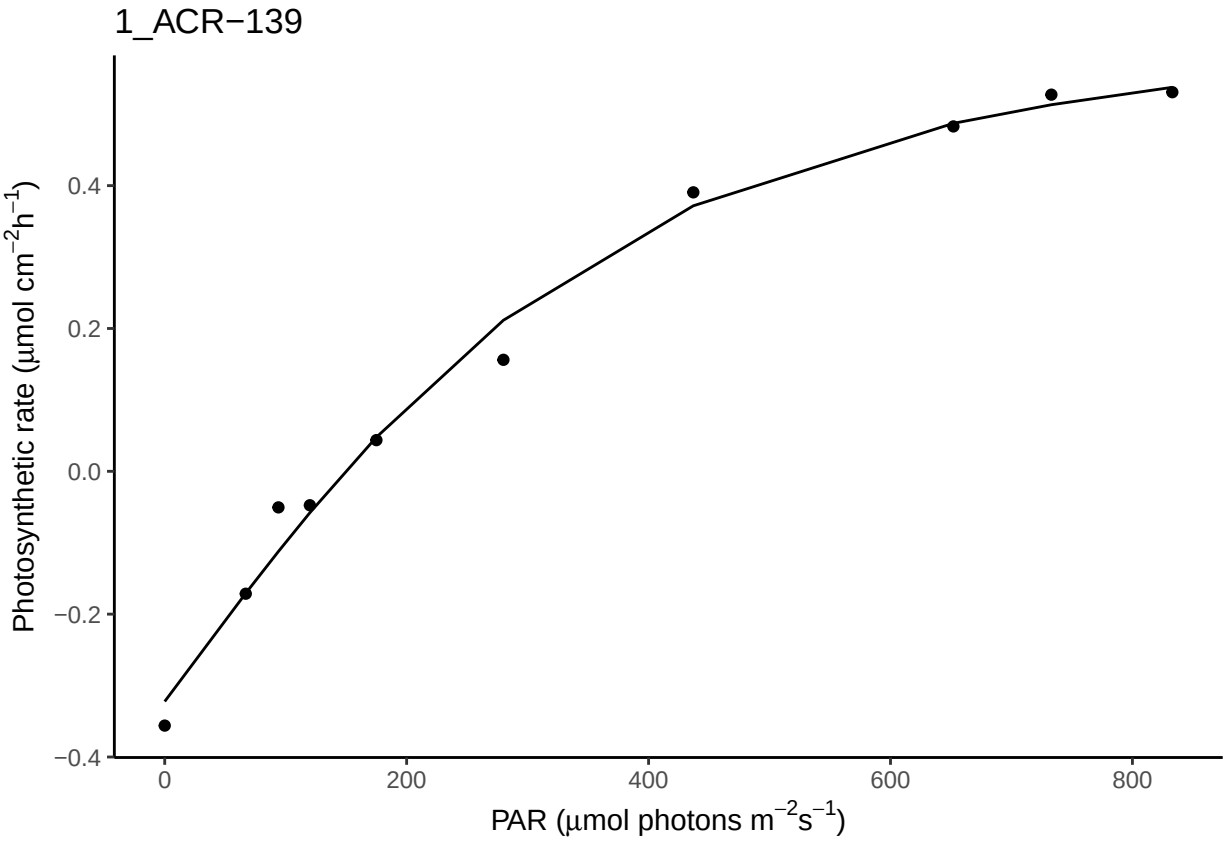

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-363
```



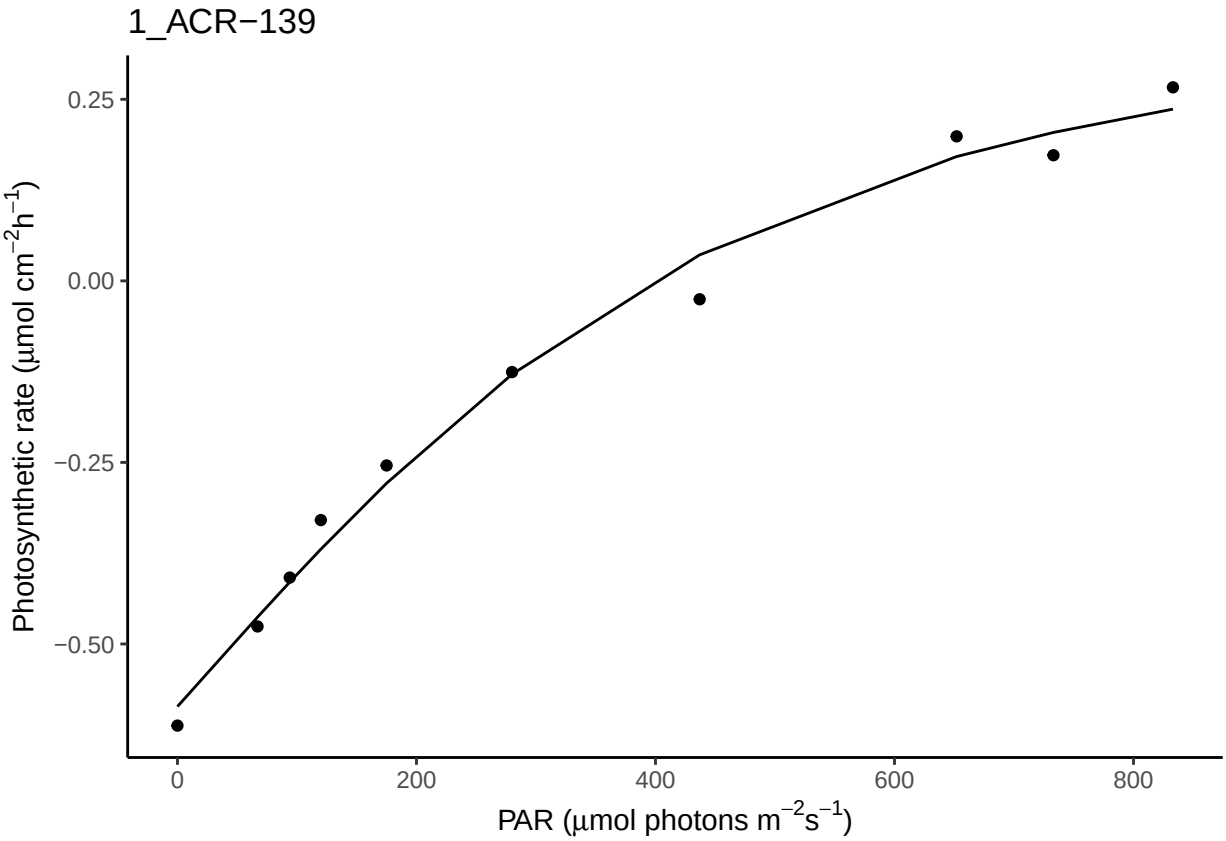

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-364
```



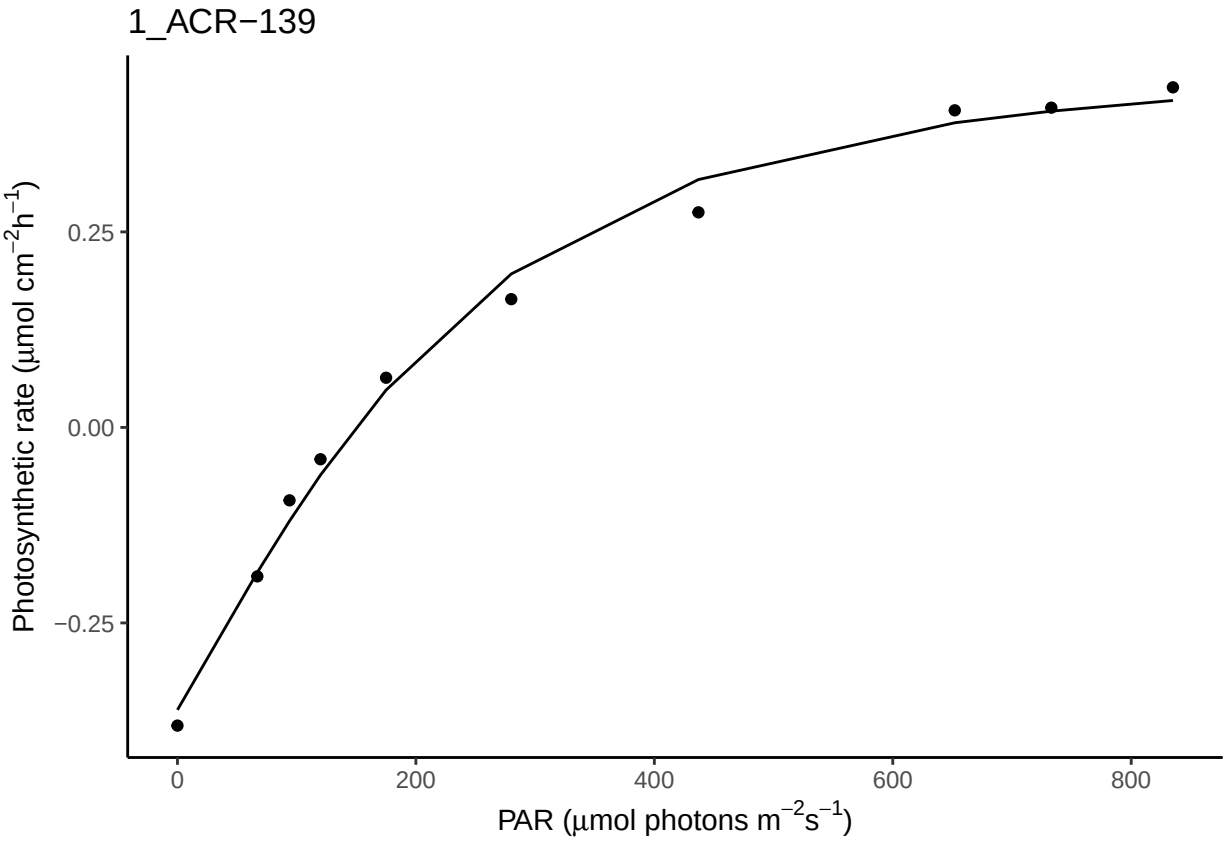

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-368
```



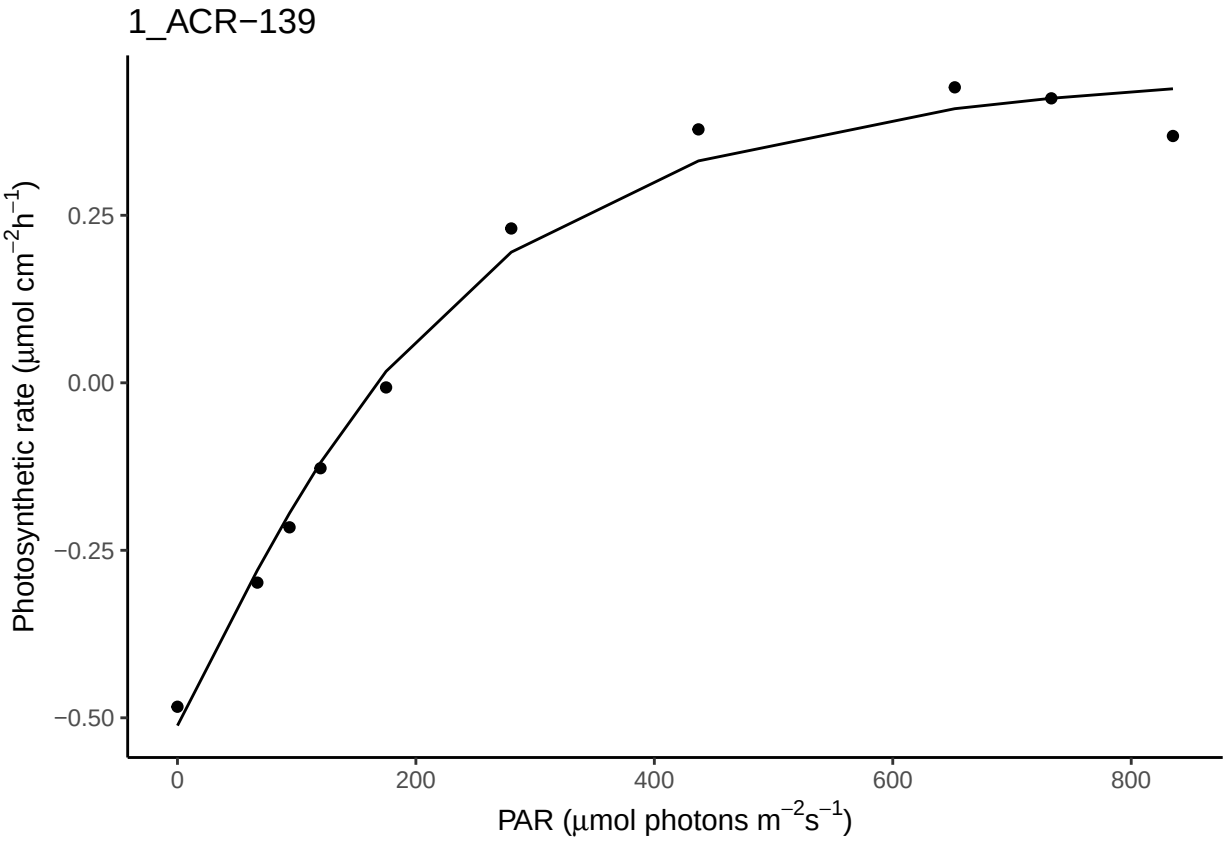

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-374
```



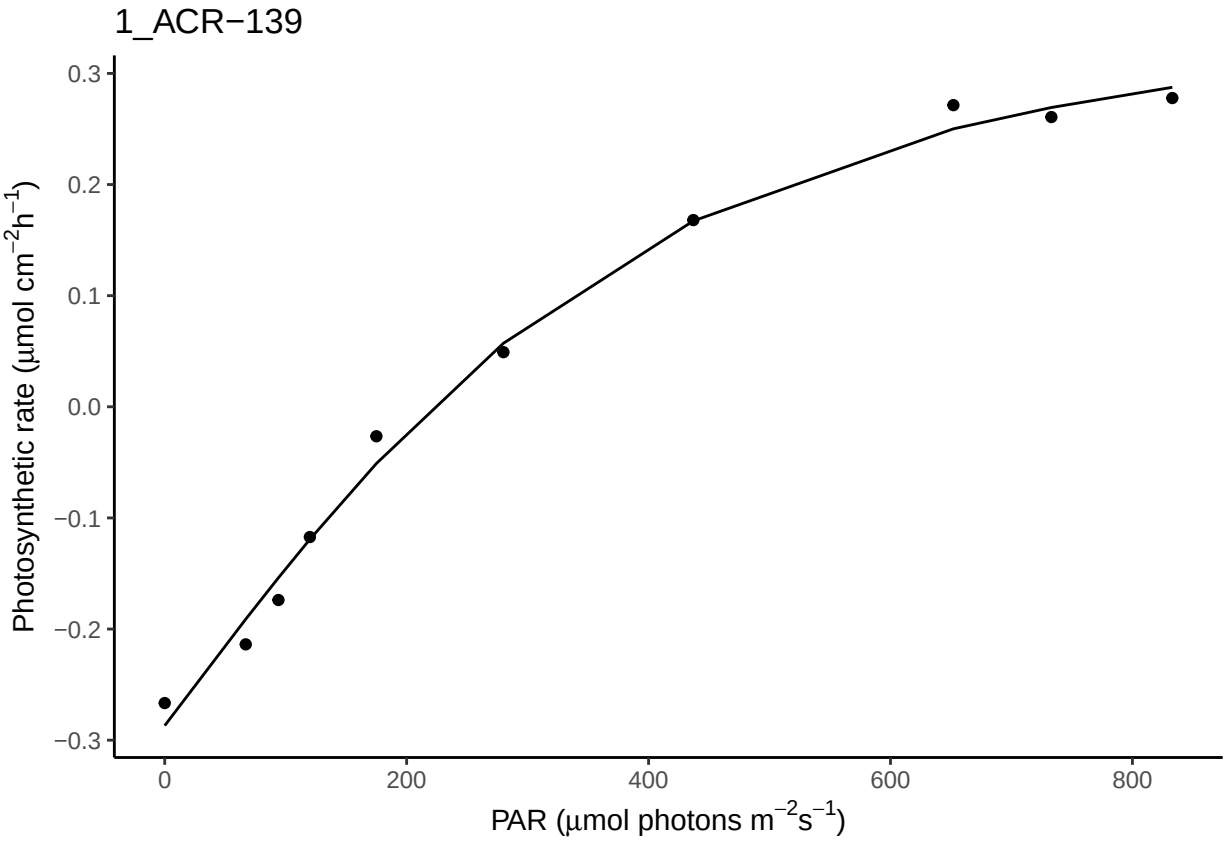

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-379
```



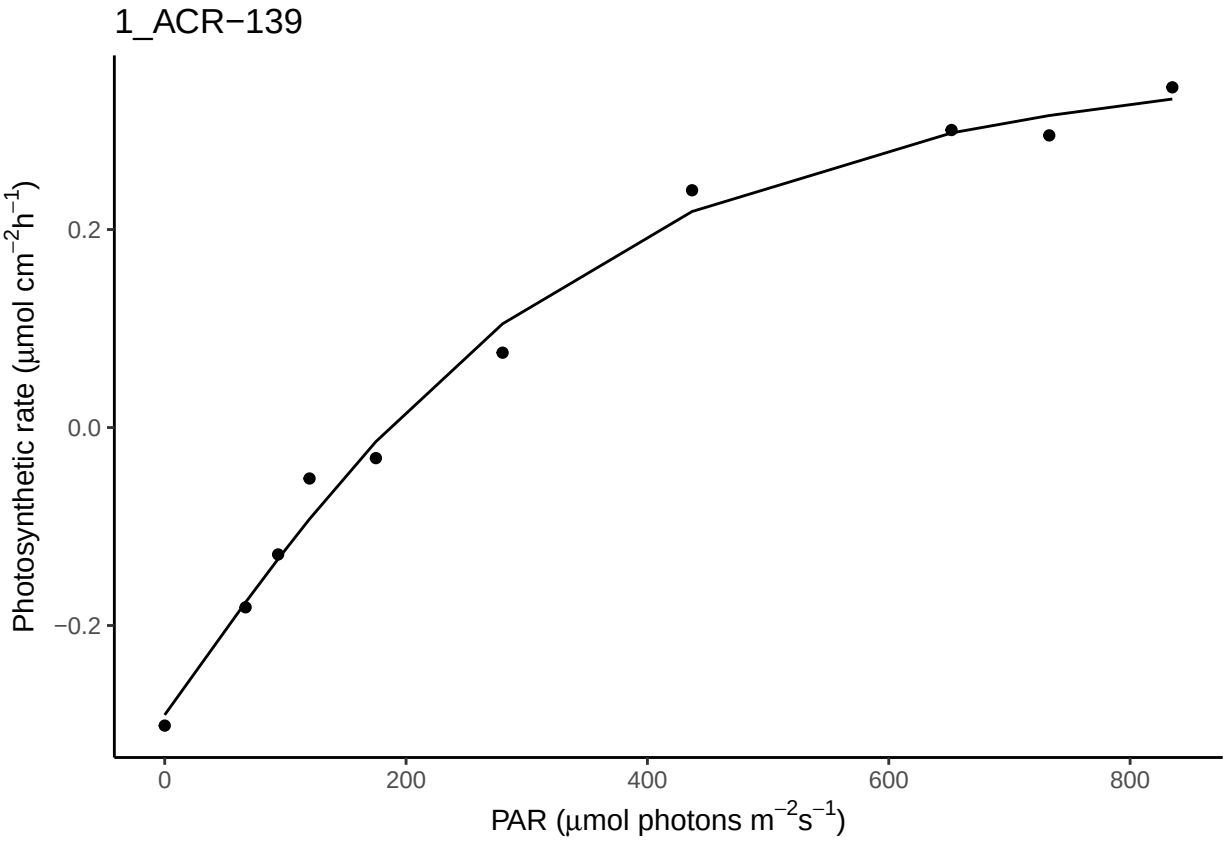

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-389
```



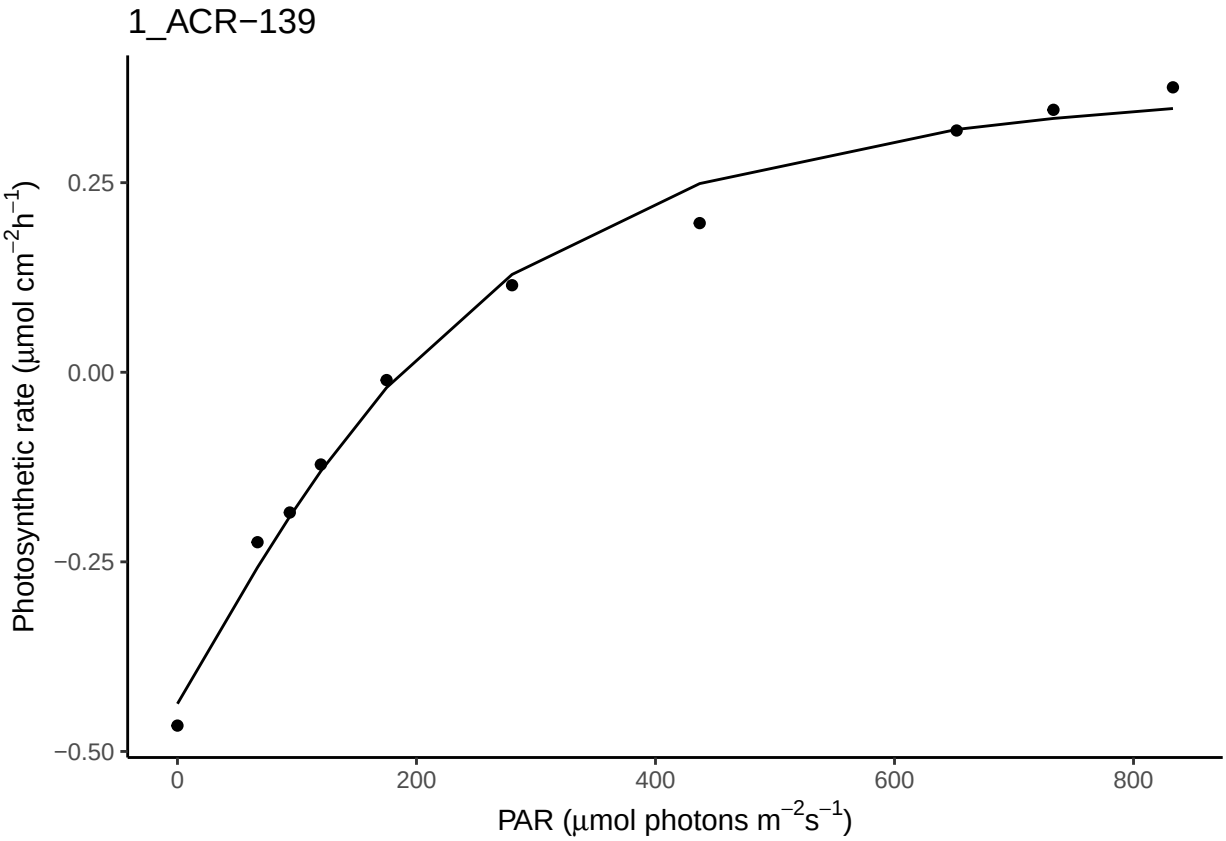

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-390
```



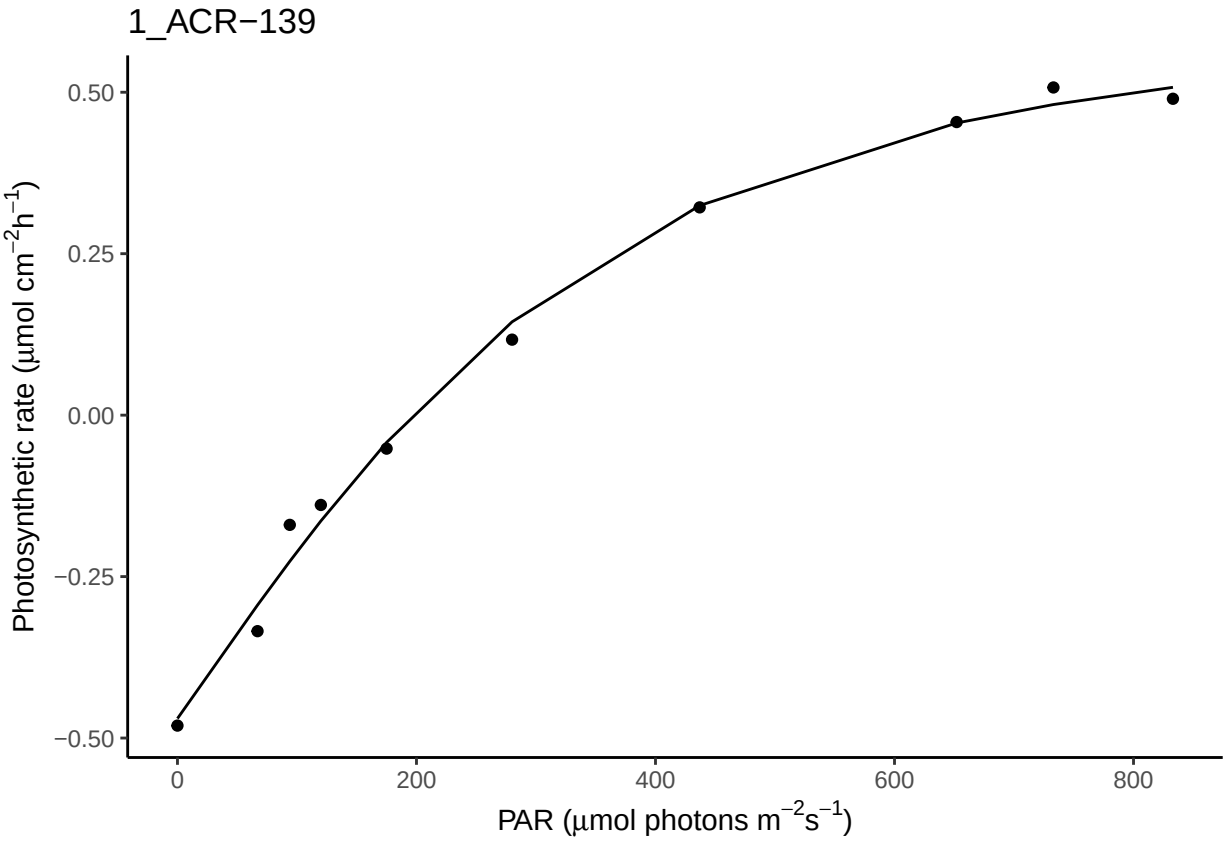

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-393
```



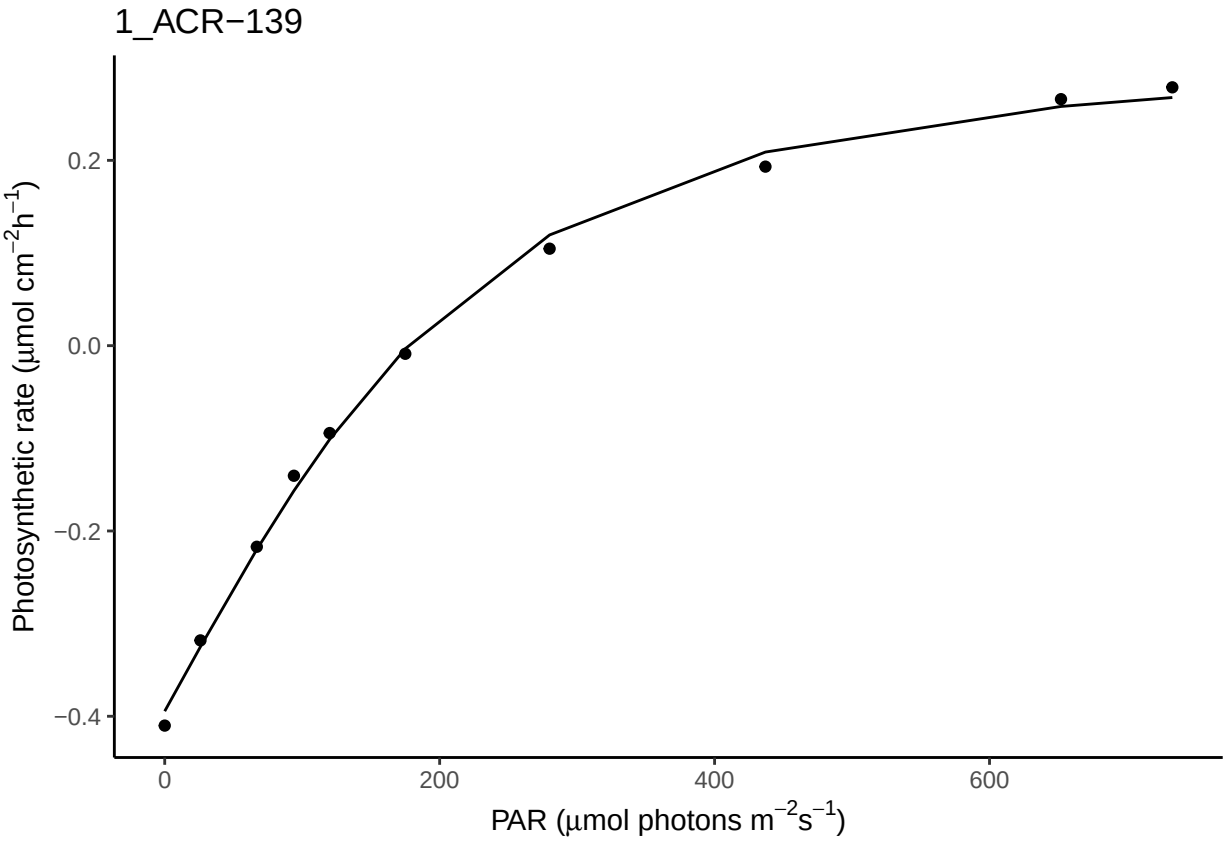

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-396
```



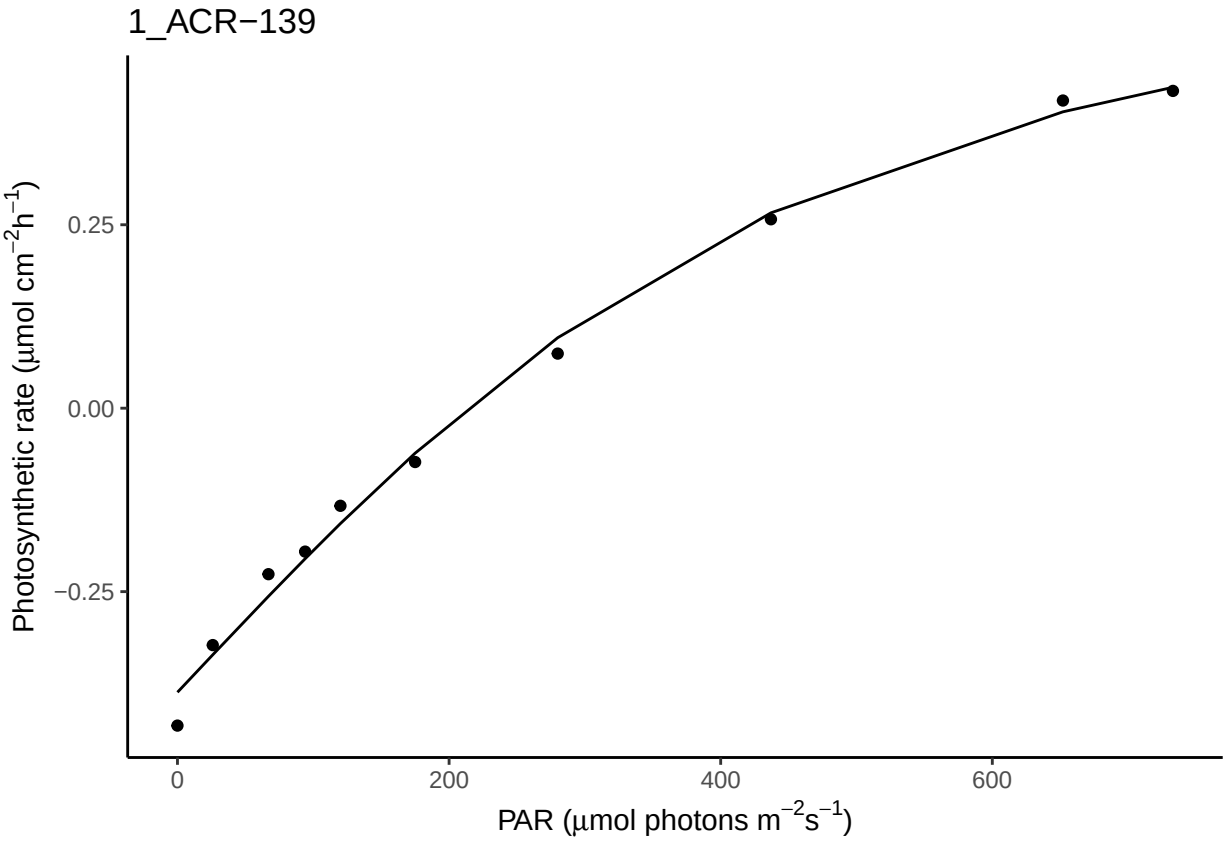

```
## ------------------------------------------------------------
## augmented$colony_id: ACR-51
```



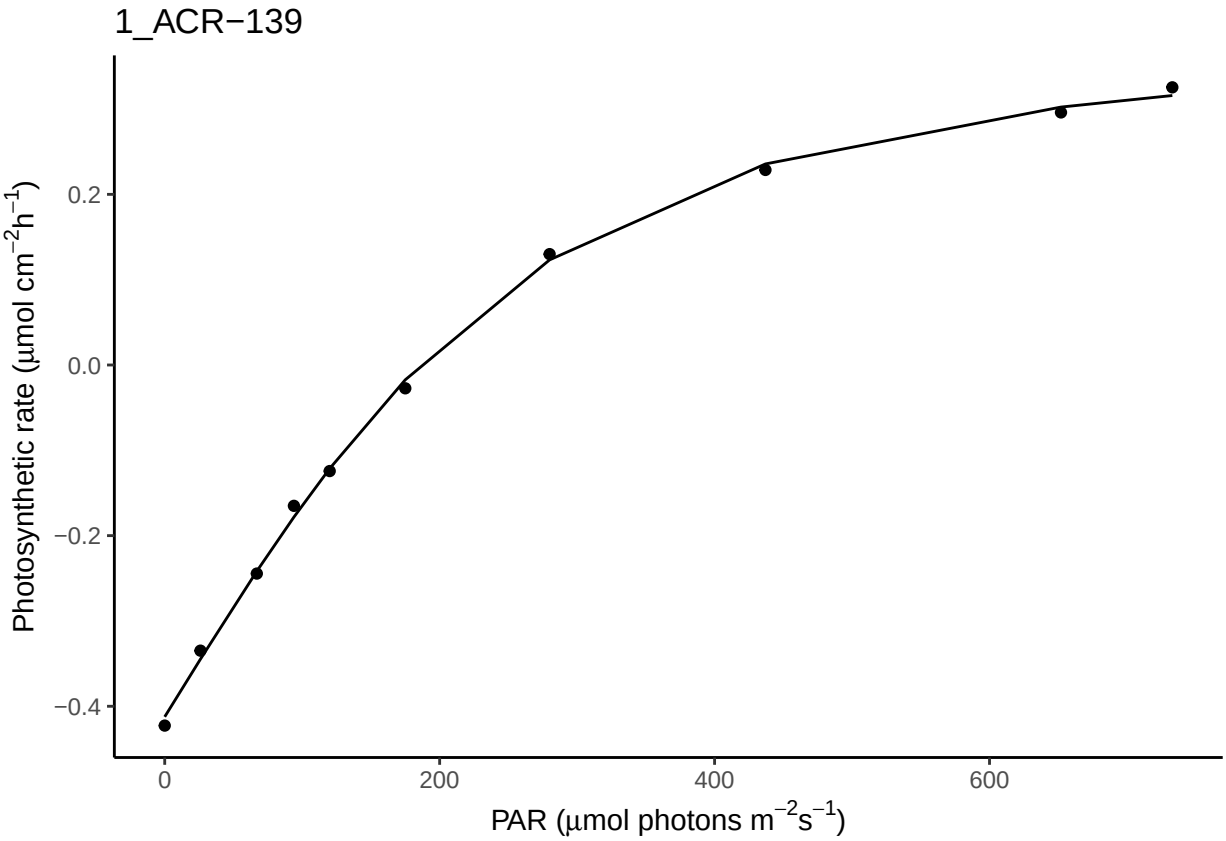

```
## ------------------------------------------------------------
## augmented$colony_id: POC-200
```



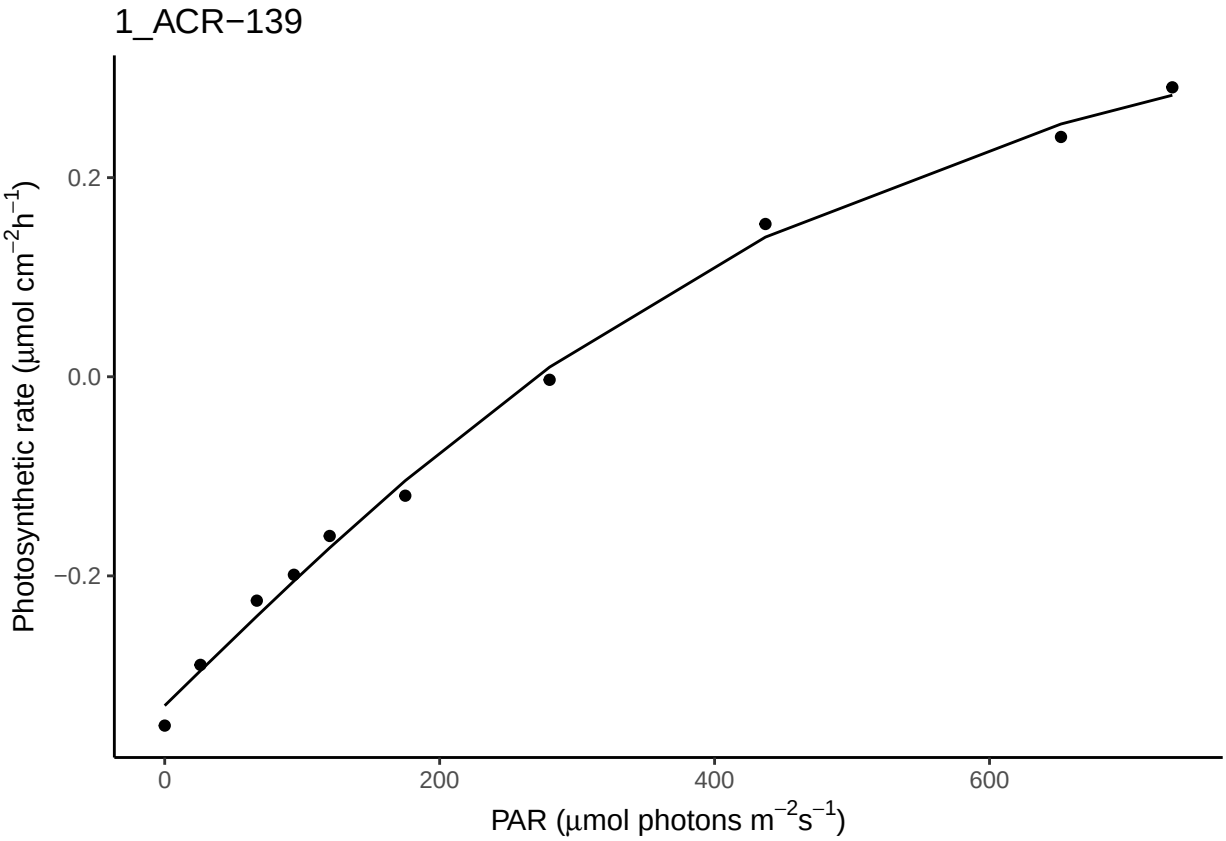

```
## ------------------------------------------------------------
## augmented$colony_id: POC-201
```



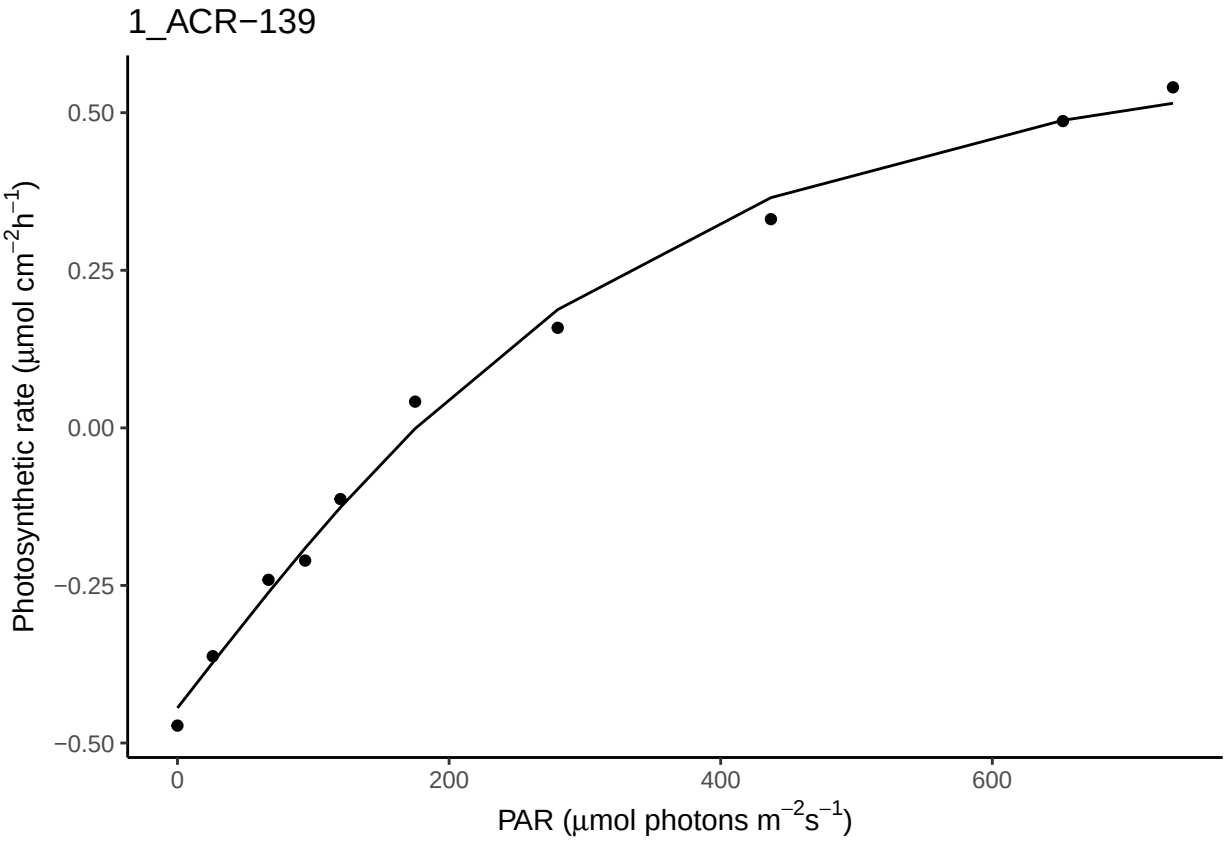

```
## ------------------------------------------------------------
## augmented$colony_id: POC-205
```



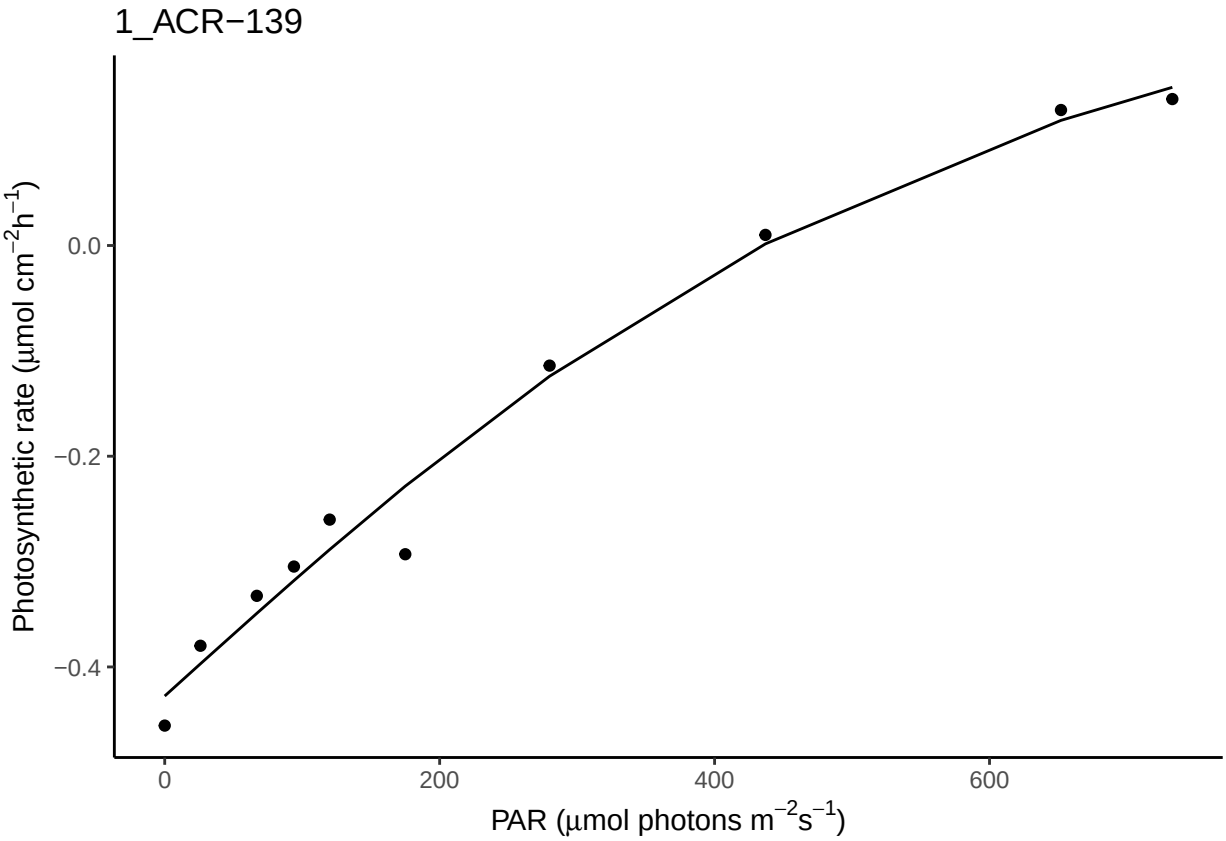

```
## ------------------------------------------------------------
## augmented$colony_id: POC-207
```



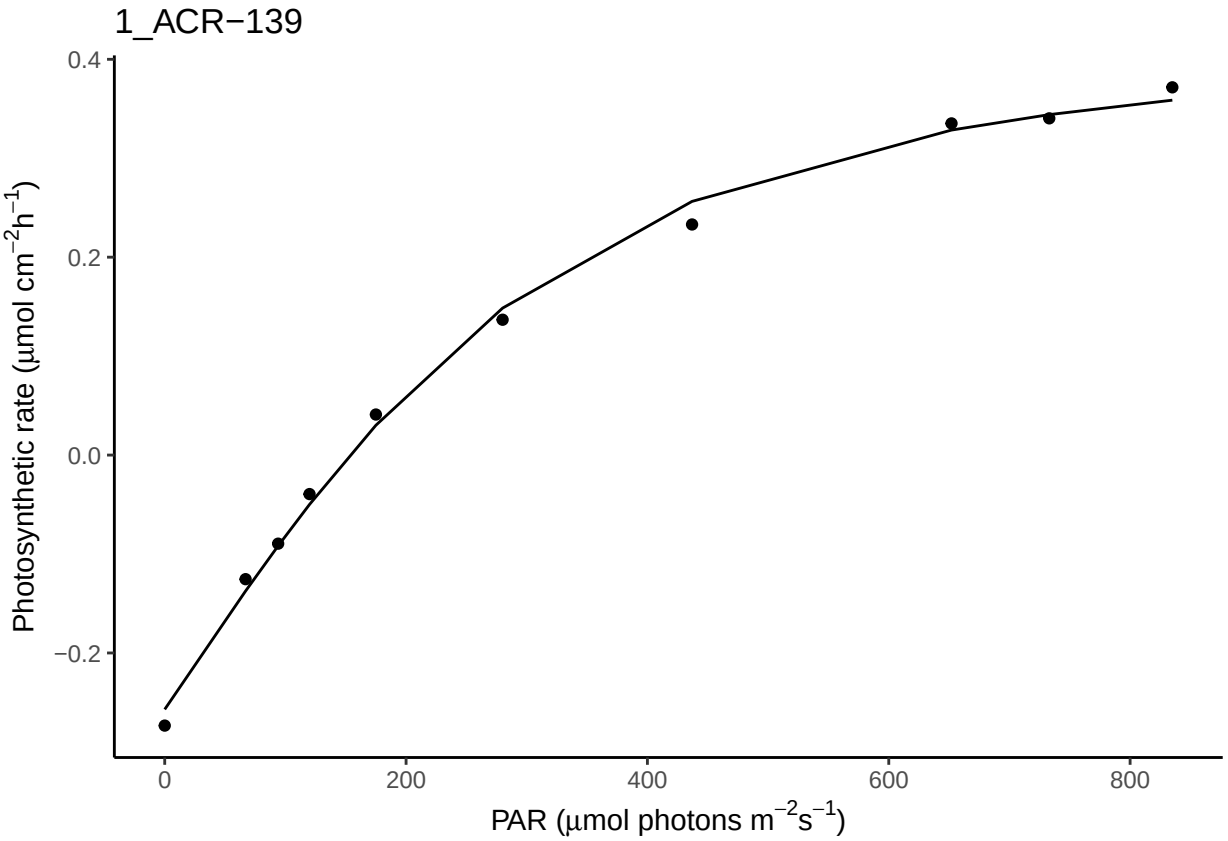

```
## ------------------------------------------------------------
## augmented$colony_id: POC-217
```



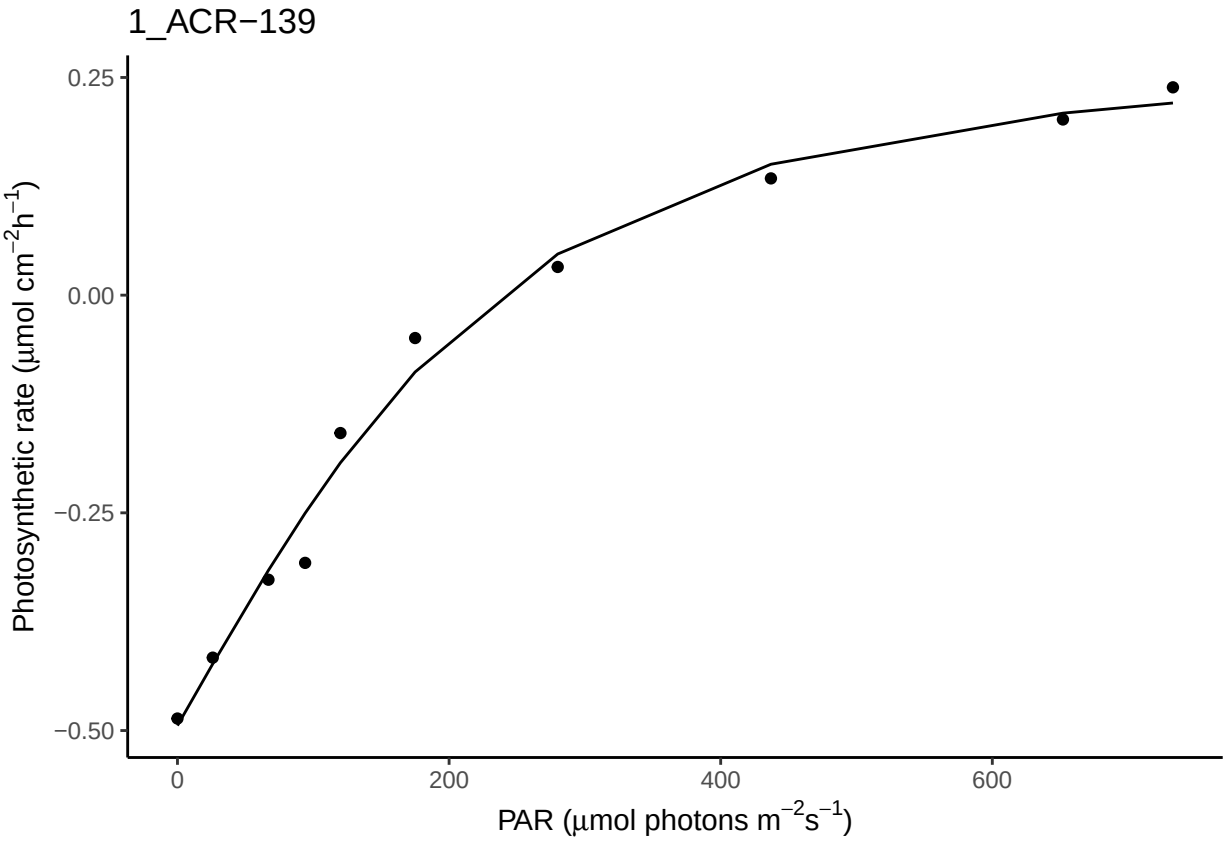

```
## ------------------------------------------------------------
## augmented$colony_id: POC-219
```



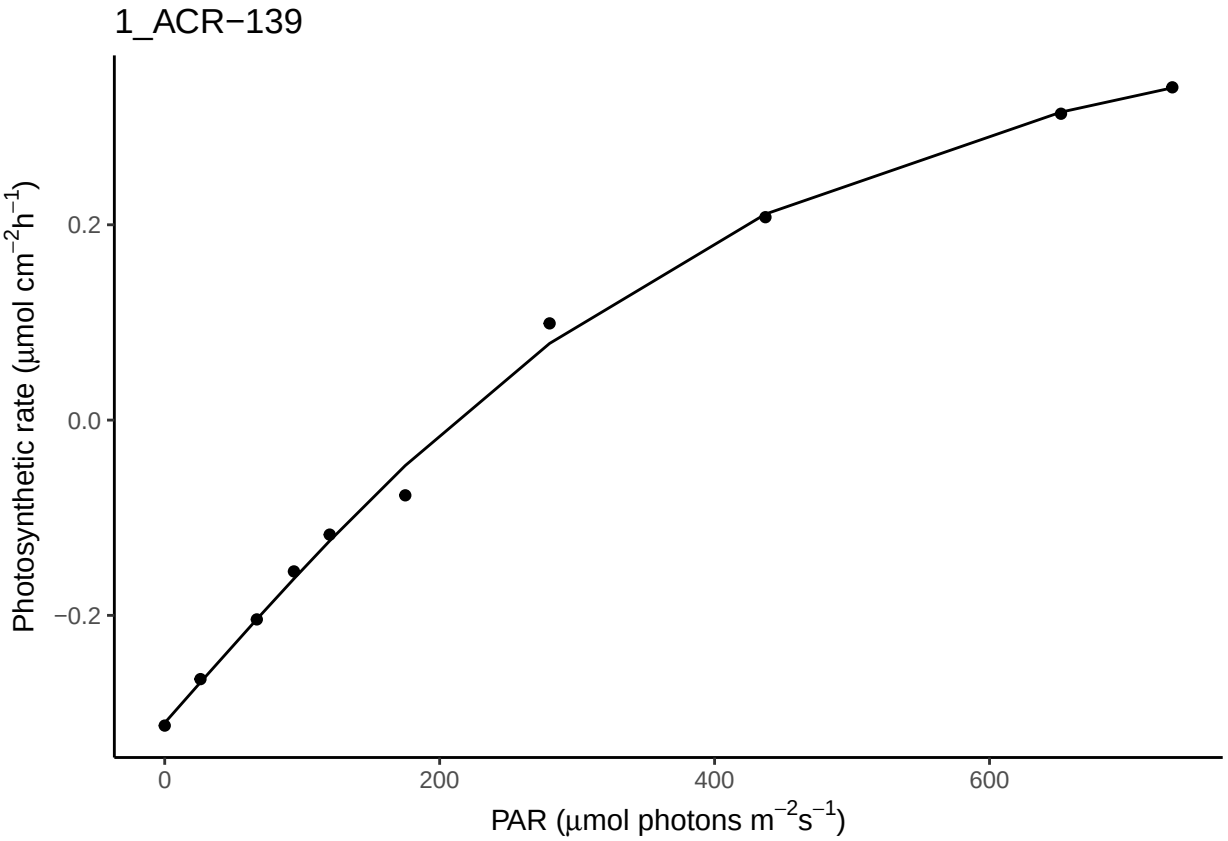

```
## ------------------------------------------------------------
## augmented$colony_id: POC-222
```



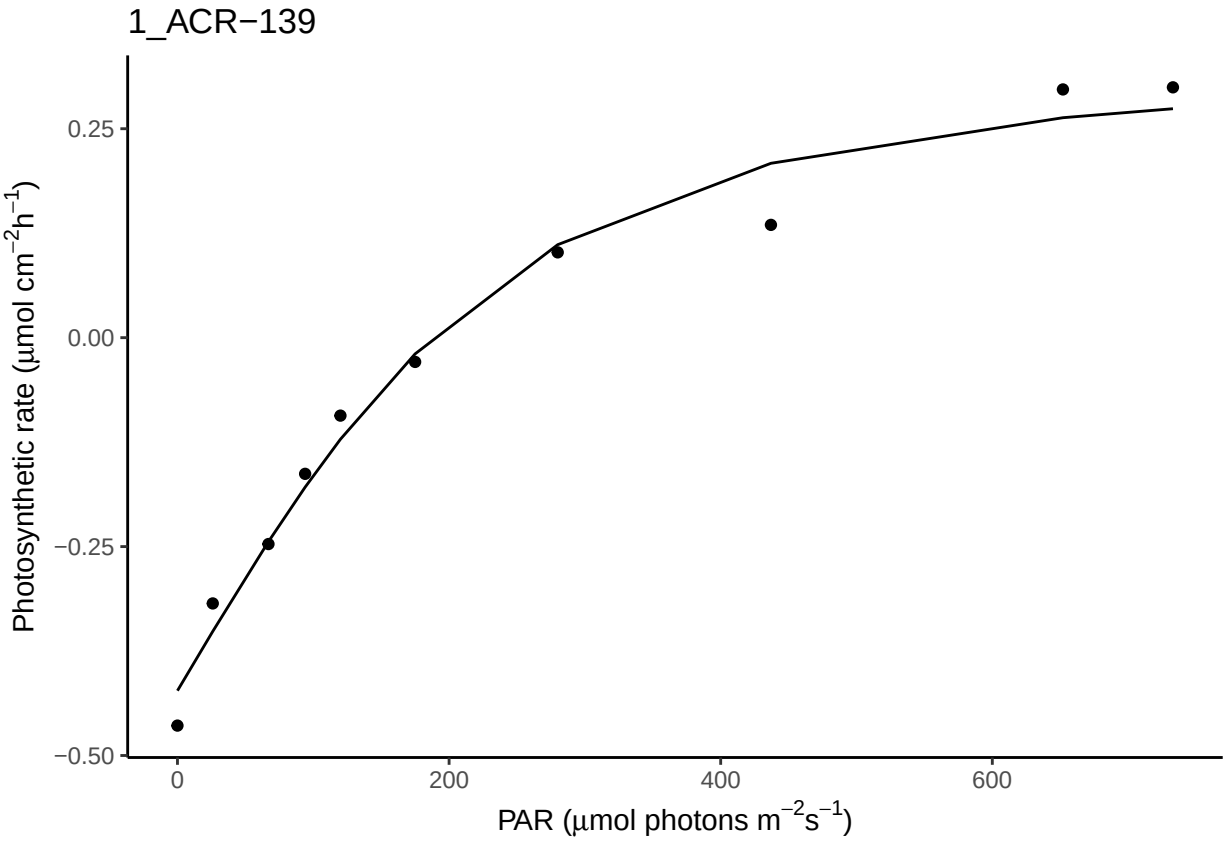

```
## ------------------------------------------------------------
## augmented$colony_id: POC-238
```



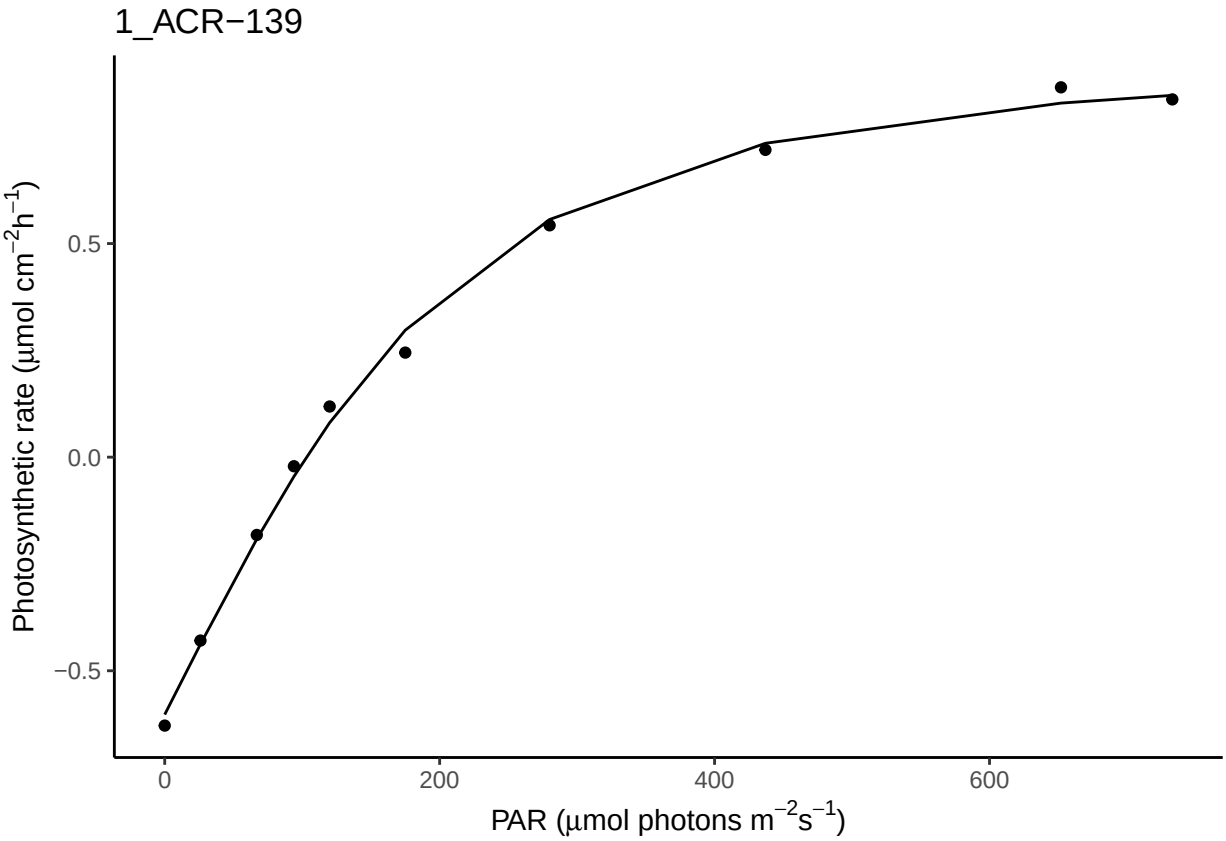

```
## ------------------------------------------------------------
## augmented$colony_id: POC-239
```



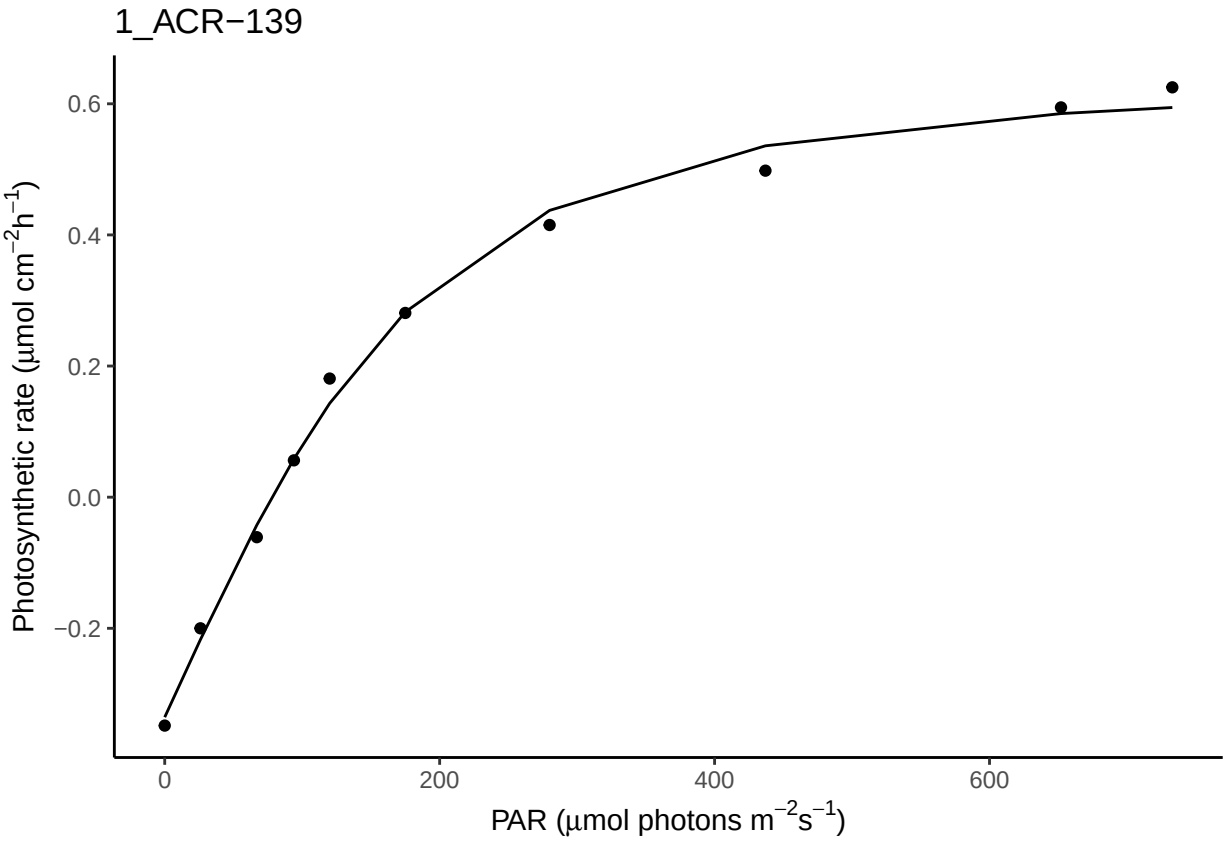

```
## ------------------------------------------------------------
## augmented$colony_id: POC-248
```



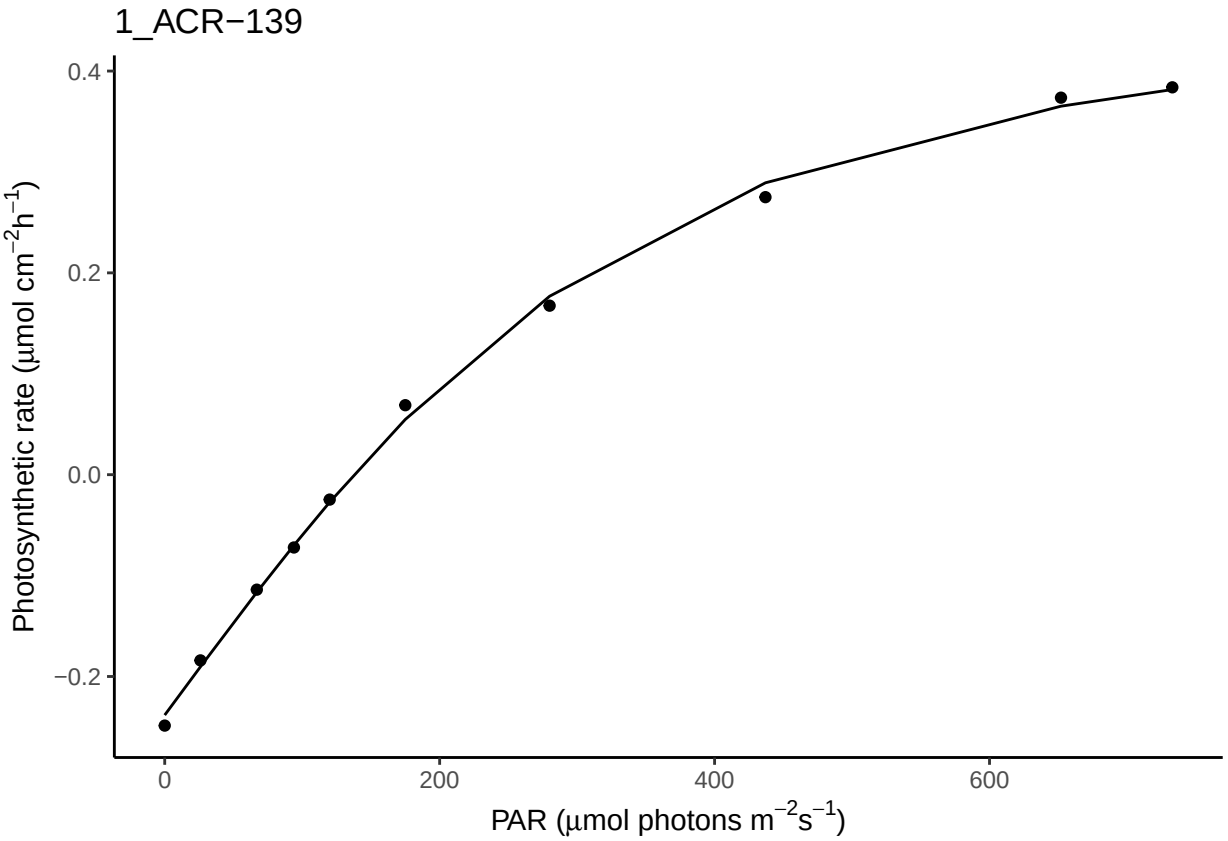

```
## ------------------------------------------------------------
## augmented$colony_id: POC-254
```



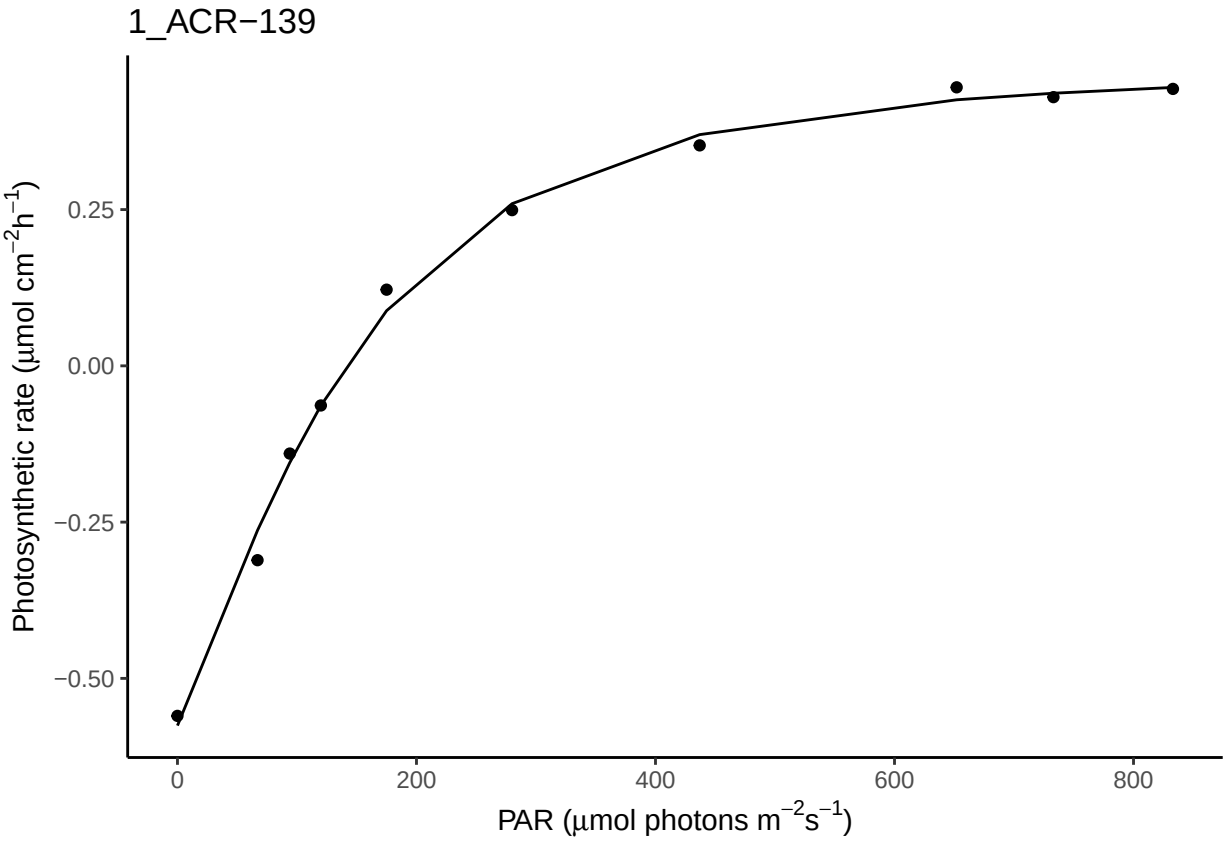

```
## ------------------------------------------------------------
## augmented$colony_id: POC-255
```



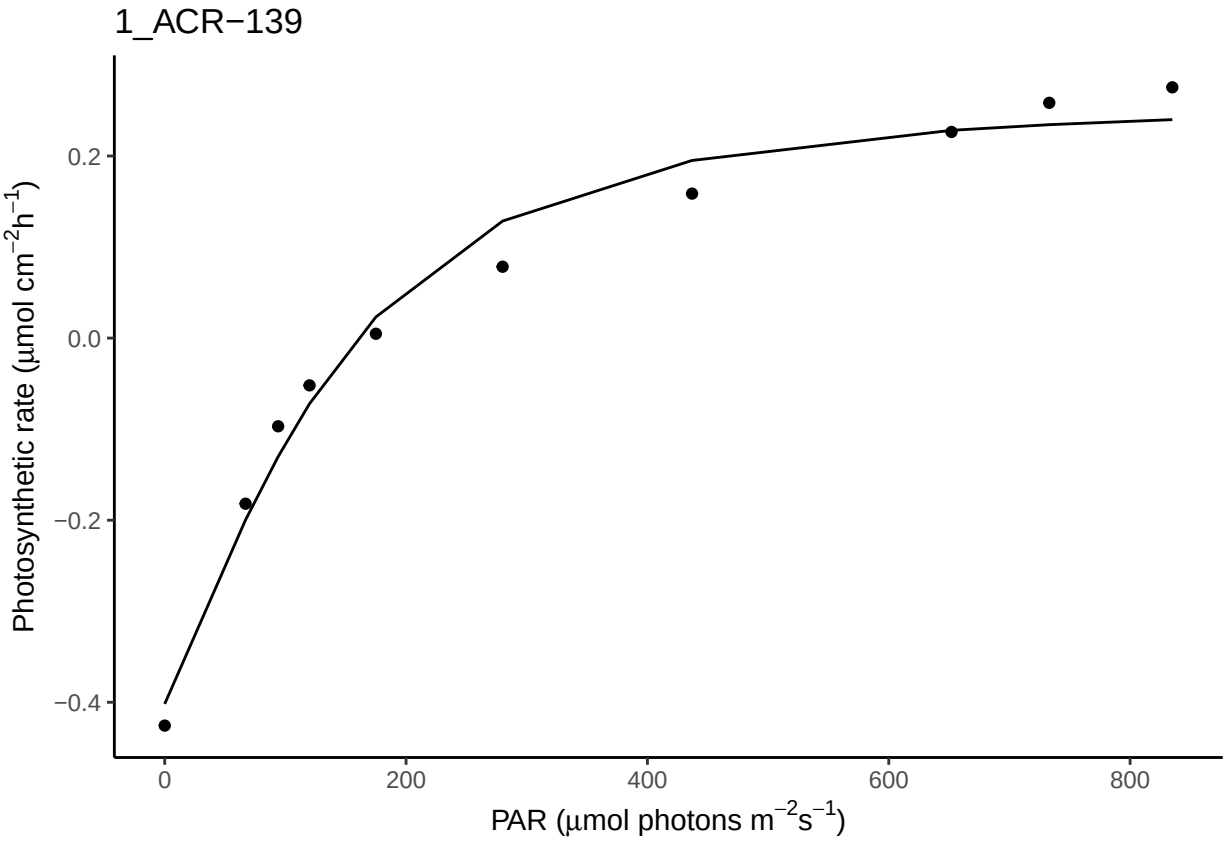

```
## ------------------------------------------------------------
## augmented$colony_id: POC-259
```



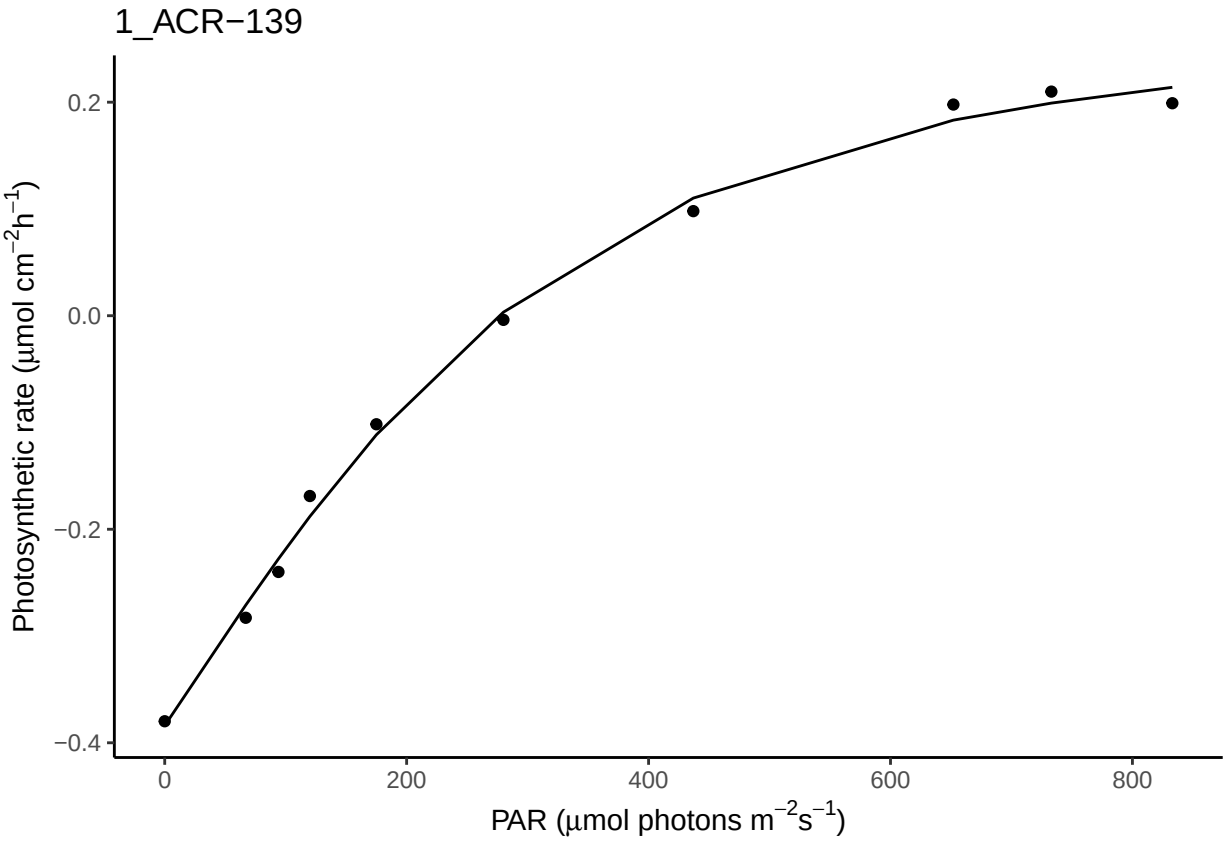

```
## ------------------------------------------------------------
## augmented$colony_id: POC-346
```



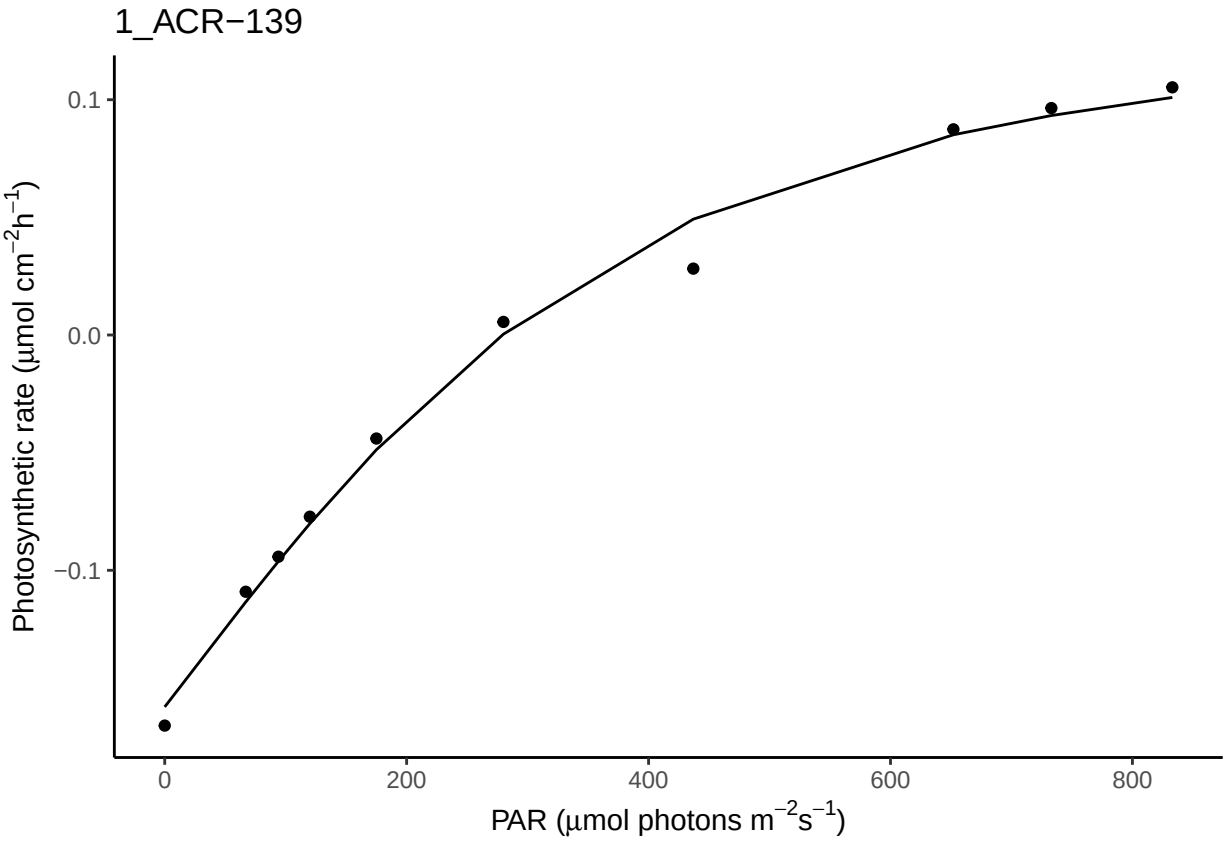

```
## ------------------------------------------------------------
## augmented$colony_id: POC-358
```



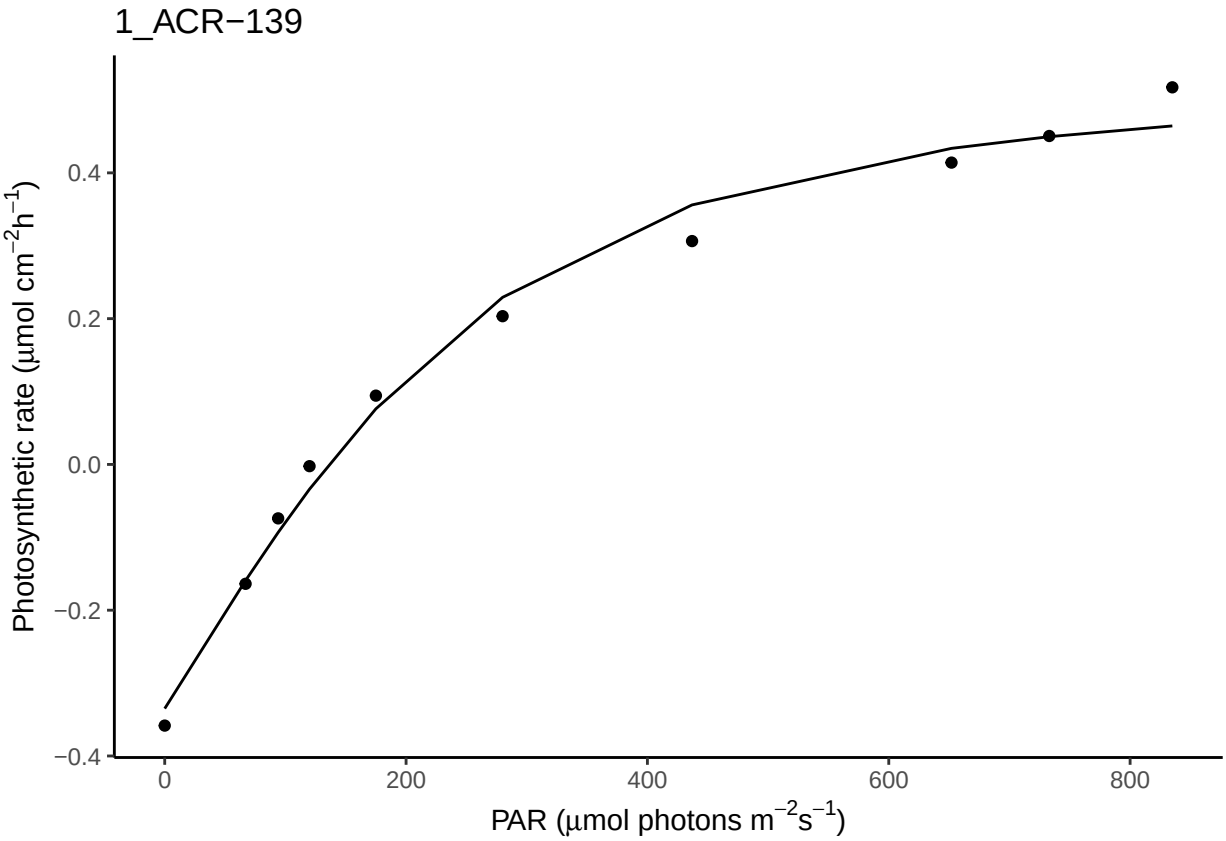

```
## ------------------------------------------------------------
## augmented$colony_id: POC-359
```



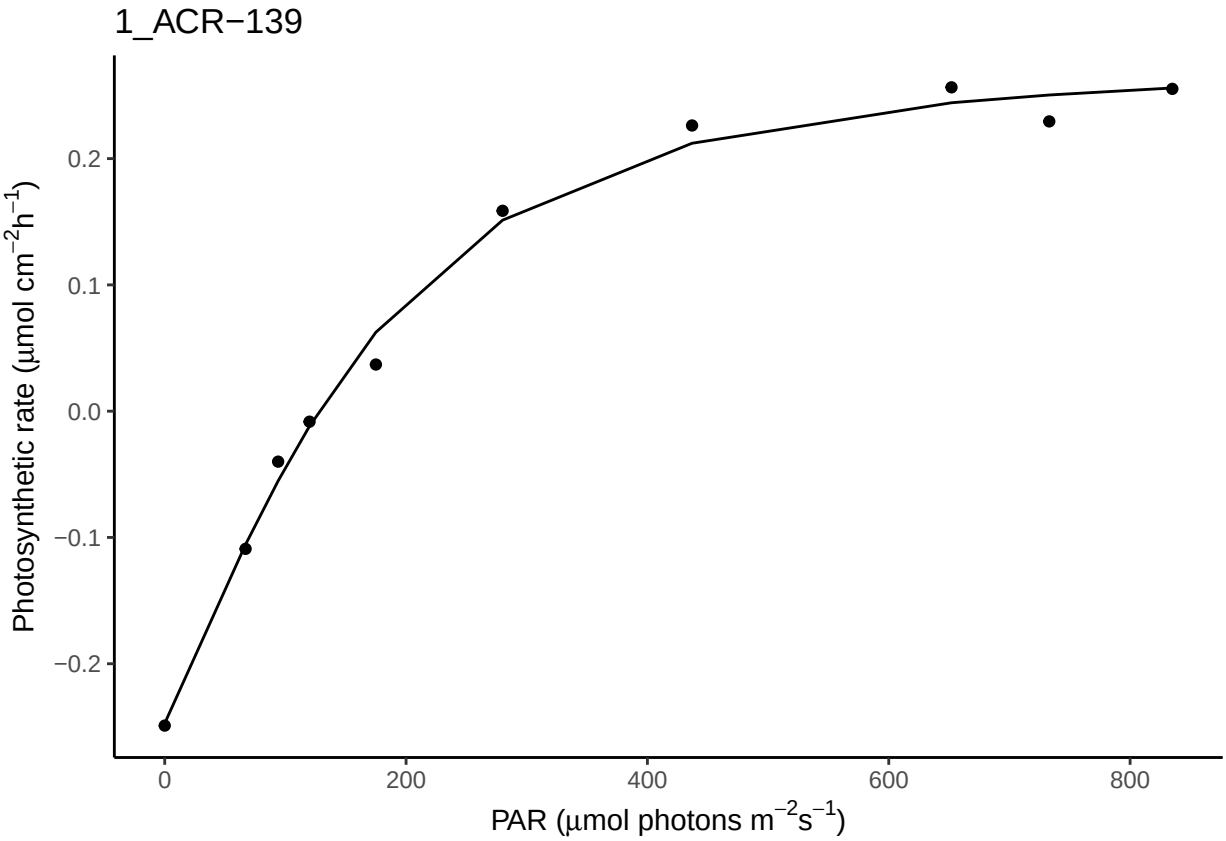

```
## ------------------------------------------------------------
## augmented$colony_id: POC-366
```



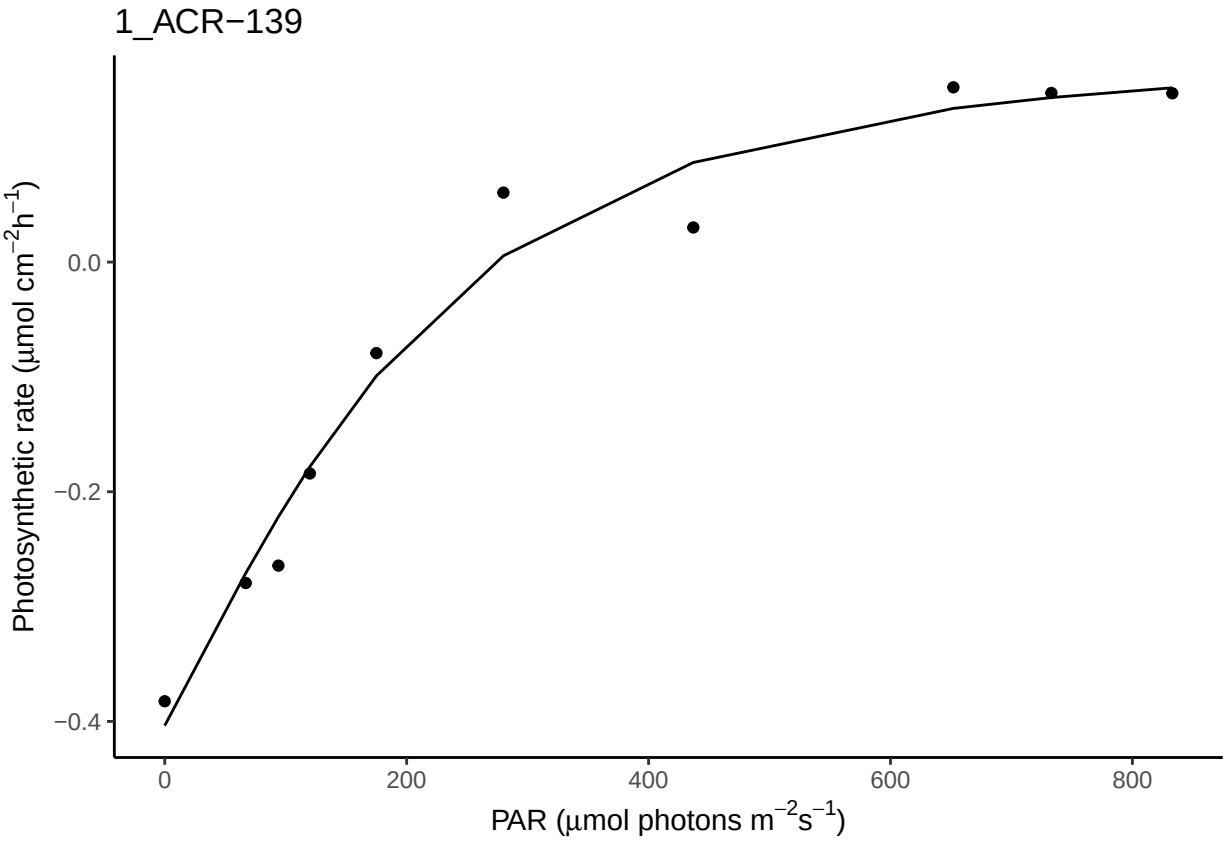

```
## ------------------------------------------------------------
## augmented$colony_id: POC-369
```



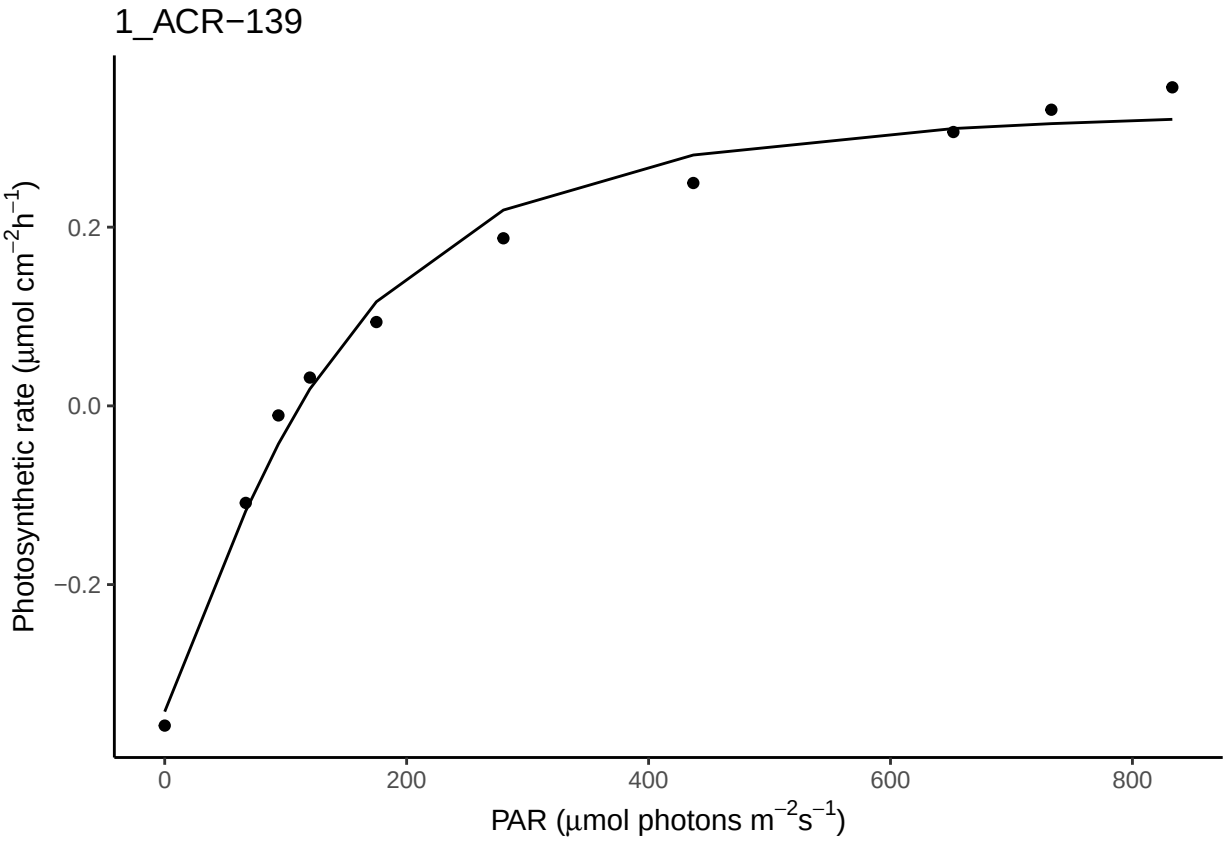

```
## ------------------------------------------------------------
## augmented$colony_id: POC-371
```



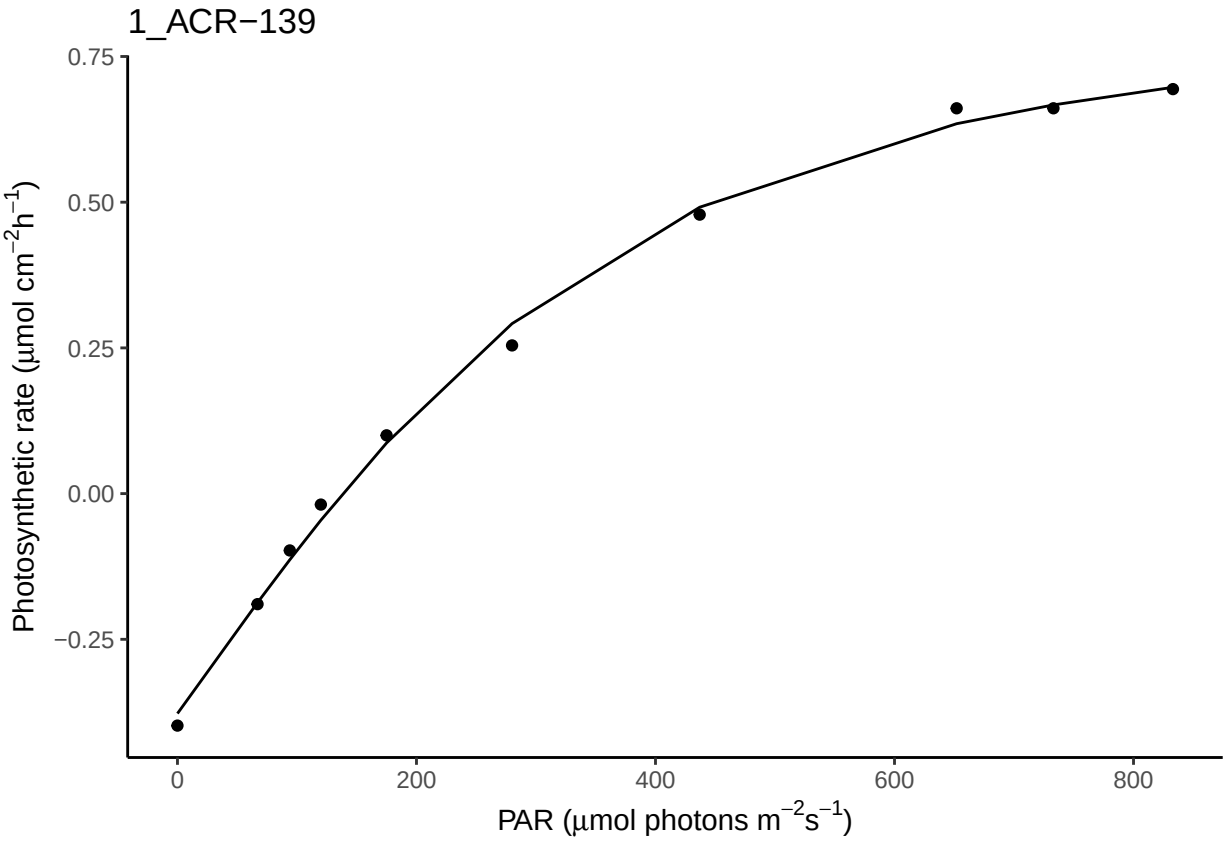

```
## ------------------------------------------------------------
## augmented$colony_id: POC-372
```



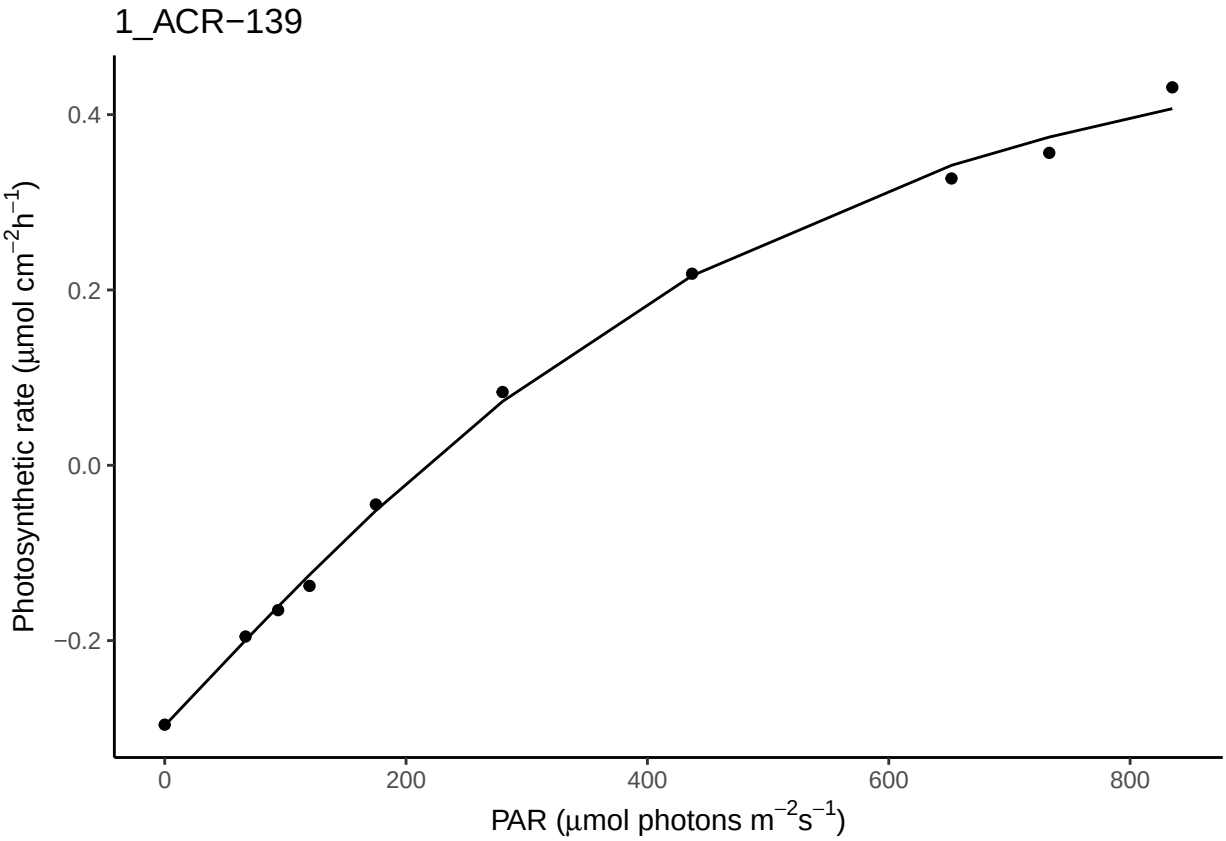

```
## ------------------------------------------------------------
## augmented$colony_id: POC-373
```



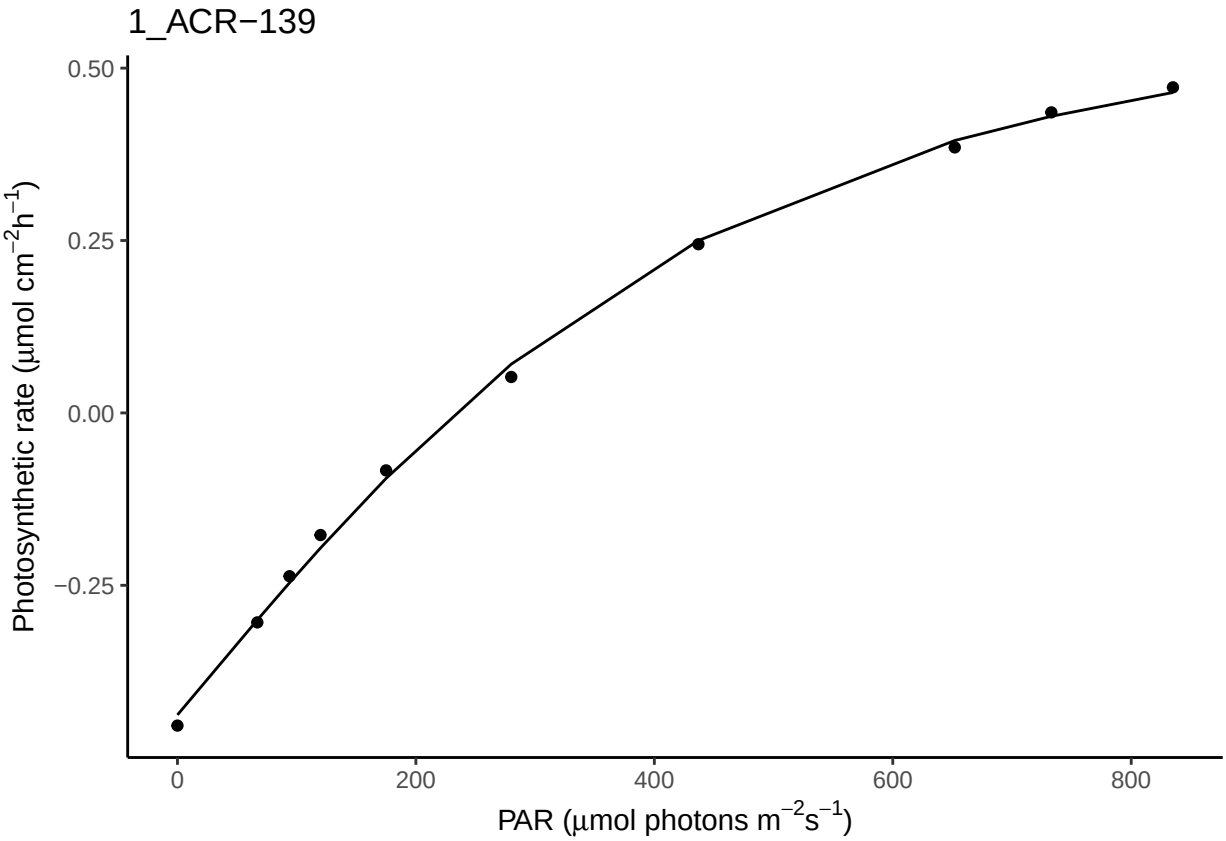

```
## ------------------------------------------------------------
## augmented$colony_id: POC-375
```



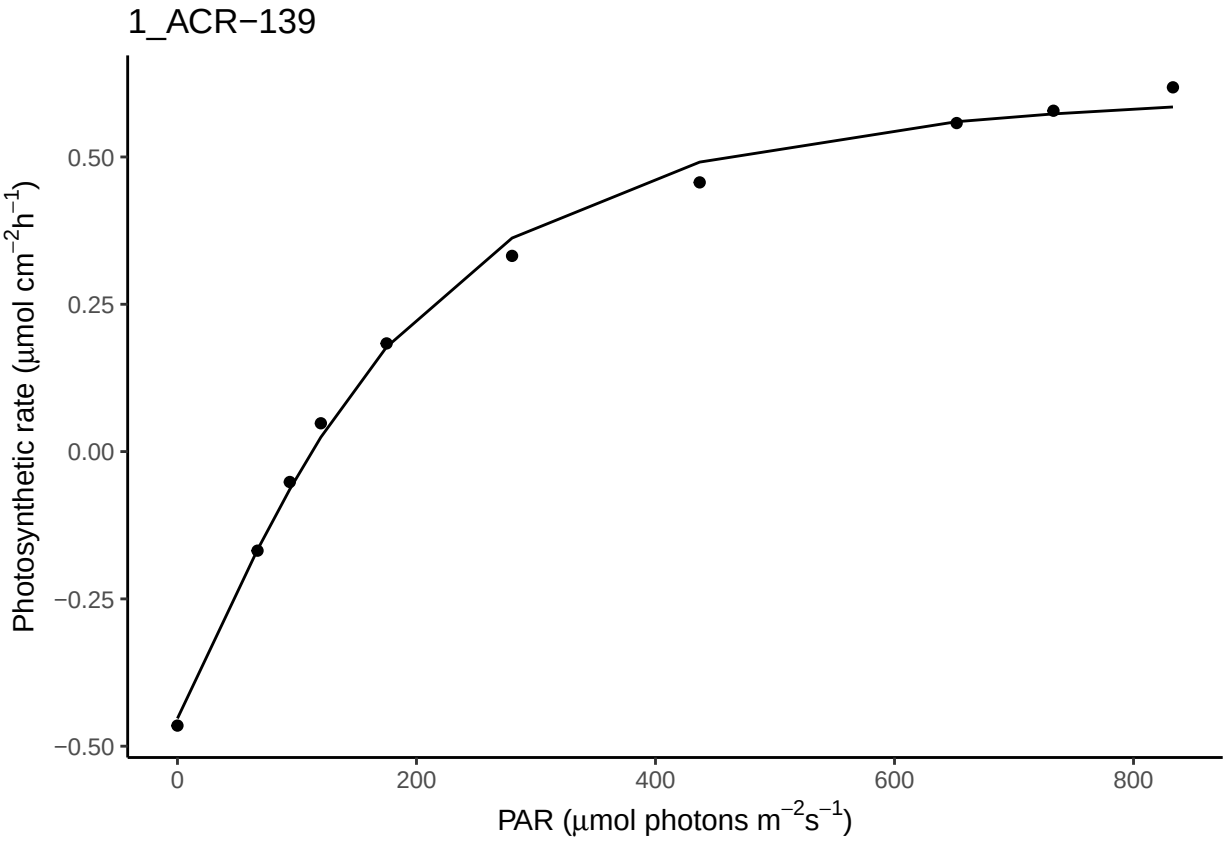

```
## ------------------------------------------------------------
## augmented$colony_id: POC-377
```



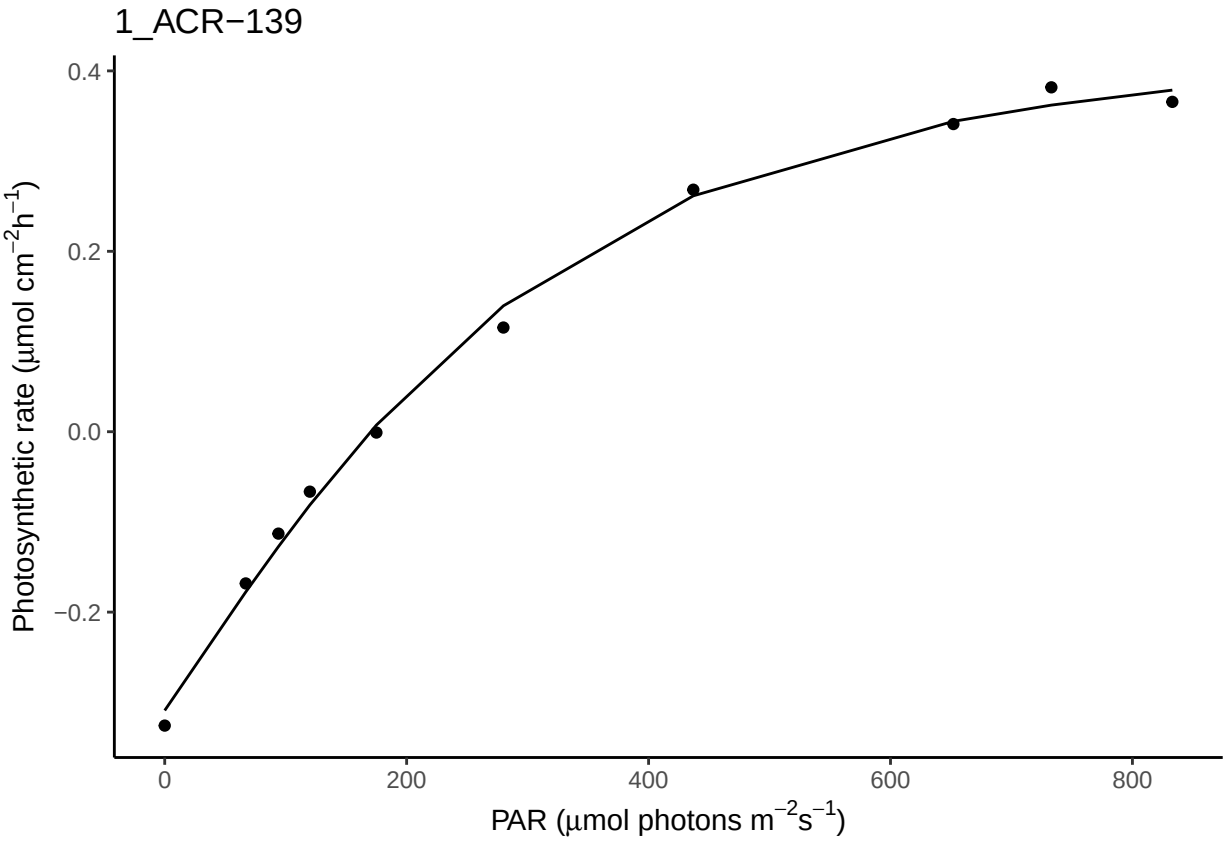

```
## ------------------------------------------------------------
## augmented$colony_id: POC-378
```



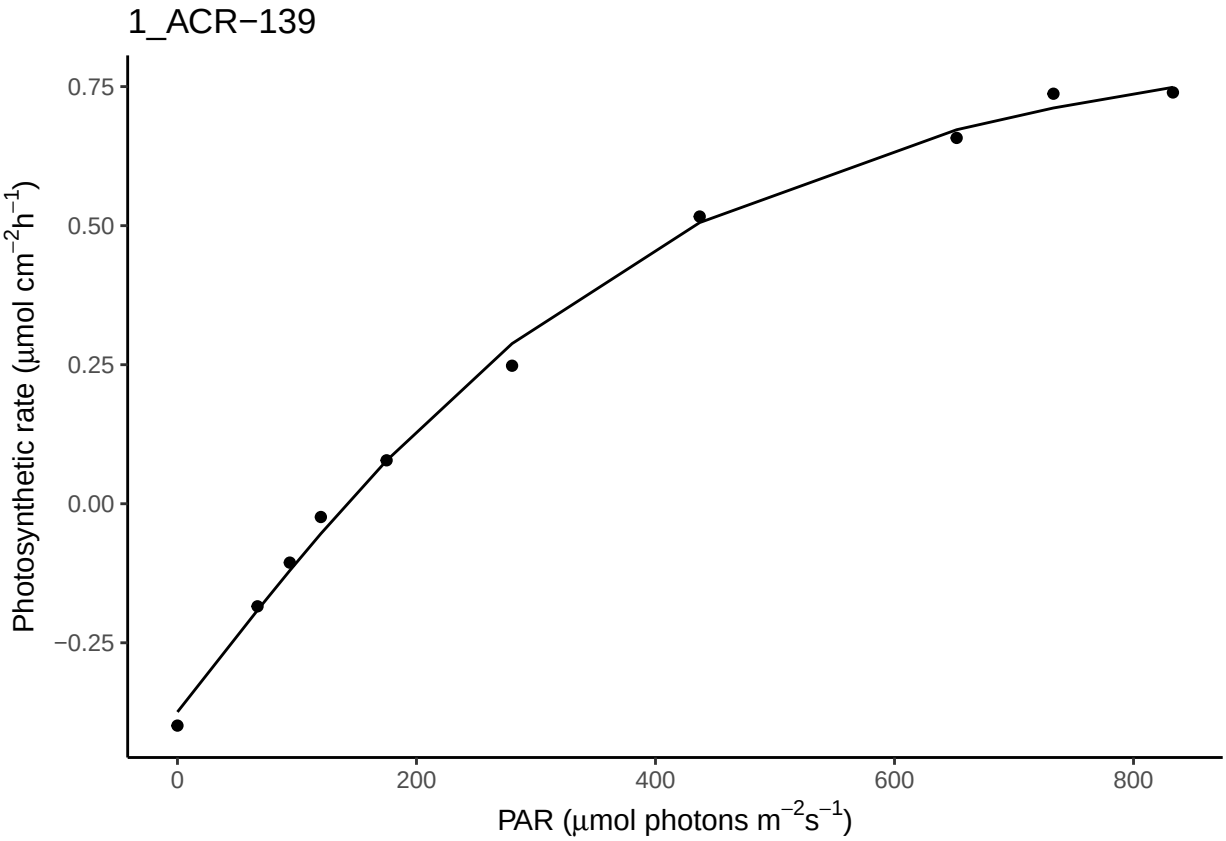

```
## ------------------------------------------------------------
## augmented$colony_id: POC-386
```



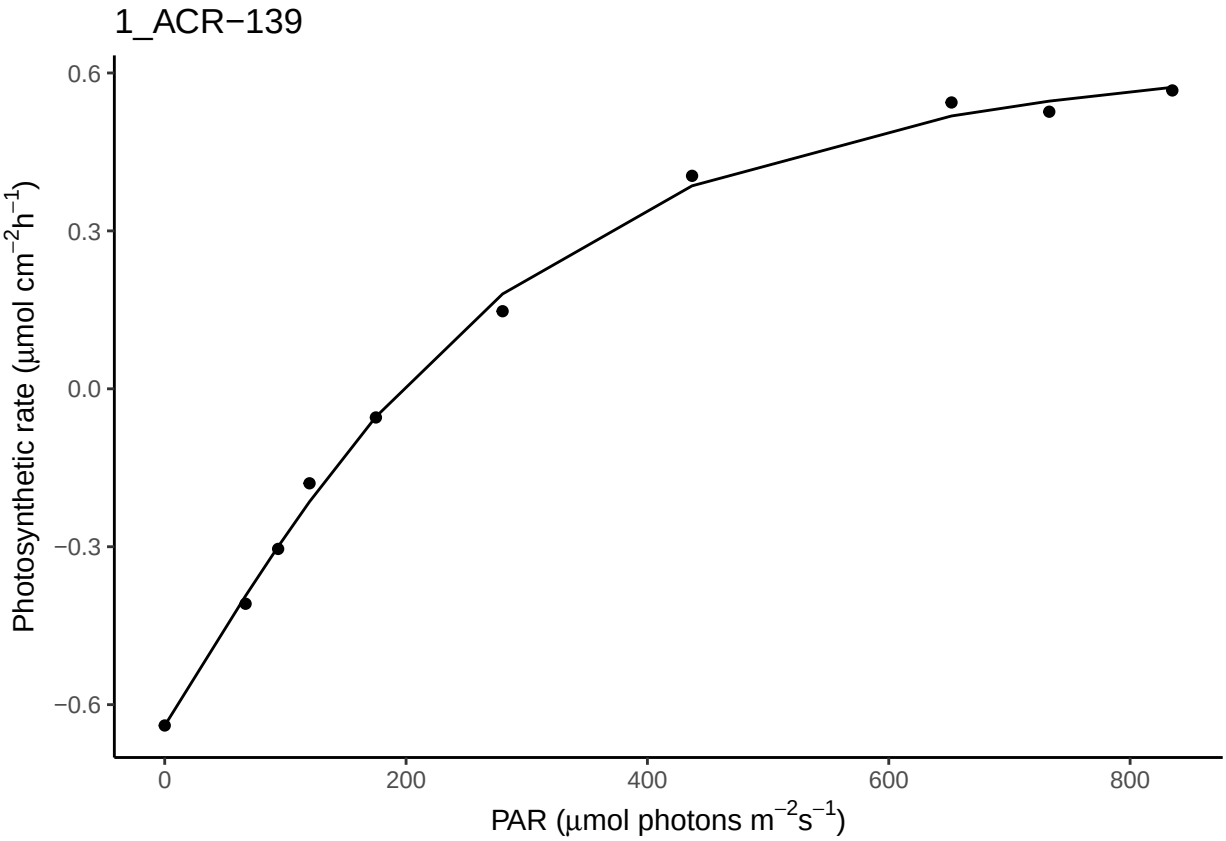

```
## ------------------------------------------------------------
## augmented$colony_id: POC-391
```



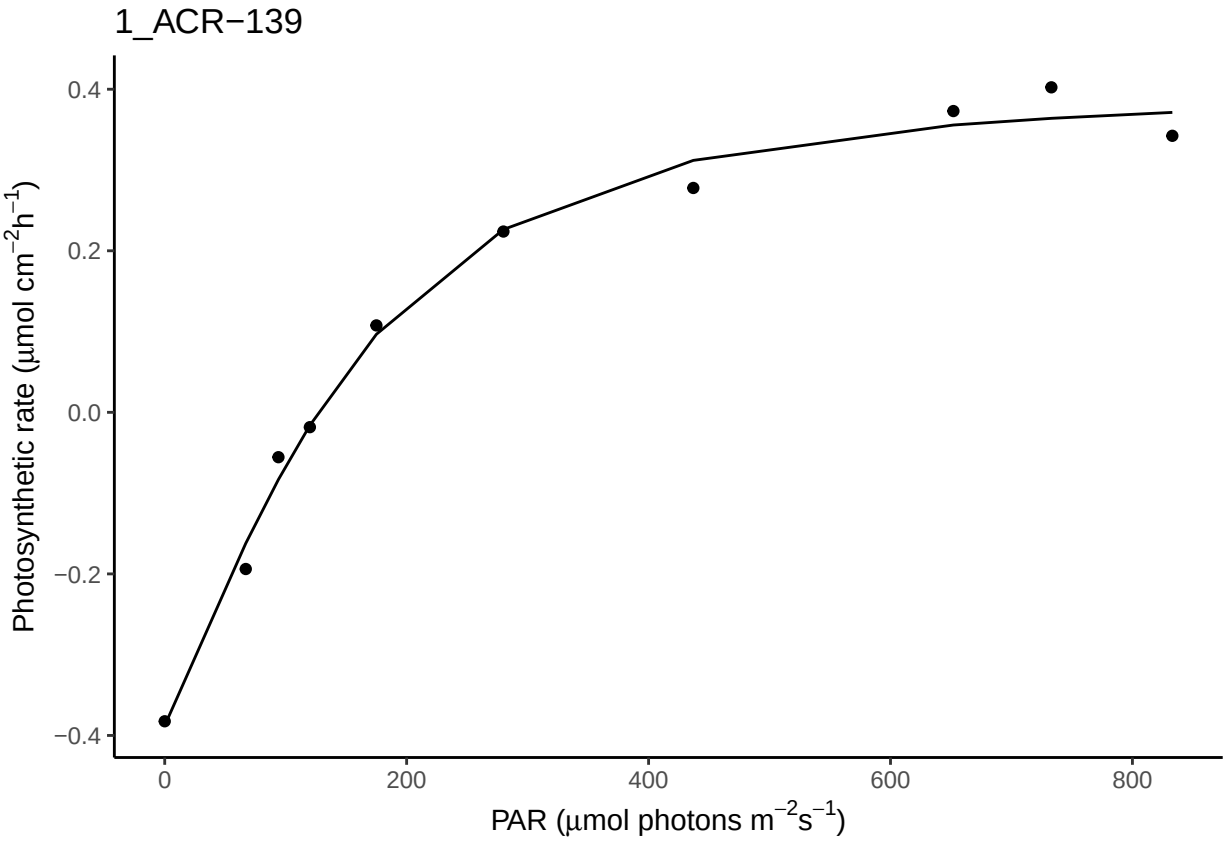

```
## ------------------------------------------------------------
## augmented$colony_id: POC-394
```



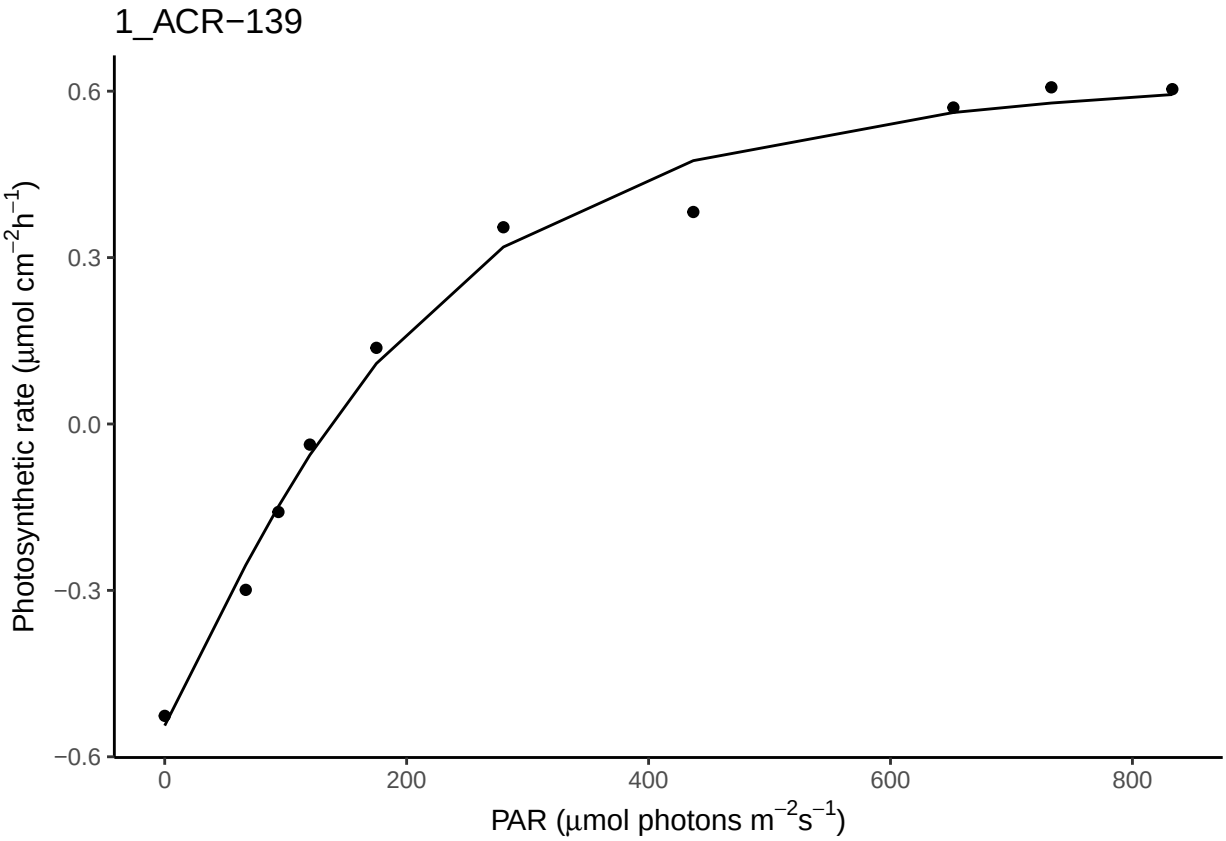

```
## ------------------------------------------------------------
## augmented$colony_id: POC-395
```



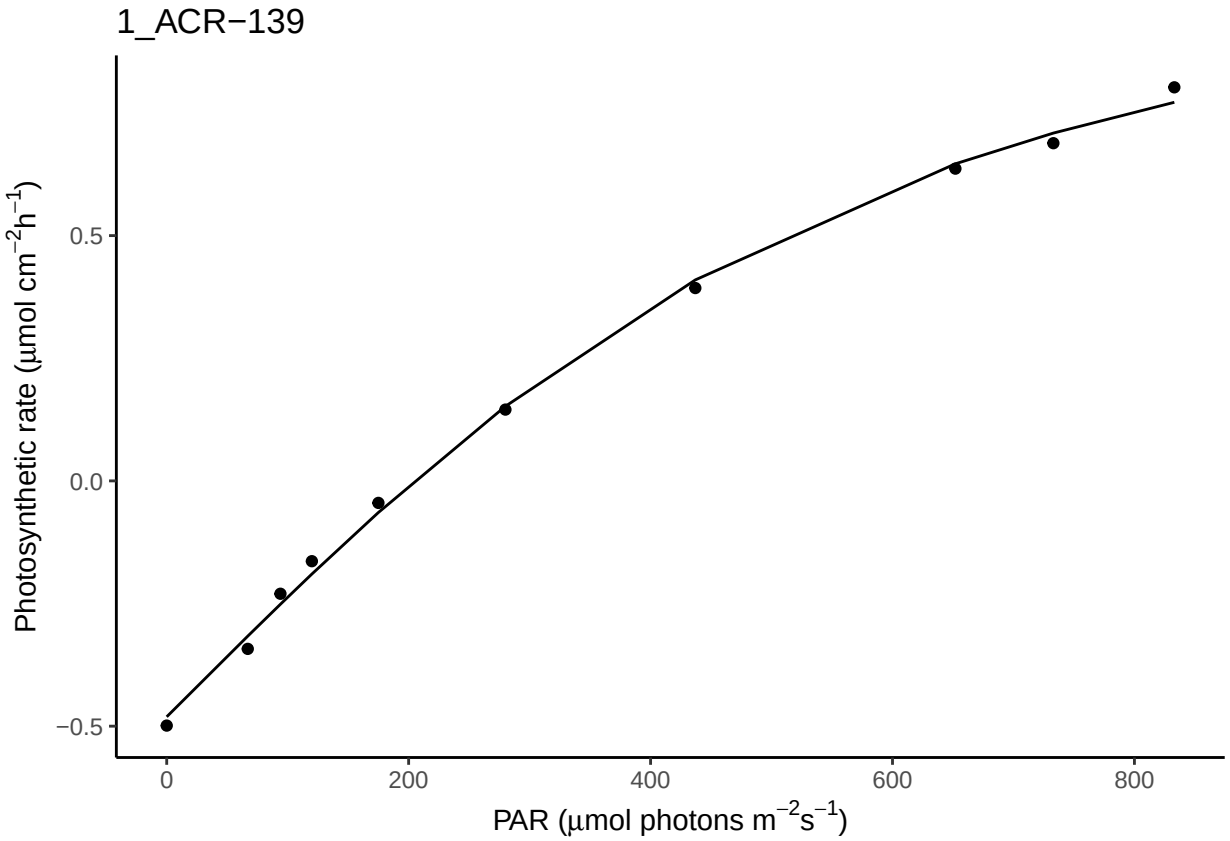

```
## ------------------------------------------------------------
## augmented$colony_id: POC-40
```



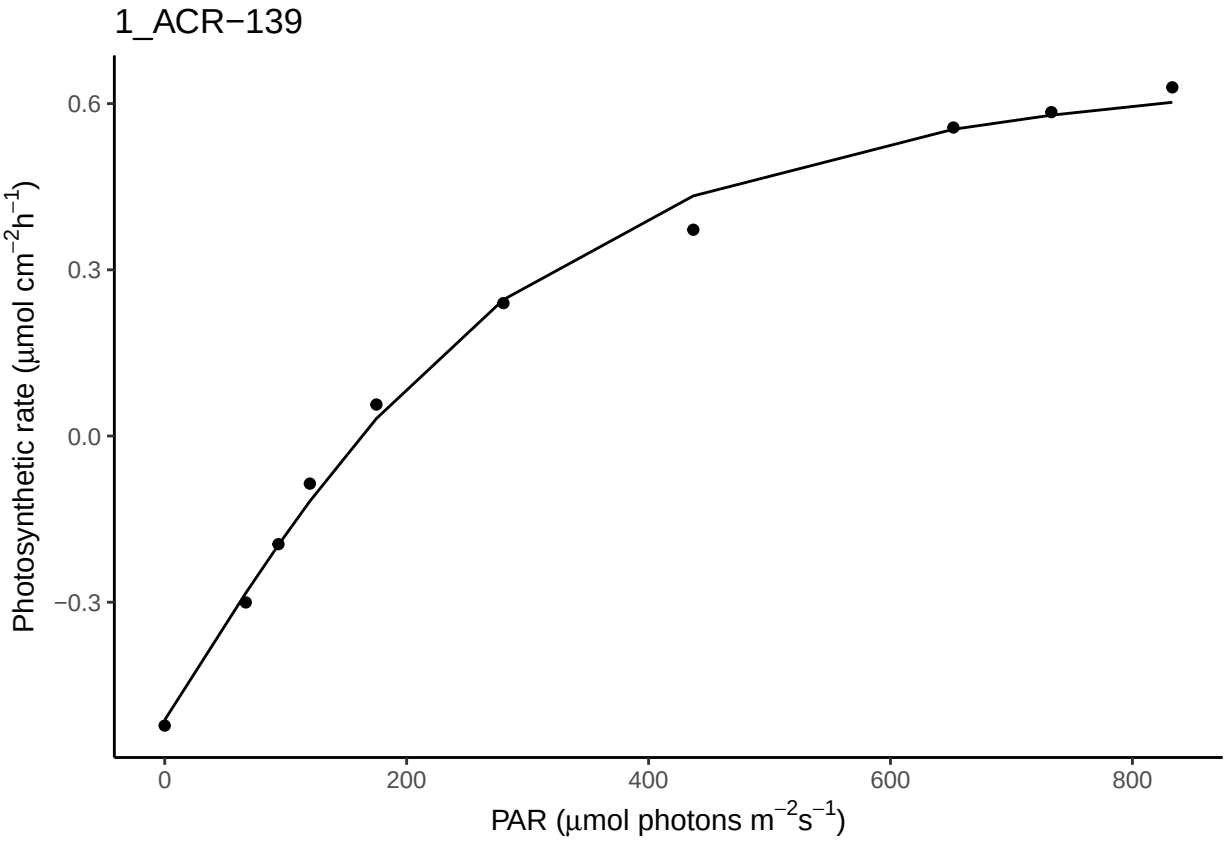

```
## ------------------------------------------------------------
## augmented$colony_id: POC-41
```



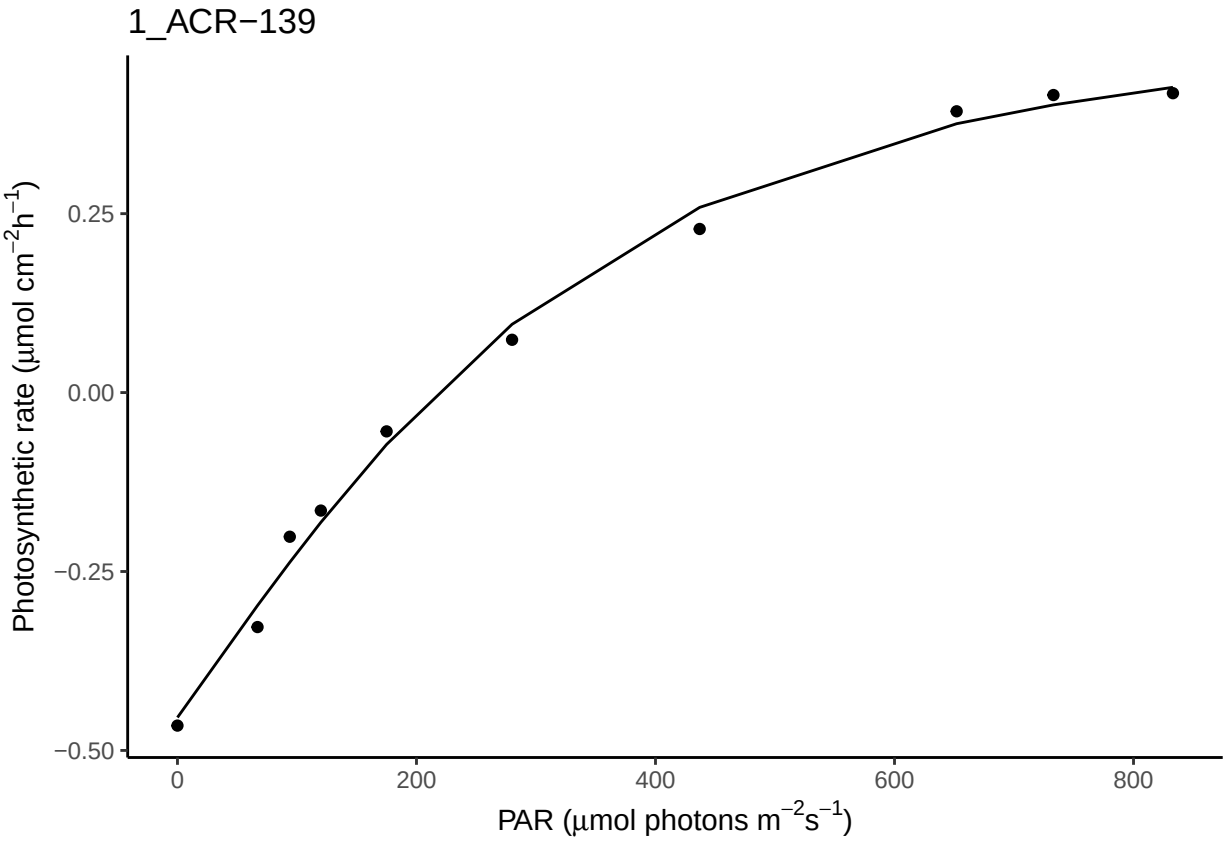

```
## ------------------------------------------------------------
## augmented$colony_id: POC-42
```



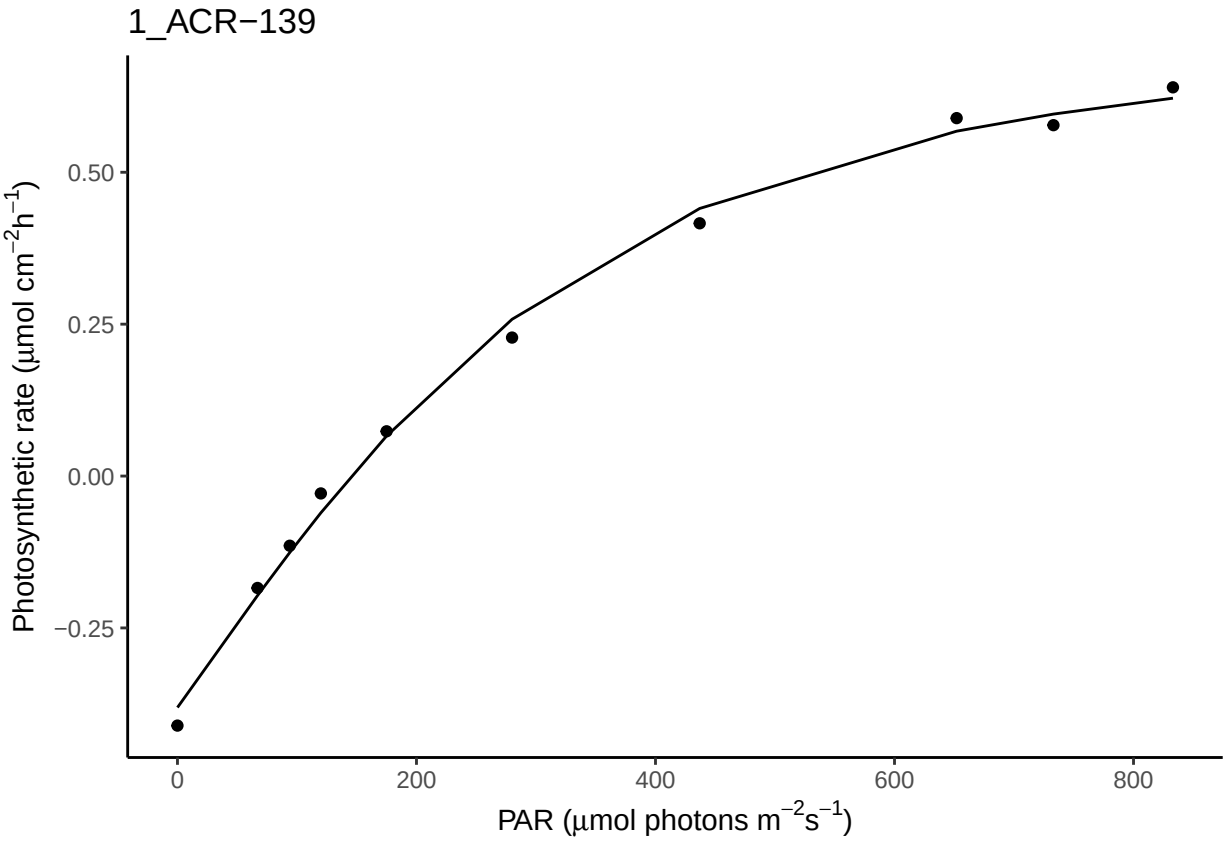

```
## ------------------------------------------------------------
## augmented$colony_id: POC-43
```



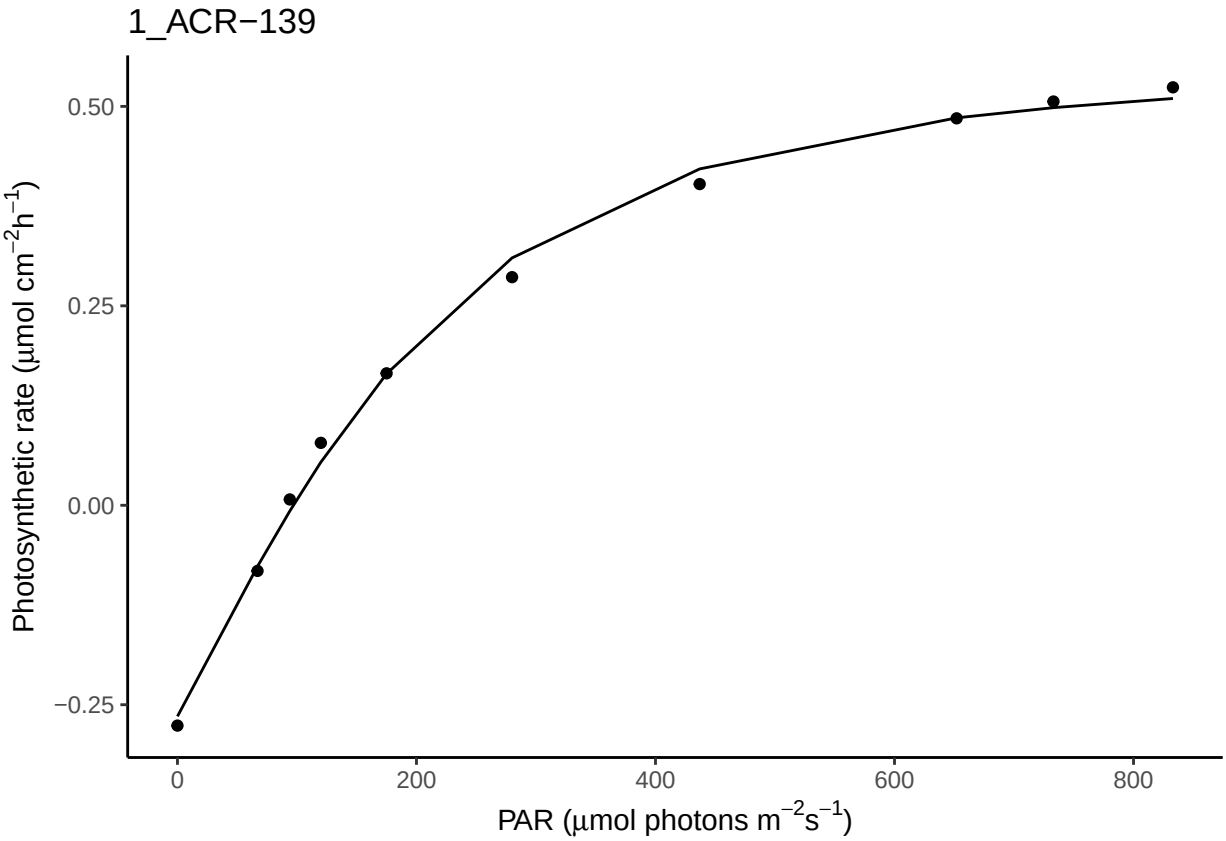

```
## ------------------------------------------------------------
## augmented$colony_id: POC-44
```



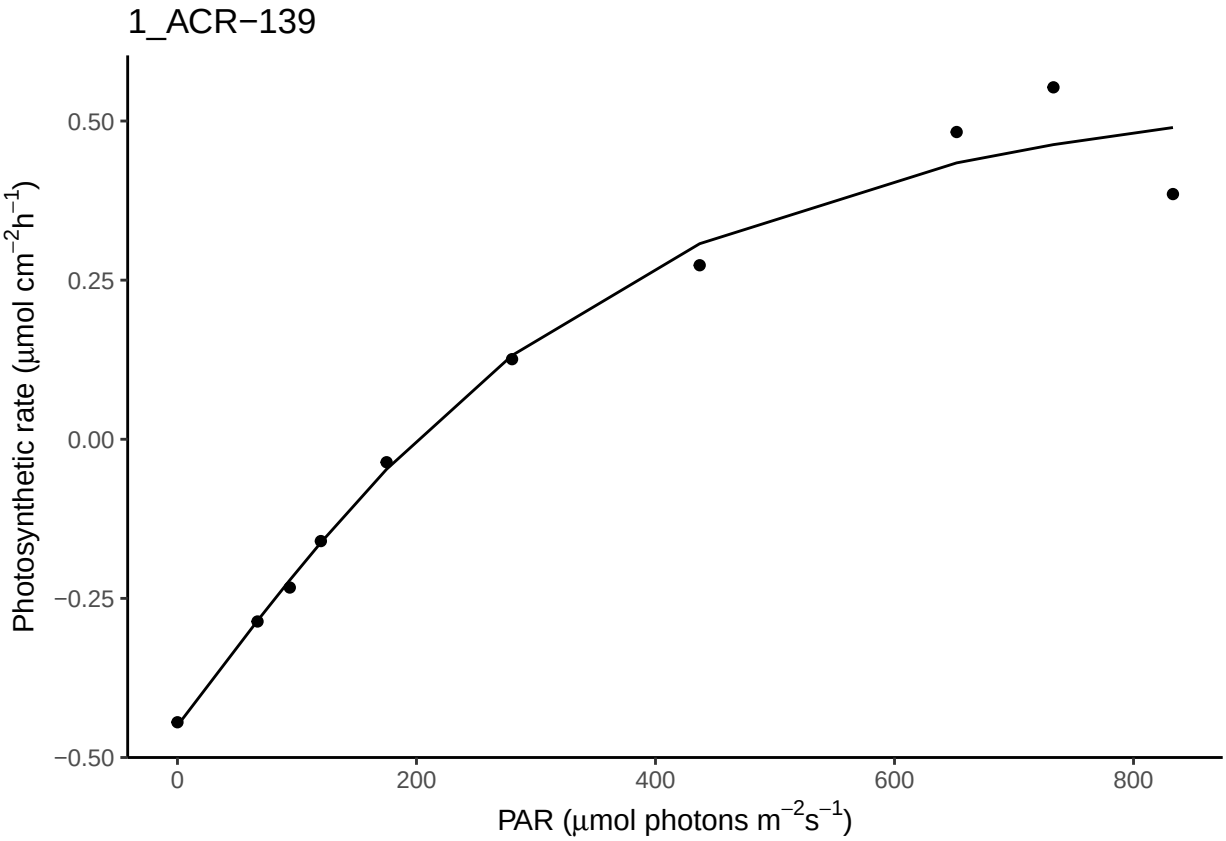

```
## ------------------------------------------------------------
## augmented$colony_id: POC-45
```



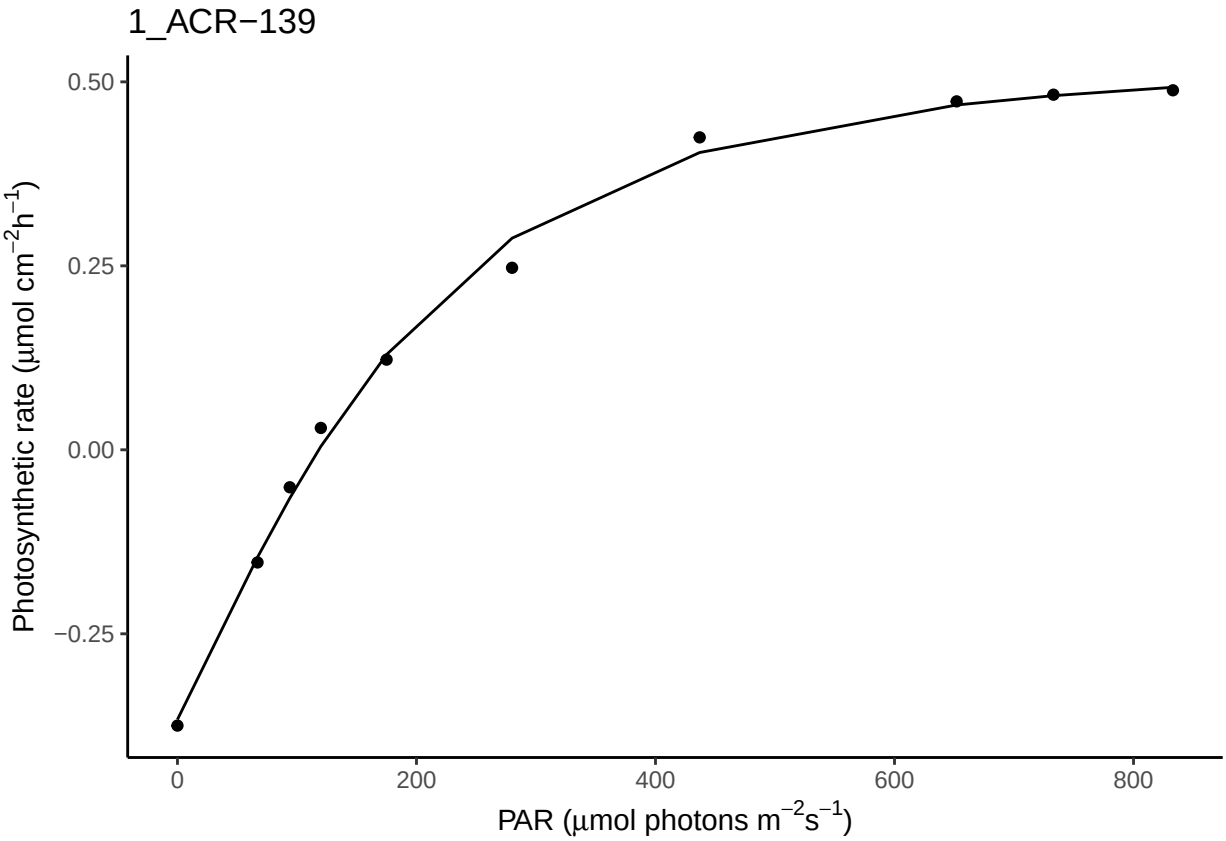

```
## ------------------------------------------------------------
## augmented$colony_id: POC-47
```



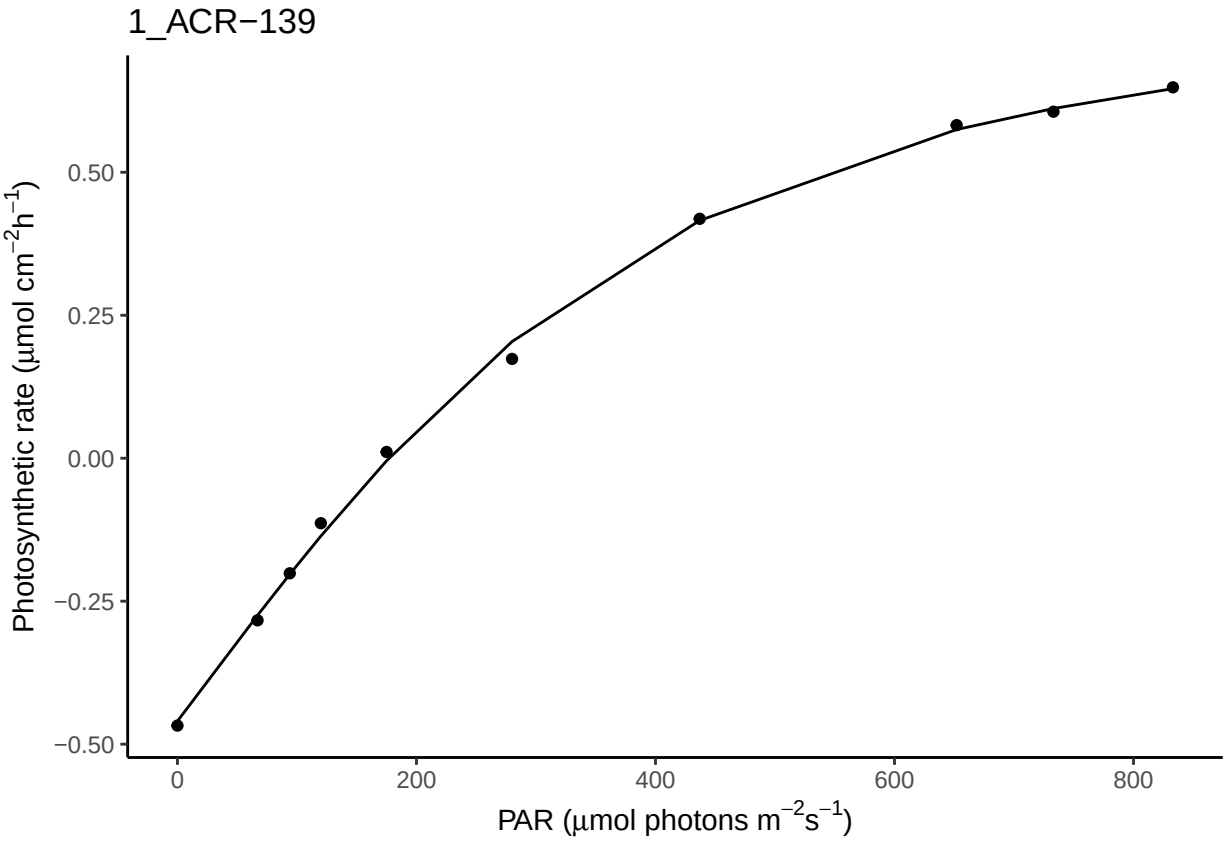

```
## ------------------------------------------------------------
## augmented$colony_id: POC-48
```



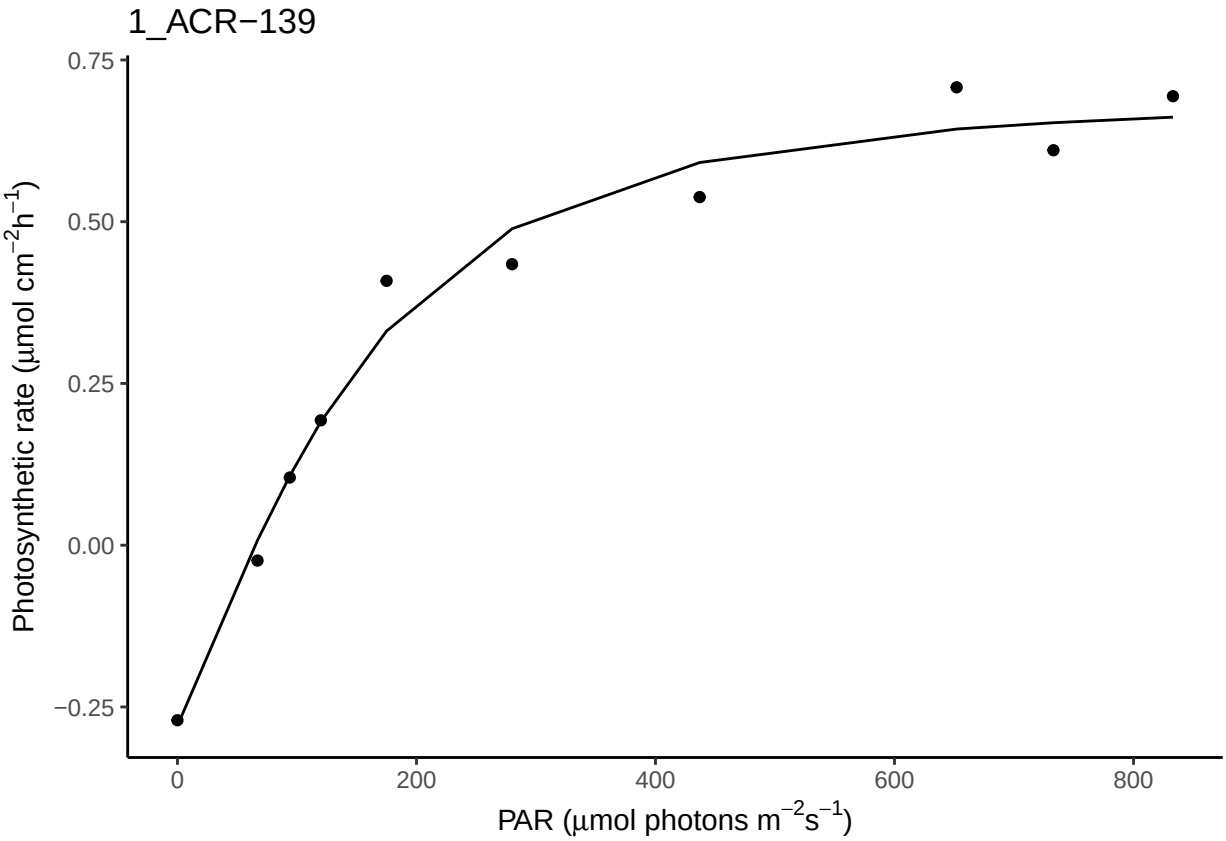

```
## ------------------------------------------------------------
## augmented$colony_id: POC-50
```



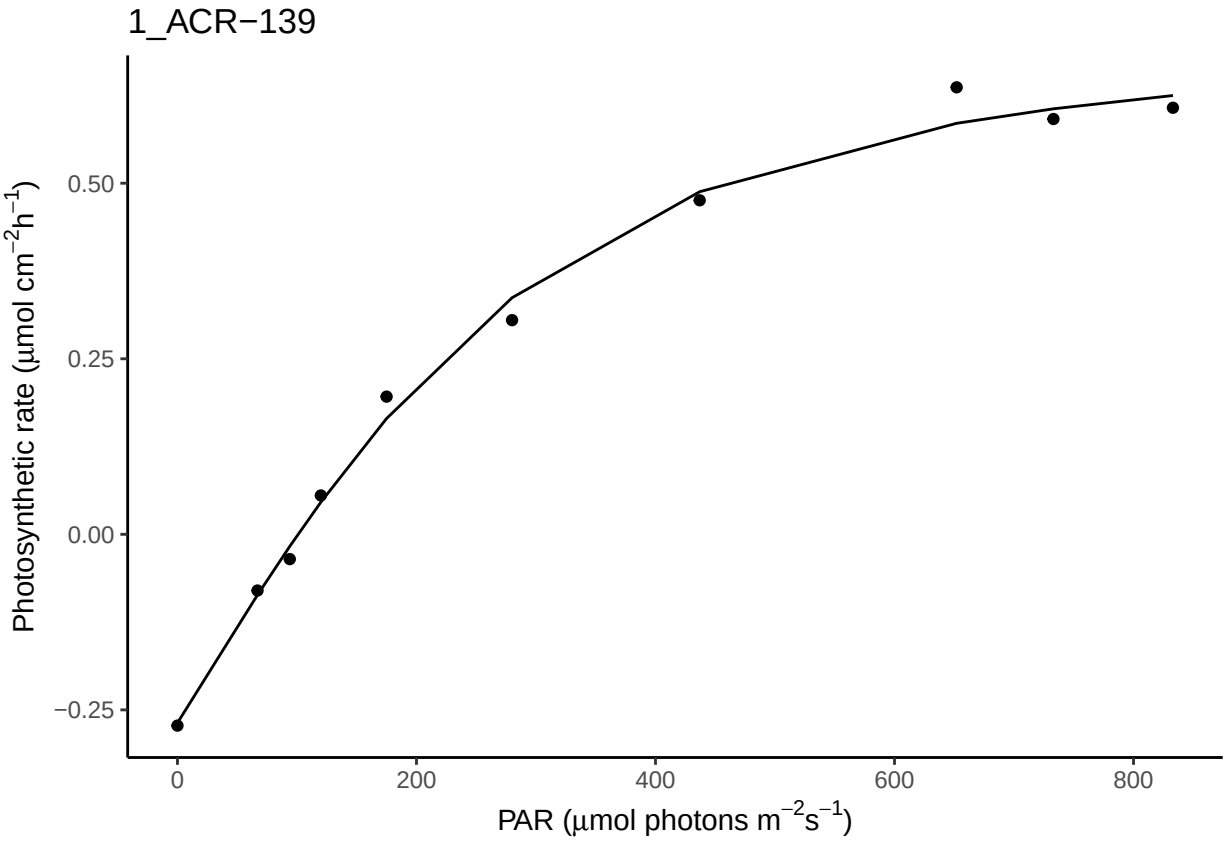

```
## ------------------------------------------------------------
## augmented$colony_id: POC-52
```



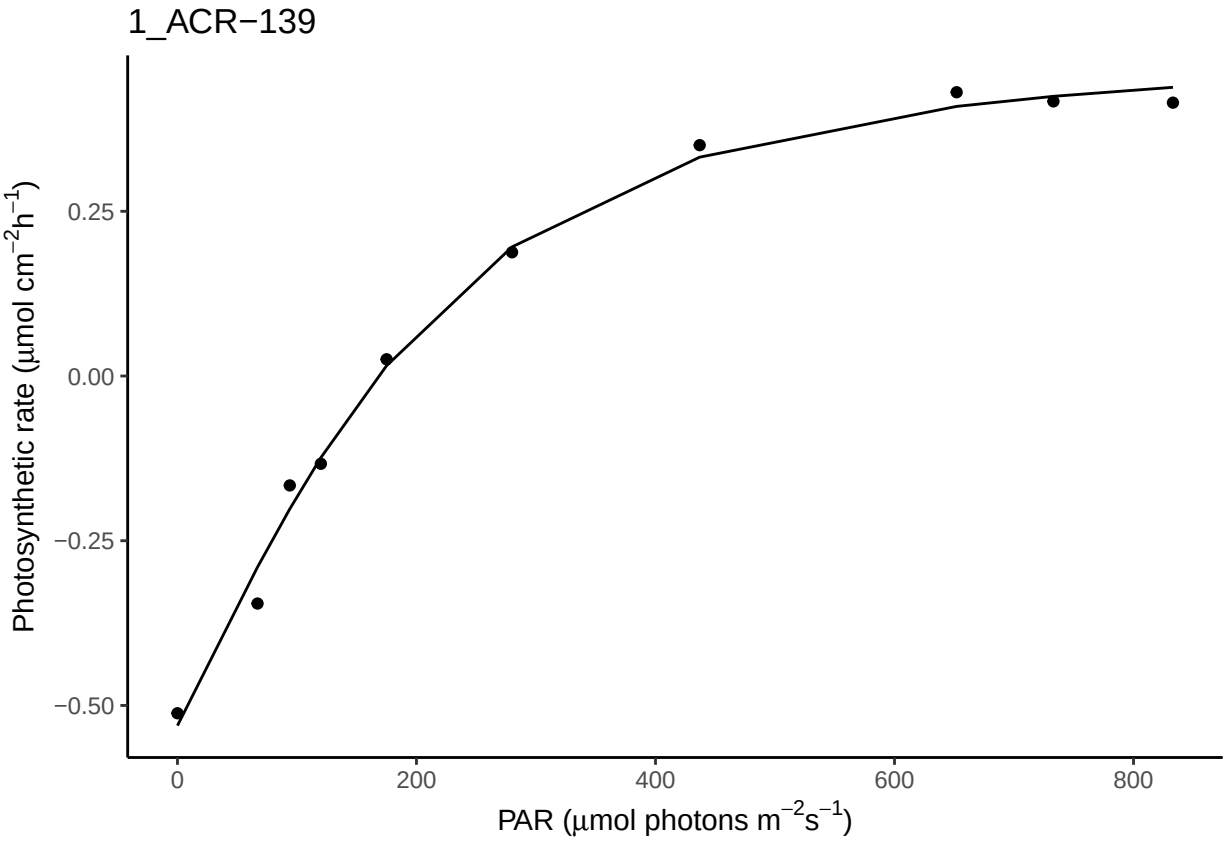

```
## ------------------------------------------------------------
## augmented$colony_id: POC-53
```



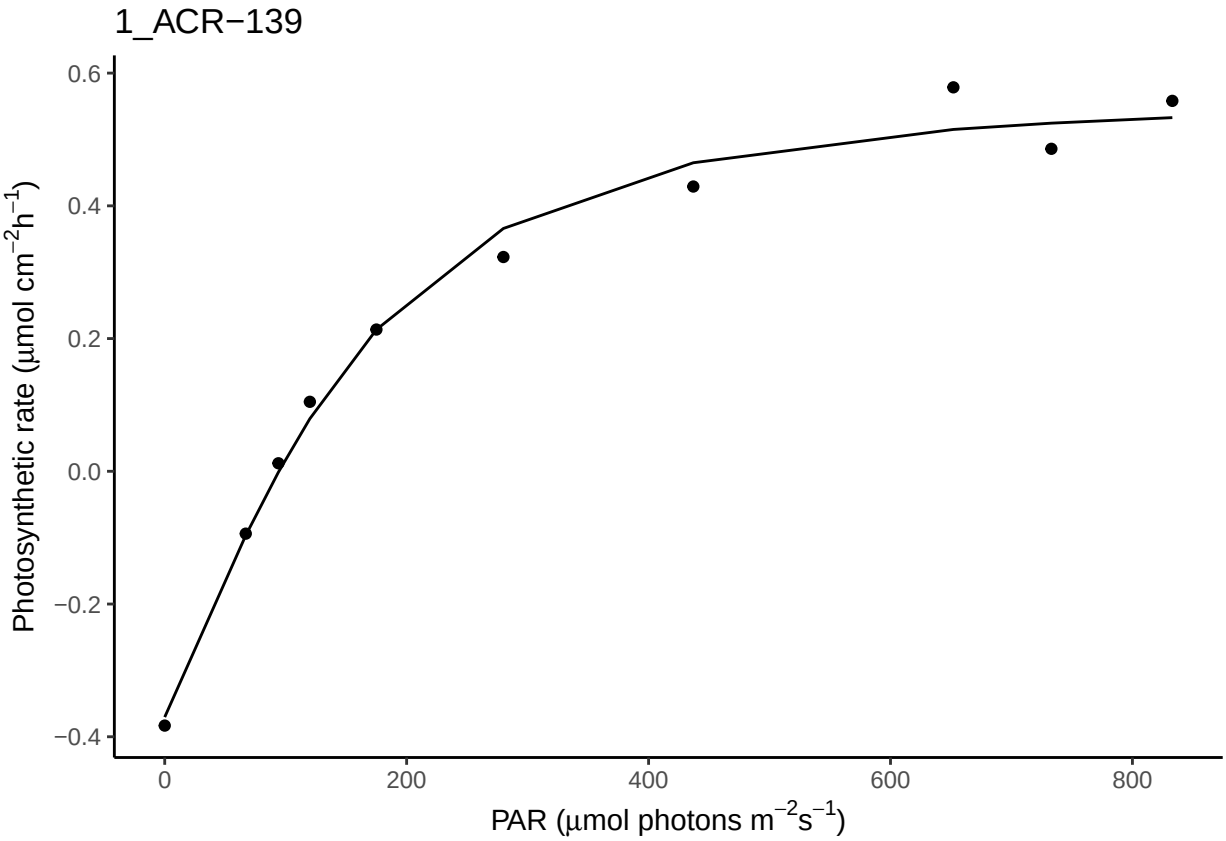

```
## ------------------------------------------------------------
## augmented$colony_id: POC-55
```



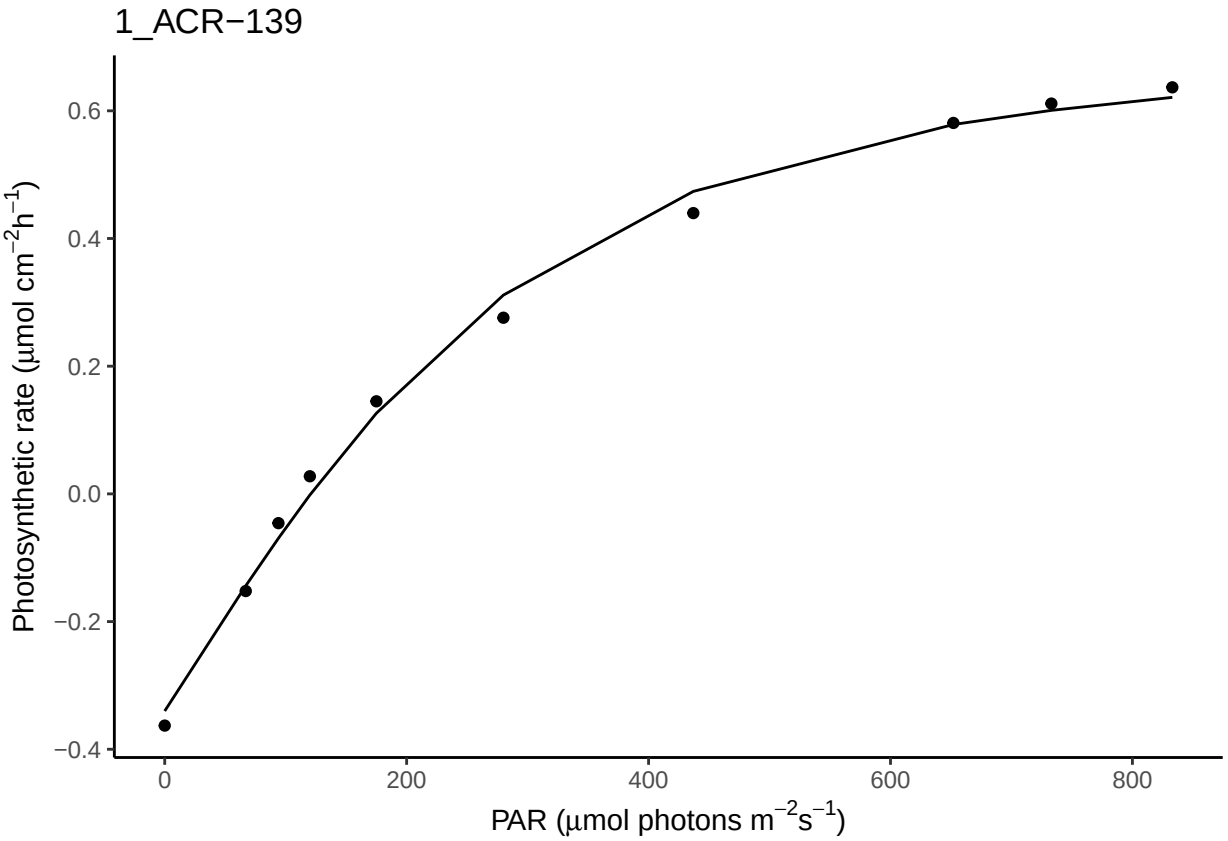

```
## ------------------------------------------------------------
## augmented$colony_id: POC-56
```



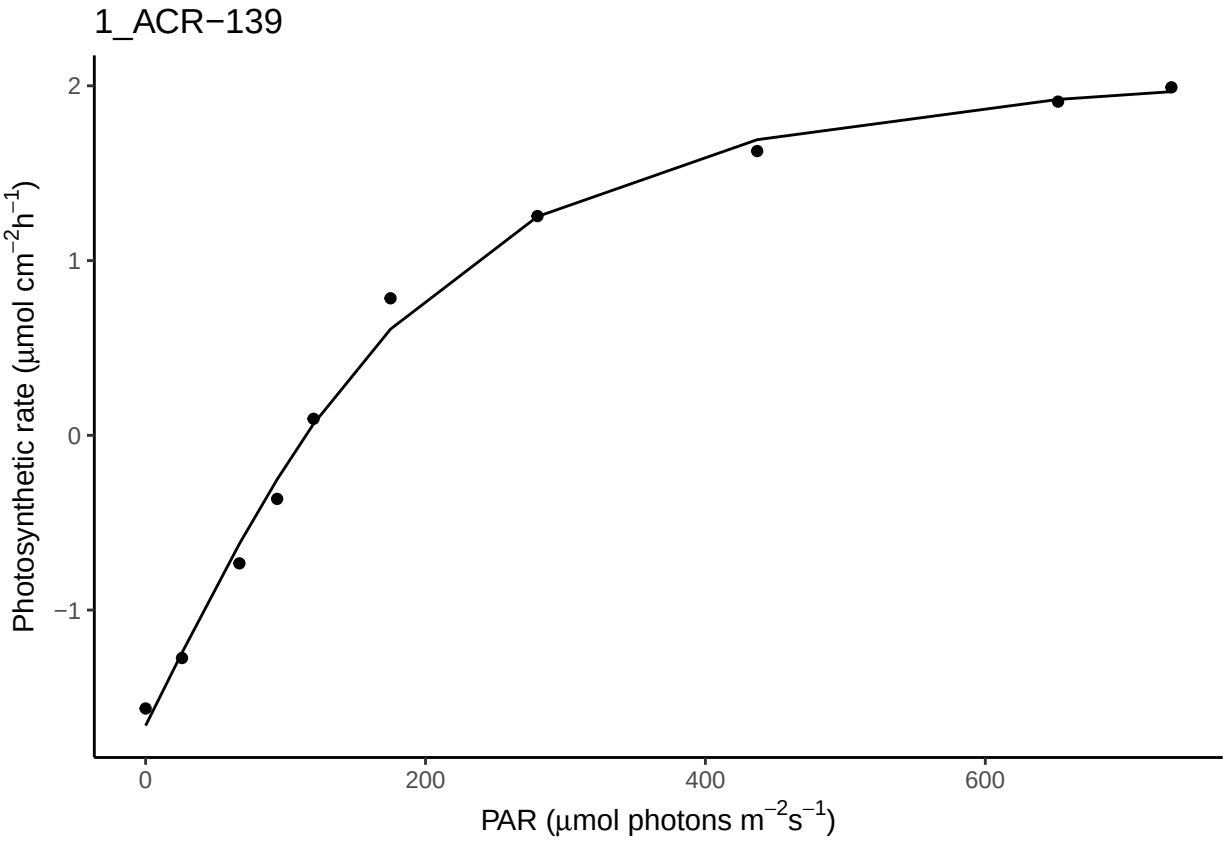

```
## ------------------------------------------------------------
## augmented$colony_id: POC-57
```



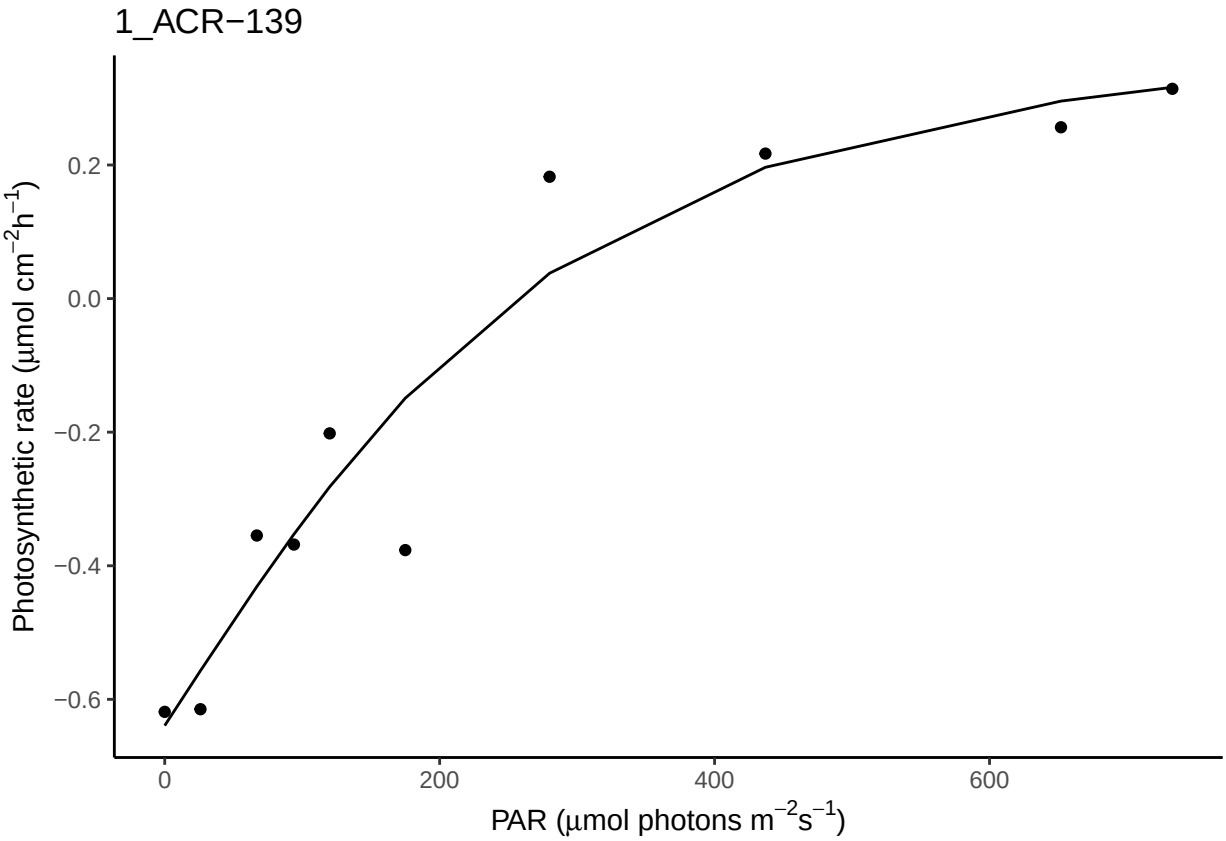

```
## ------------------------------------------------------------
## augmented$colony_id: POC-68
```



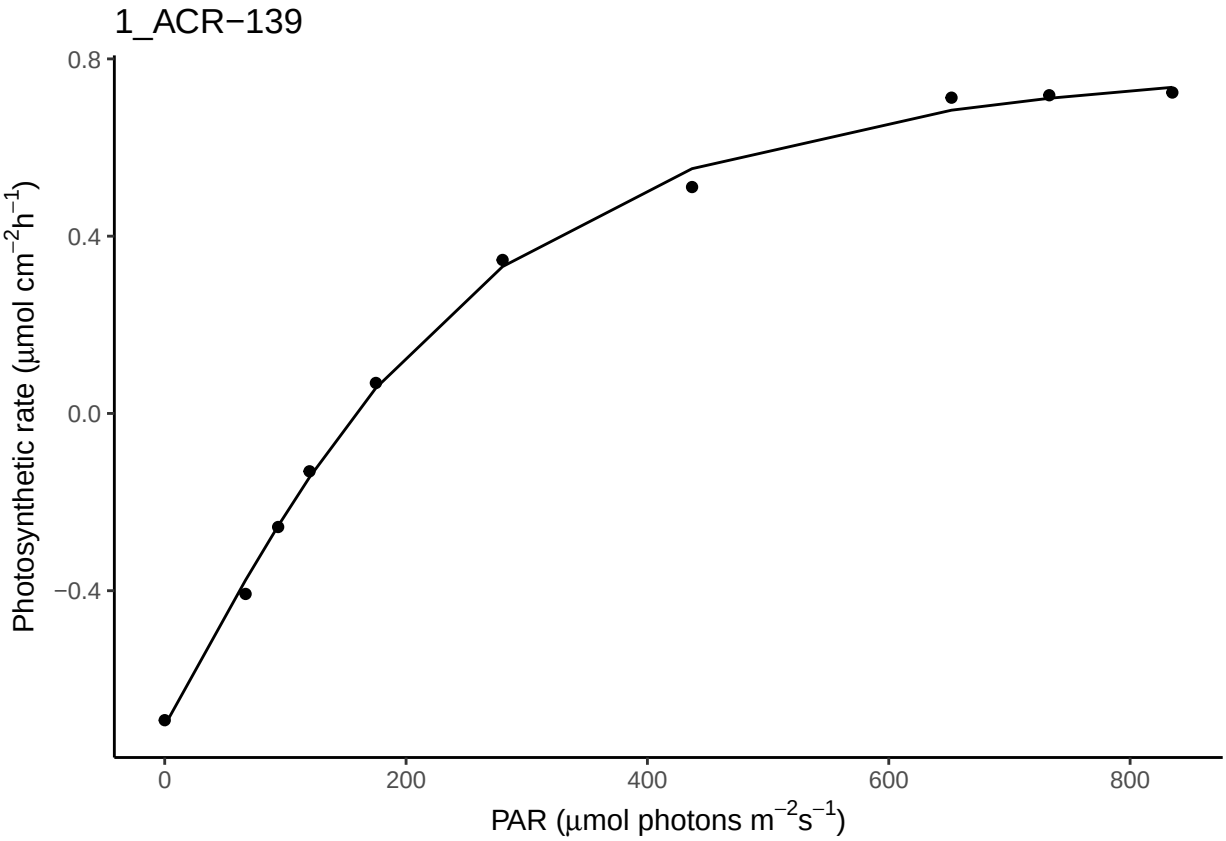

```
## ------------------------------------------------------------
## augmented$colony_id: POR-209
```



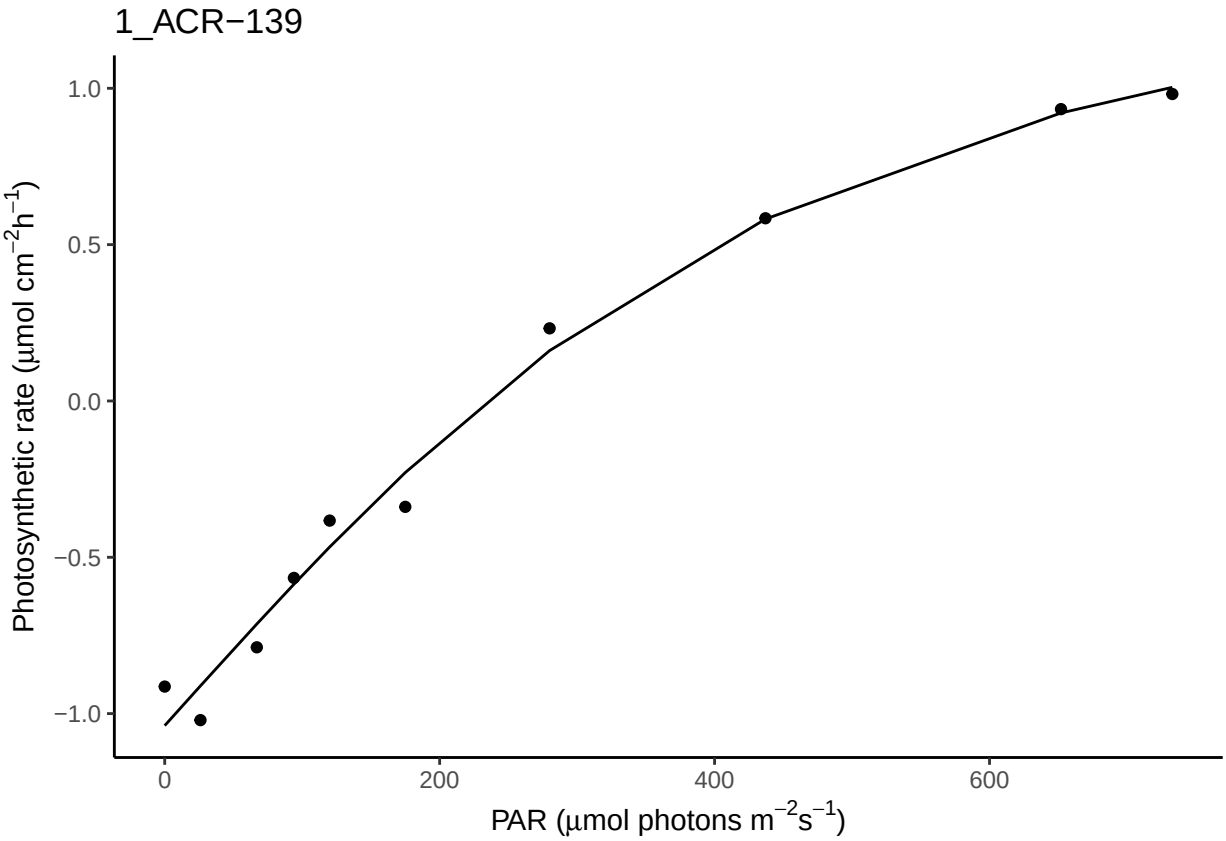

```
## ------------------------------------------------------------
## augmented$colony_id: POR-214
```



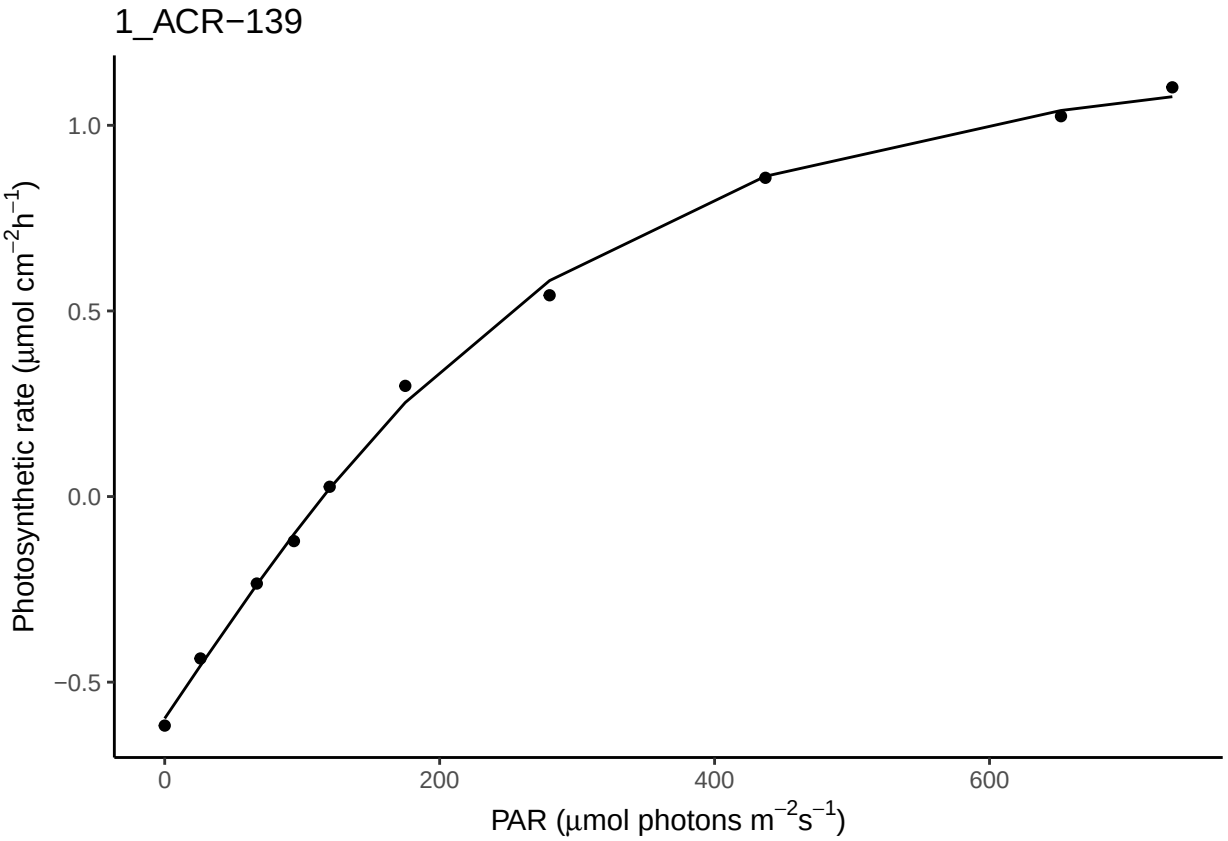

```
## ------------------------------------------------------------
## augmented$colony_id: POR-216
```



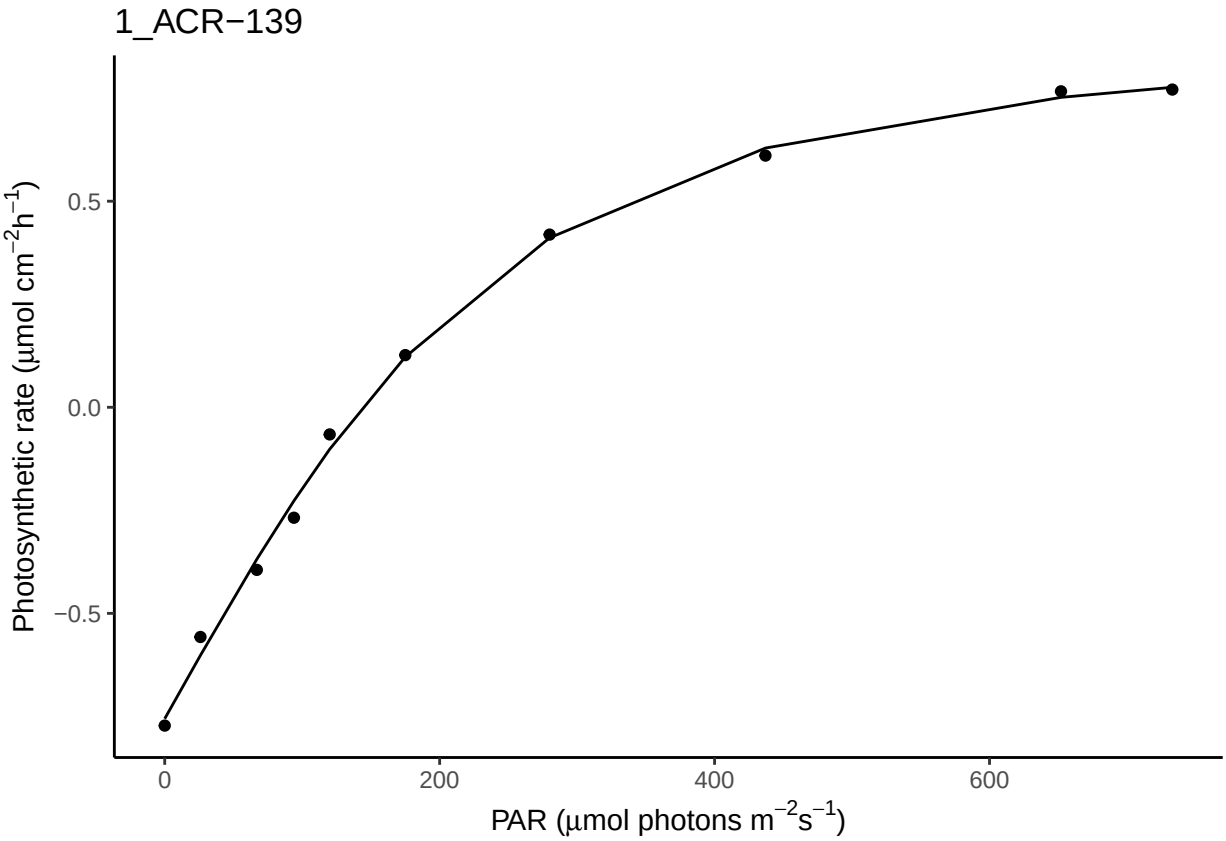

```
## ------------------------------------------------------------
## augmented$colony_id: POR-221
```



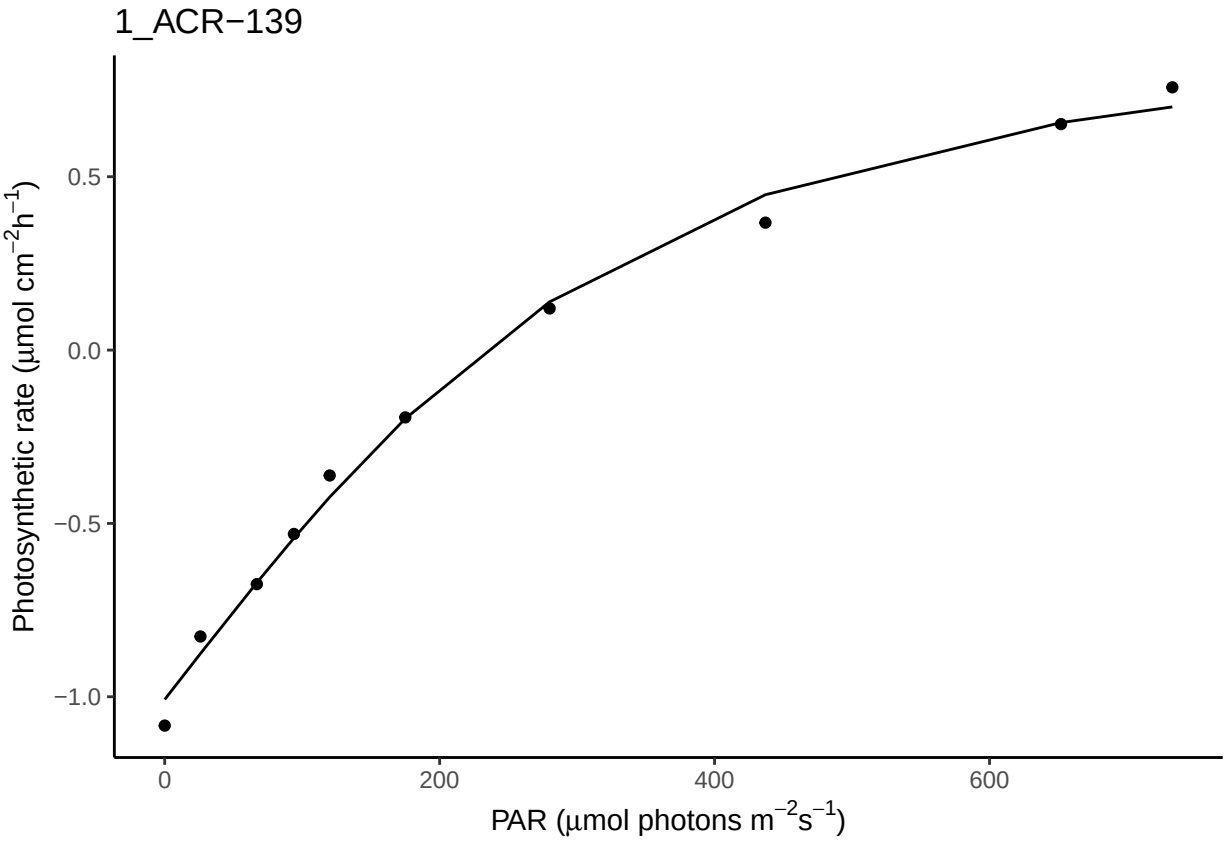

```
## ------------------------------------------------------------
## augmented$colony_id: POR-224
```



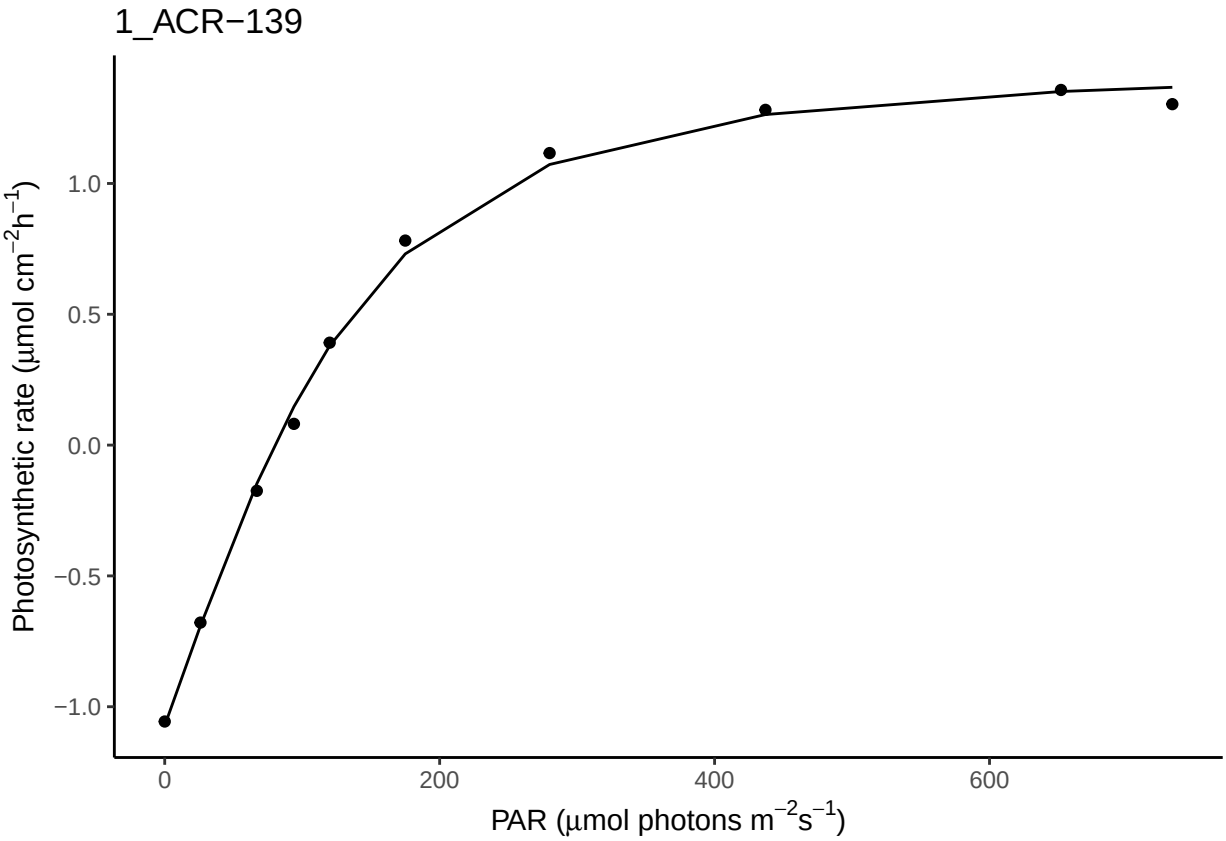

```
## ------------------------------------------------------------
## augmented$colony_id: POR-235
```



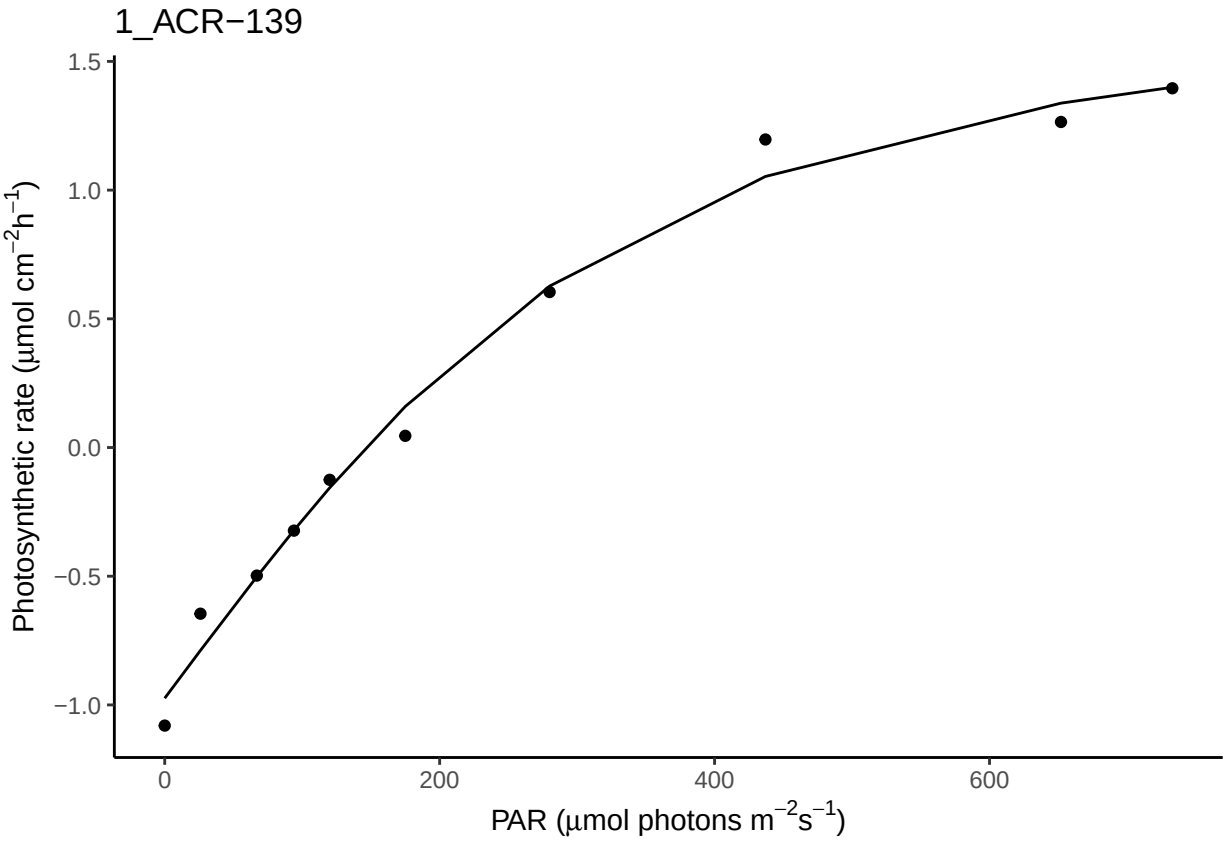

```
## ------------------------------------------------------------
## augmented$colony_id: POR-236
```



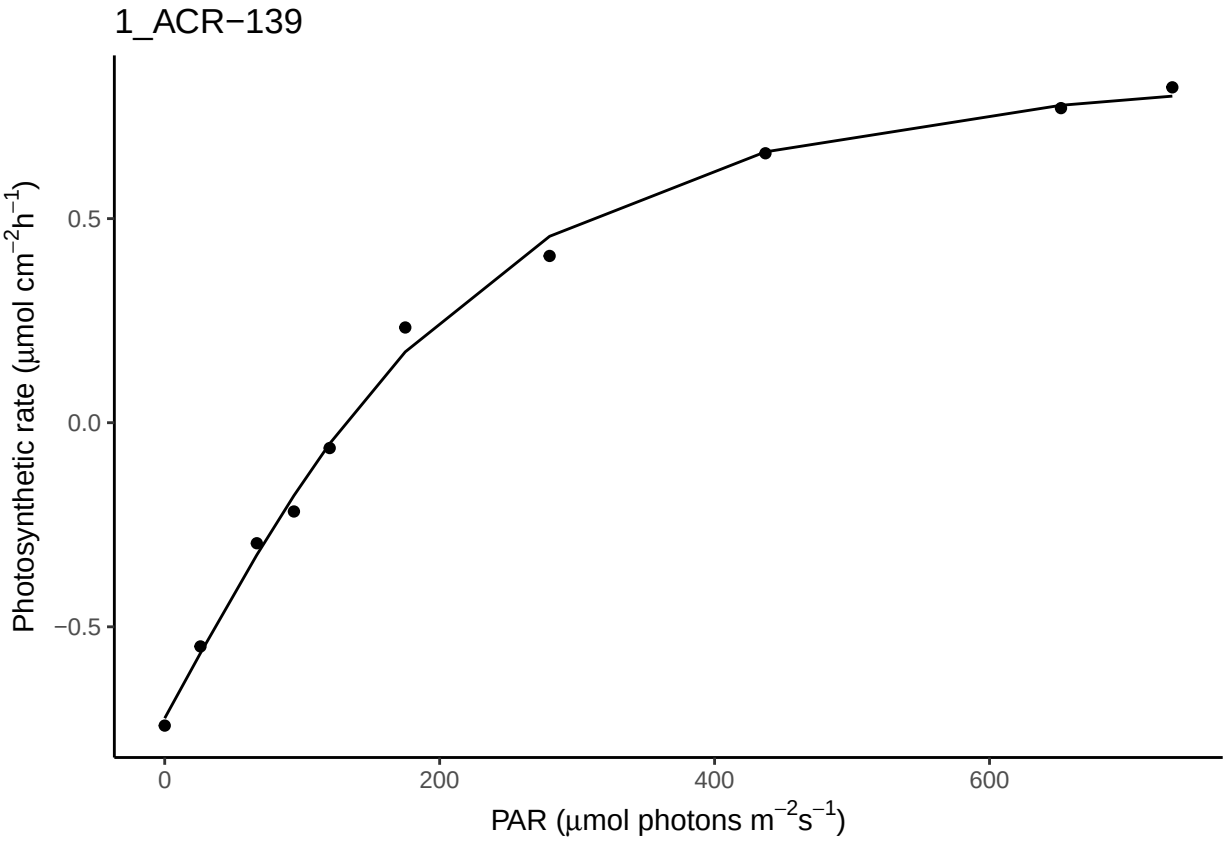

```
## ------------------------------------------------------------
## augmented$colony_id: POR-240
```



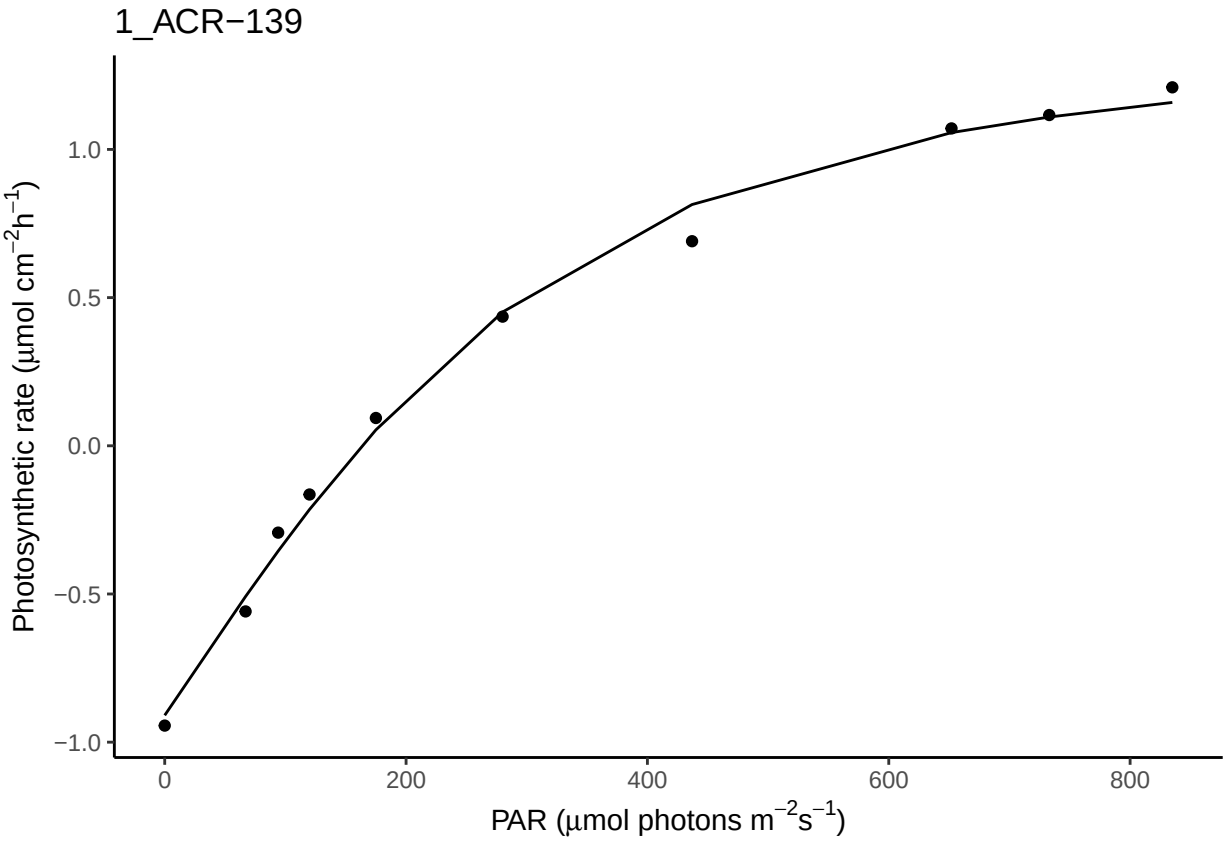

```
## ------------------------------------------------------------
## augmented$colony_id: POR-242
```



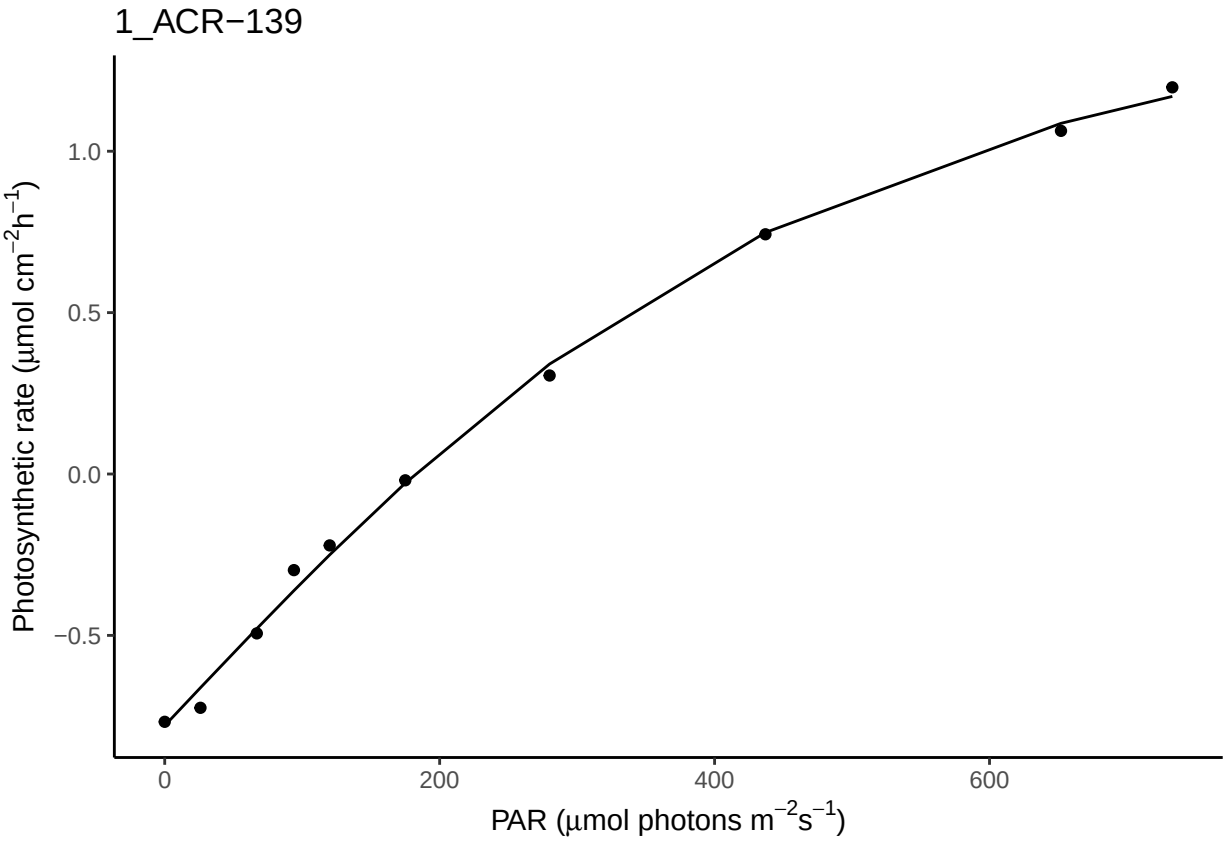

```
## ------------------------------------------------------------
## augmented$colony_id: POR-245
```



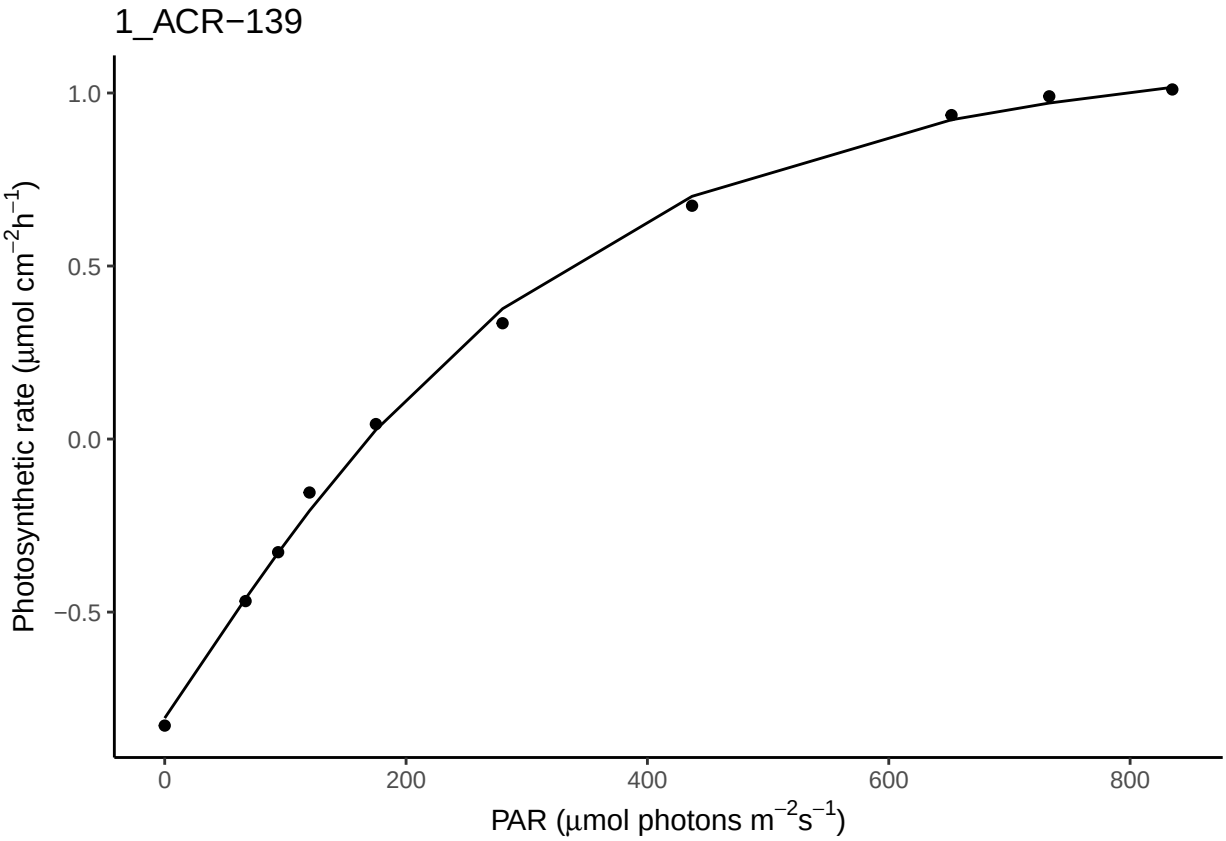

```
## ------------------------------------------------------------
## augmented$colony_id: POR-251
```



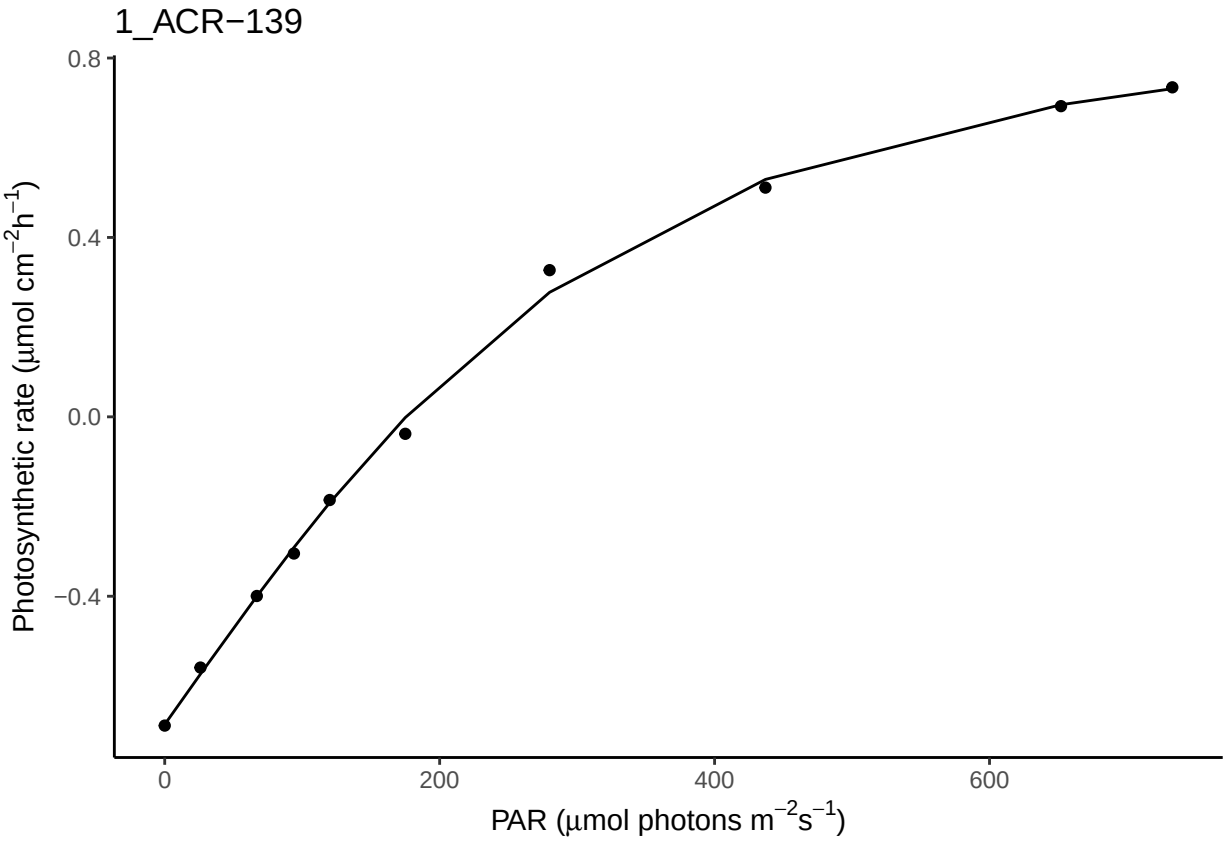

```
## ------------------------------------------------------------
## augmented$colony_id: POR-253
```



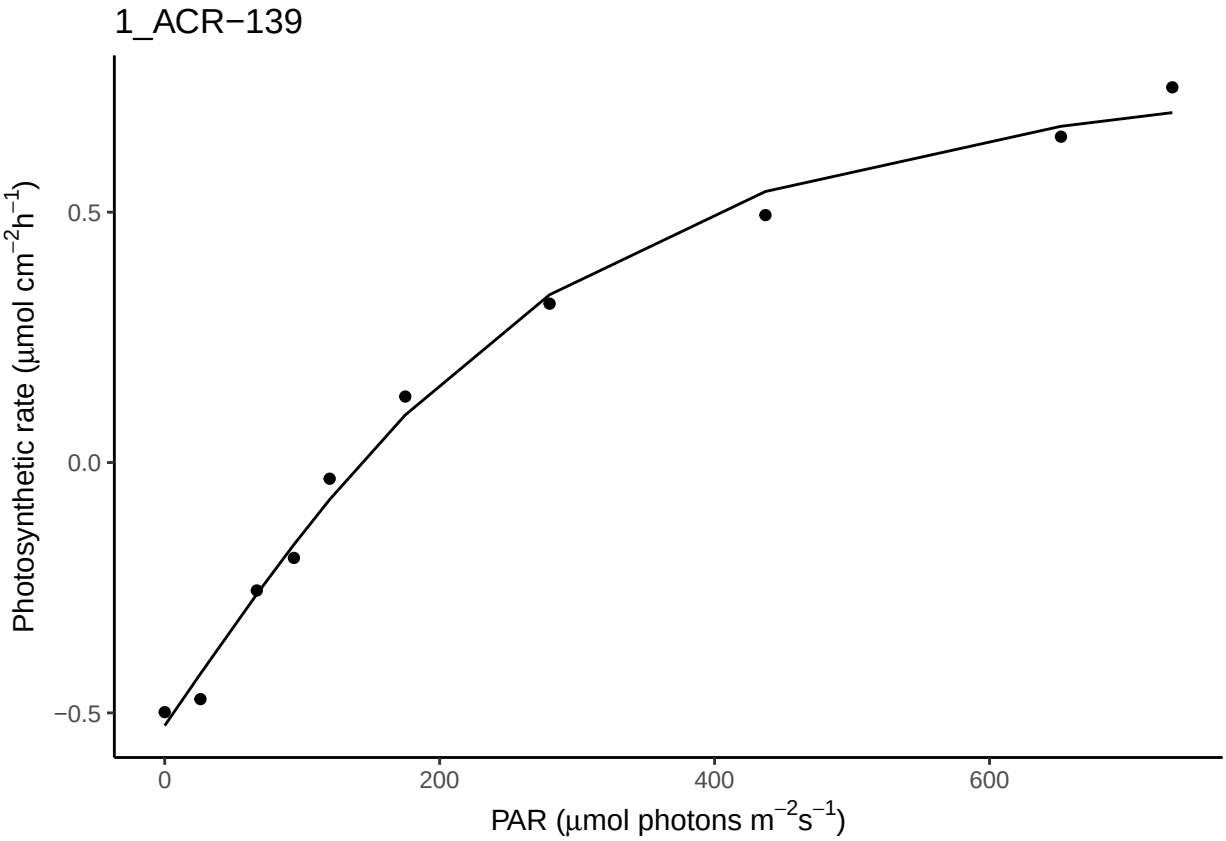

```
## ------------------------------------------------------------
## augmented$colony_id: POR-260
```



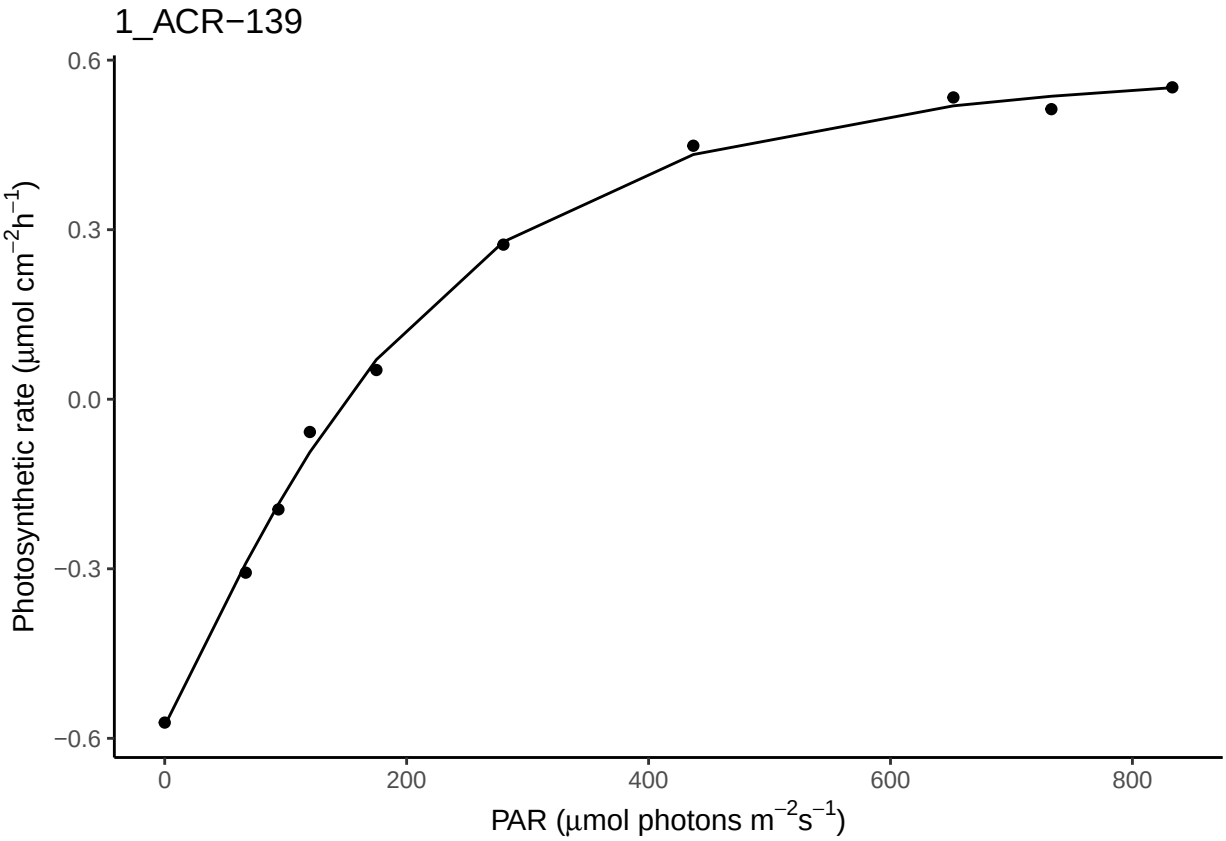

```
## ------------------------------------------------------------
## augmented$colony_id: POR-262
```



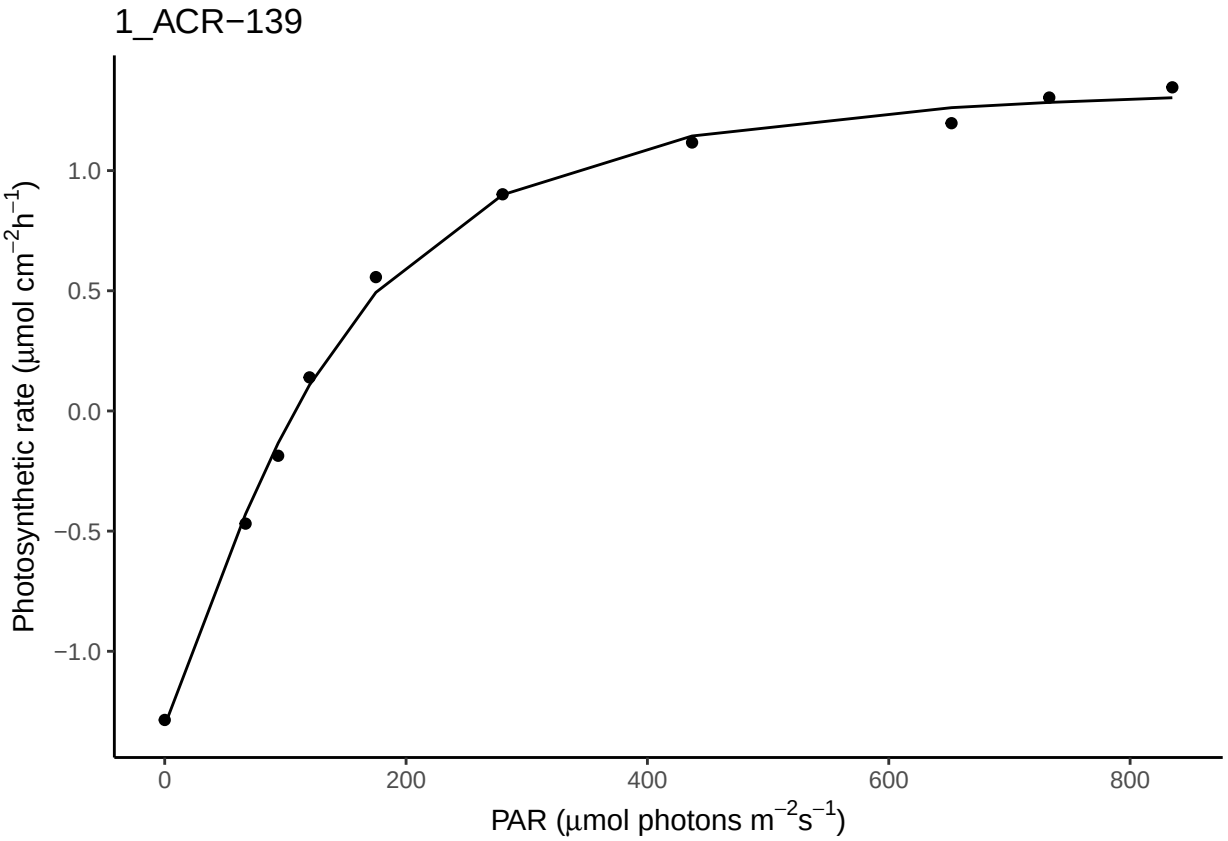

```
## ------------------------------------------------------------
## augmented$colony_id: POR-266
```



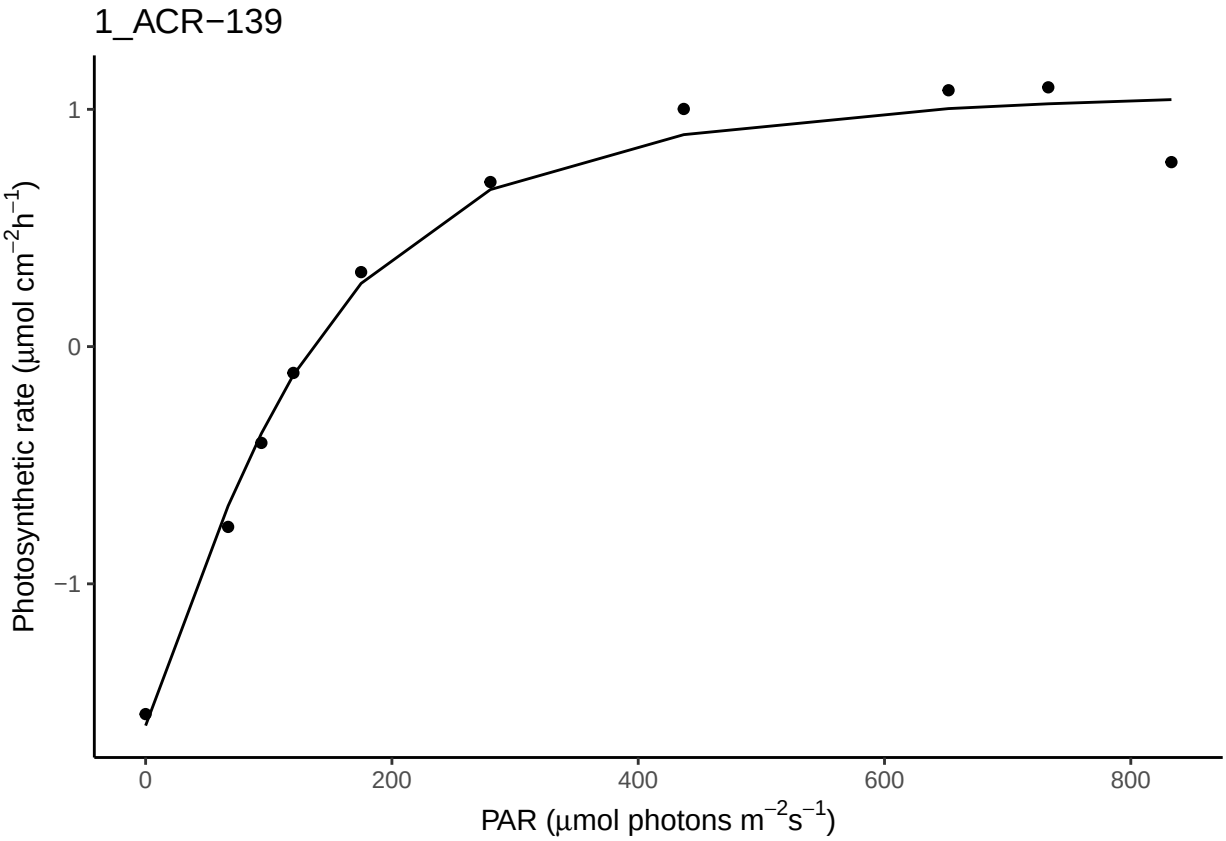

```
## ------------------------------------------------------------
## augmented$colony_id: POR-338
```



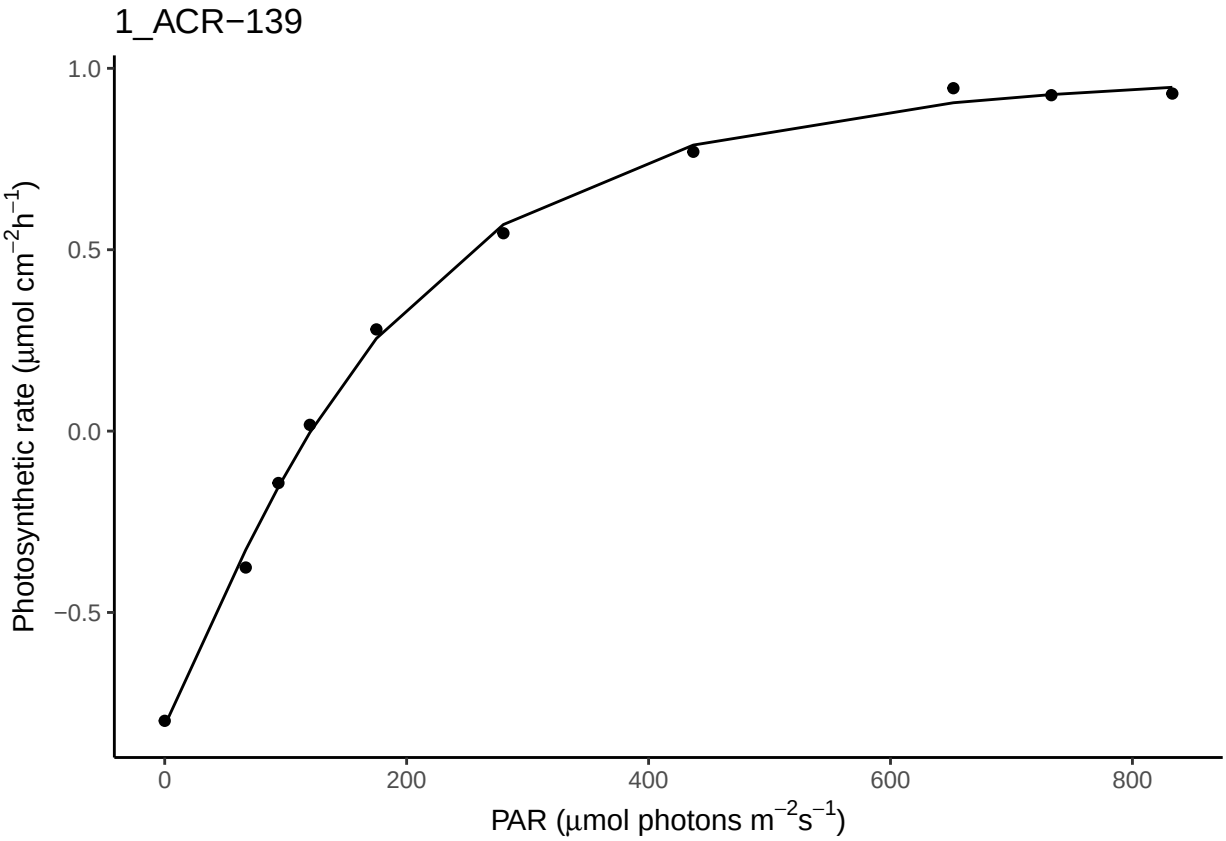

```
## ------------------------------------------------------------
## augmented$colony_id: POR-340
```



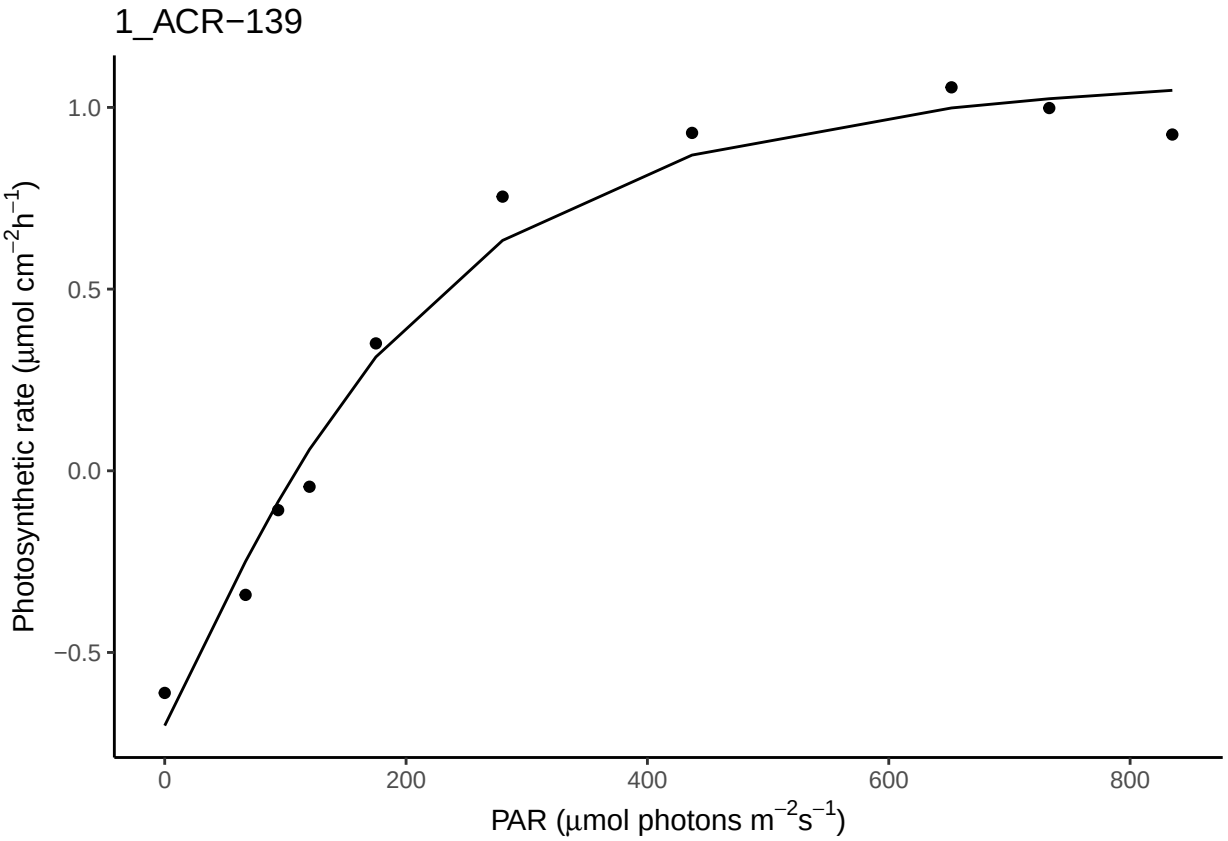

```
## ------------------------------------------------------------
## augmented$colony_id: POR-341
```



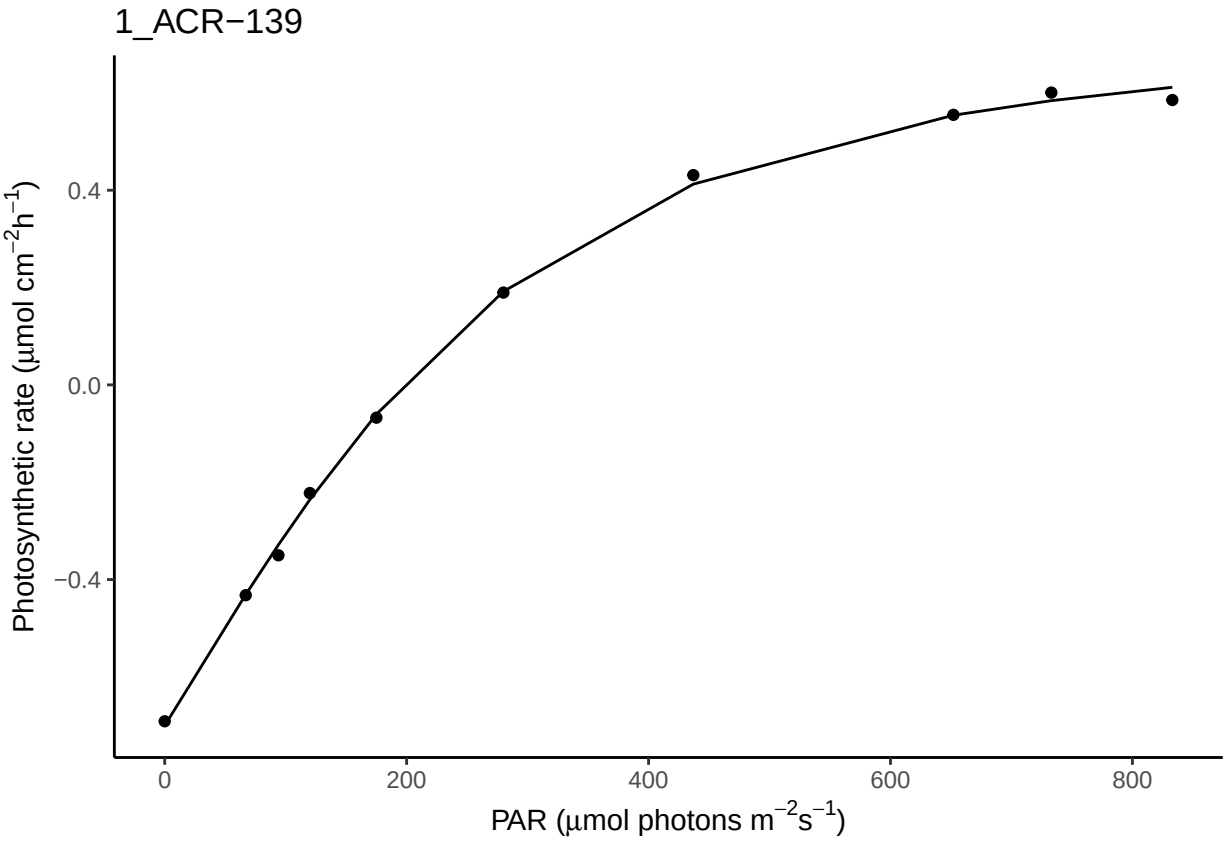

```
## ------------------------------------------------------------
## augmented$colony_id: POR-349
```



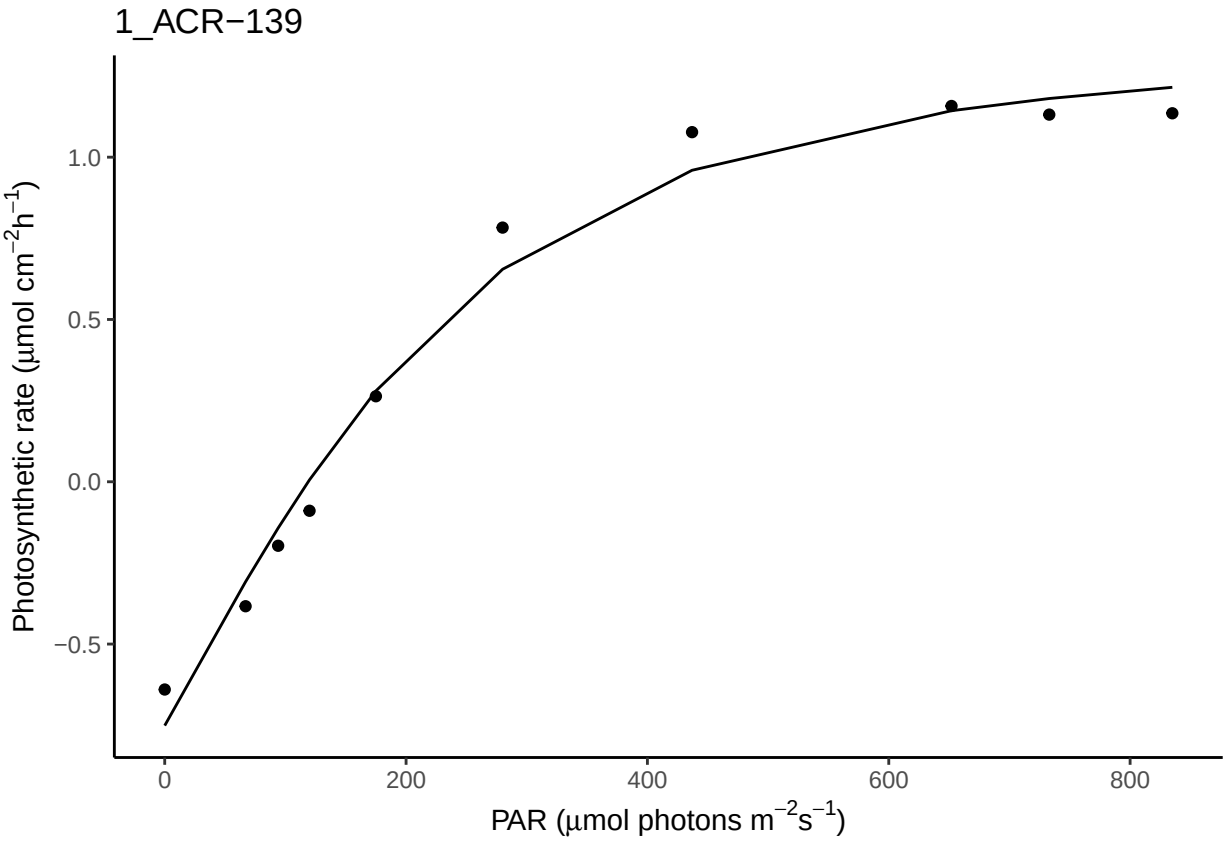

```
## ------------------------------------------------------------
## augmented$colony_id: POR-353
```



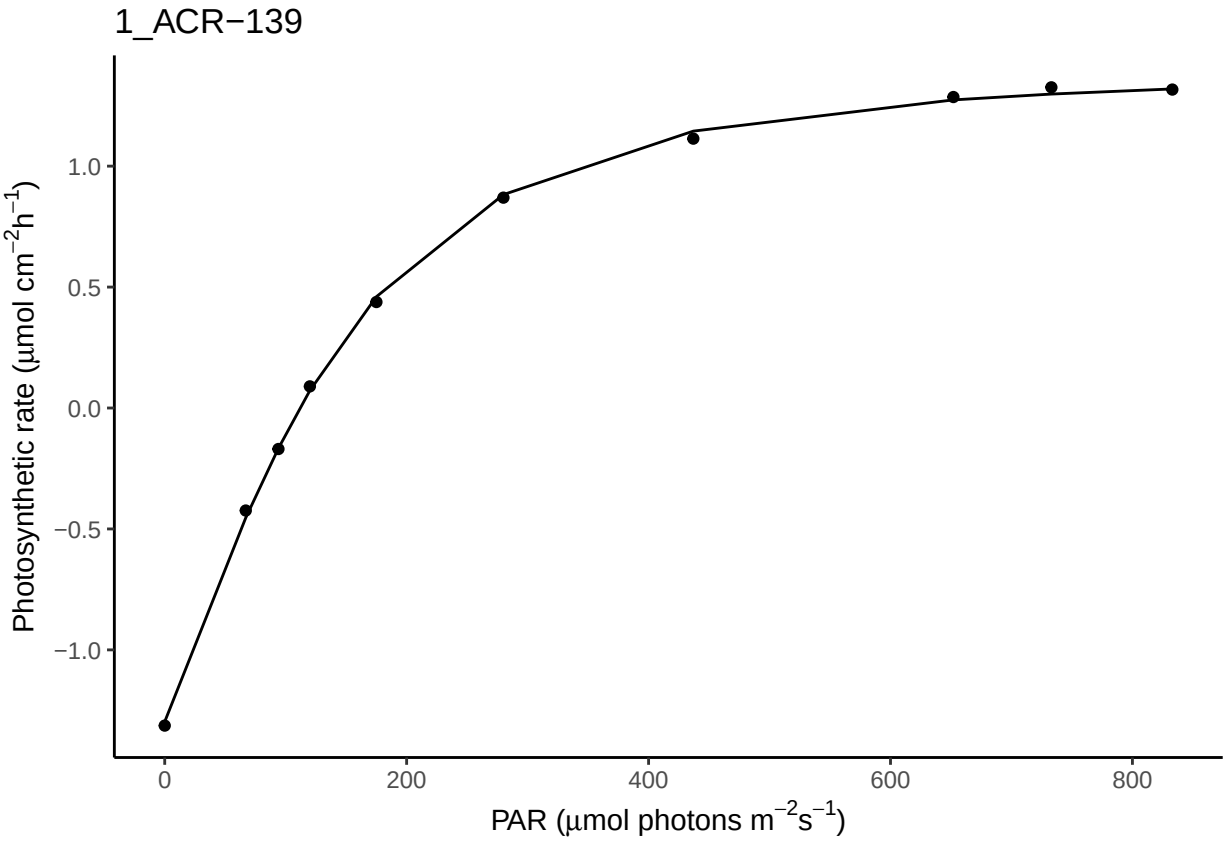

```
## ------------------------------------------------------------
## augmented$colony_id: POR-354
```



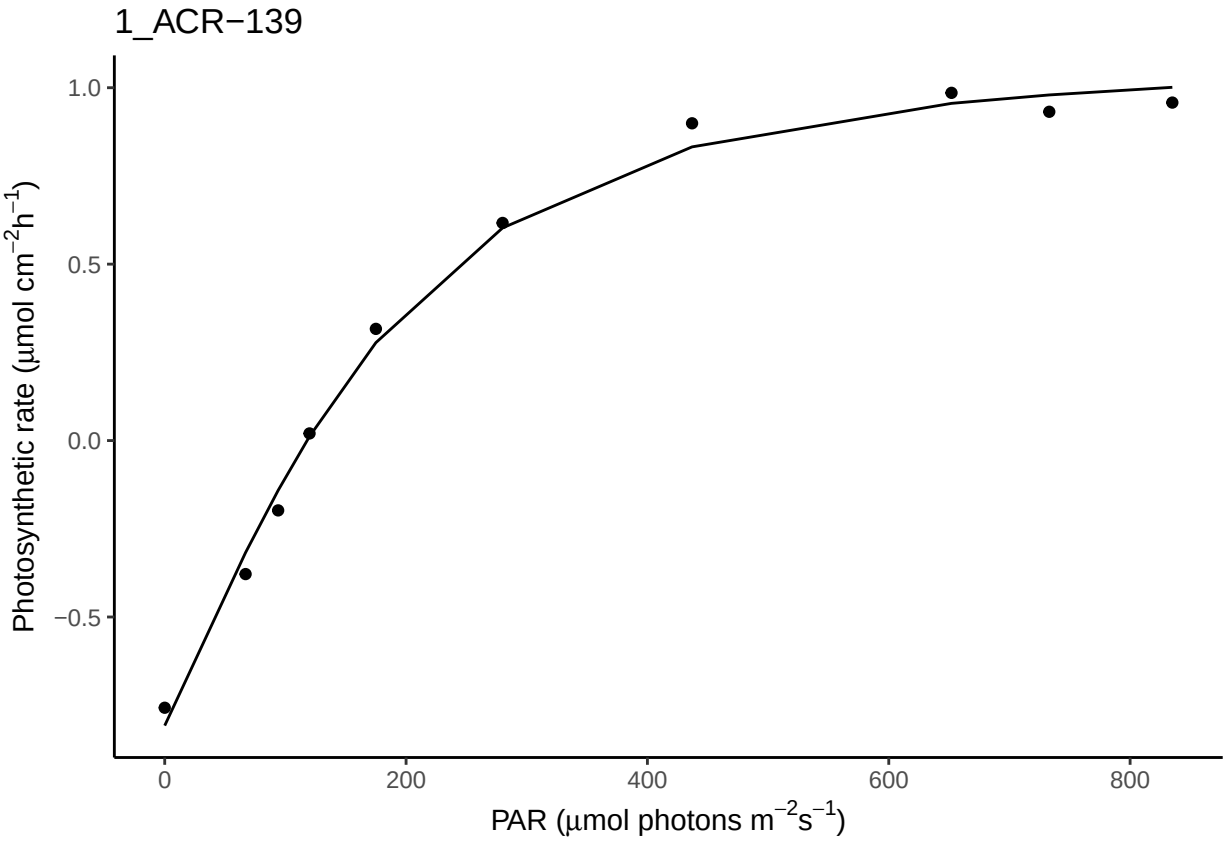

```
## ------------------------------------------------------------
## augmented$colony_id: POR-355
```



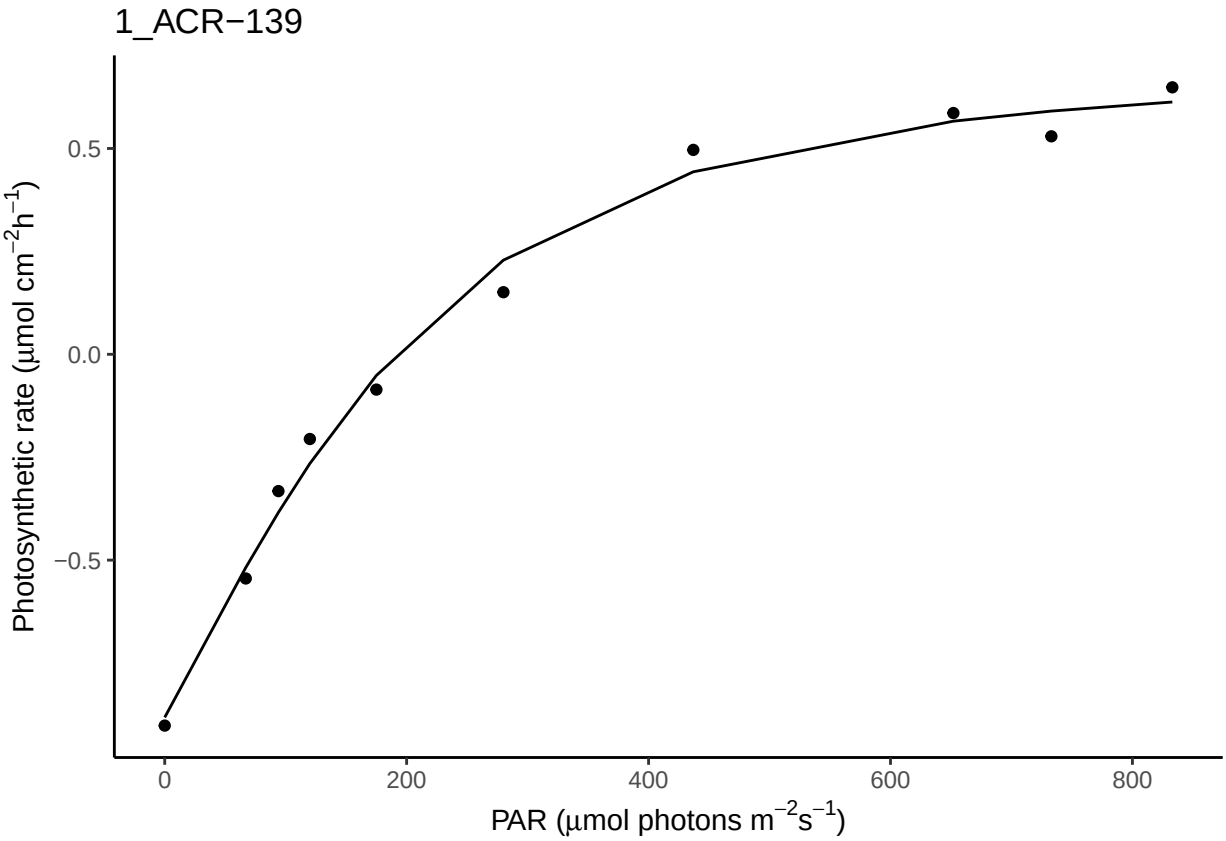

```
## ------------------------------------------------------------
## augmented$colony_id: POR-357
```



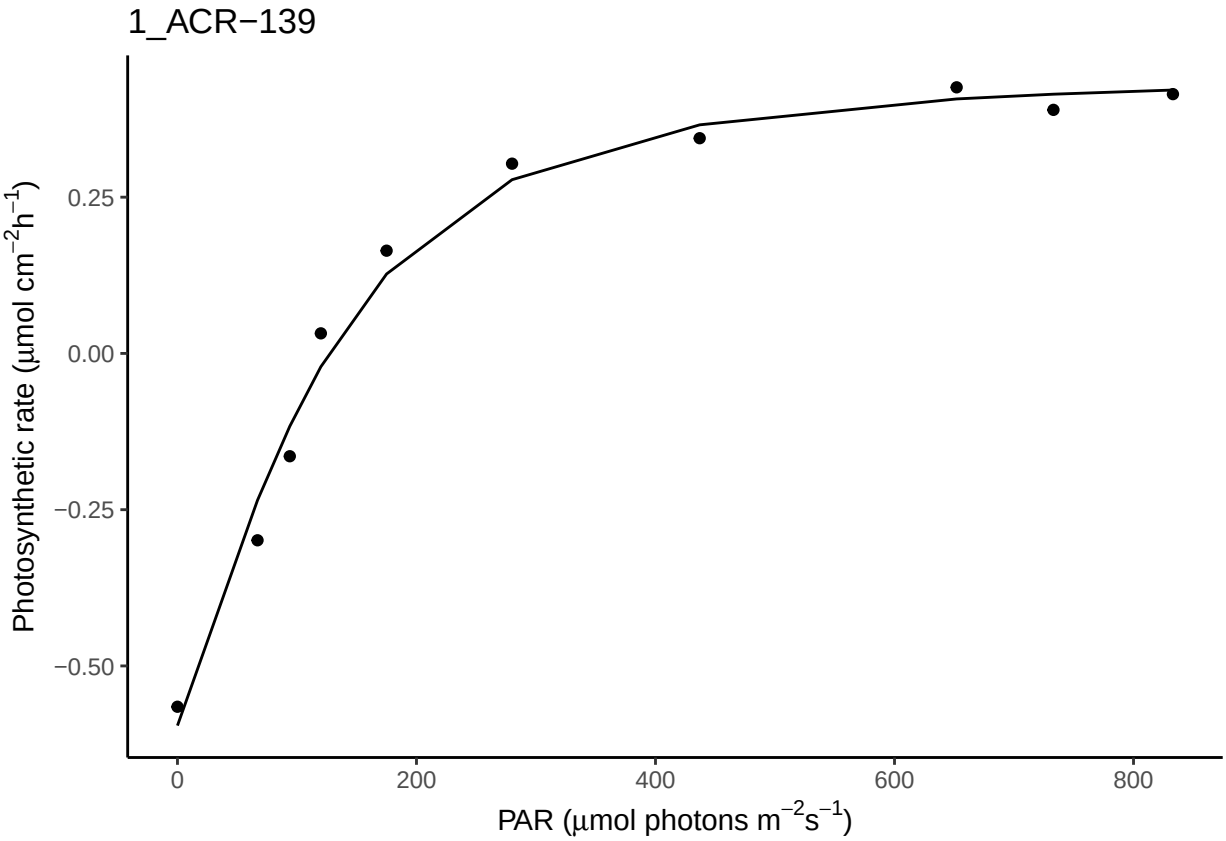

```
## ------------------------------------------------------------
## augmented$colony_id: POR-362
```



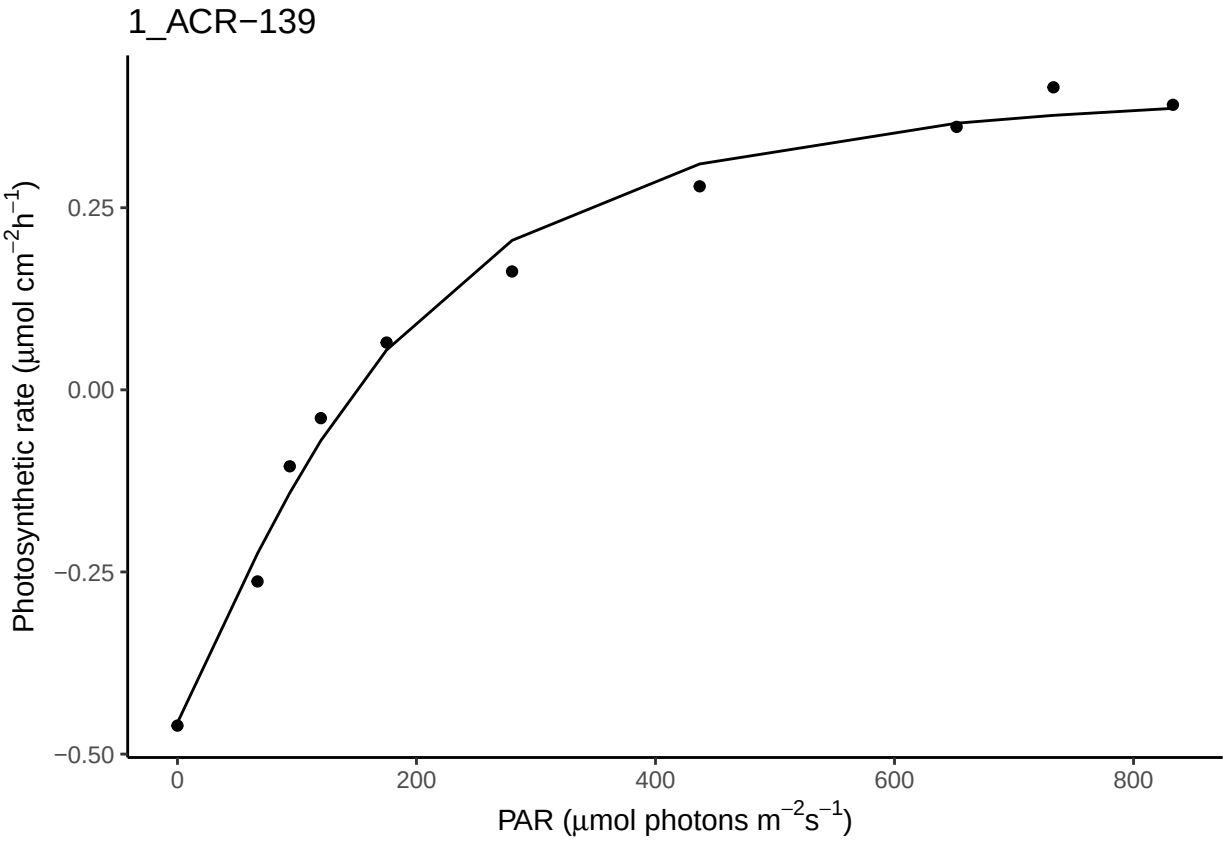

```
## ------------------------------------------------------------
## augmented$colony_id: POR-365
```



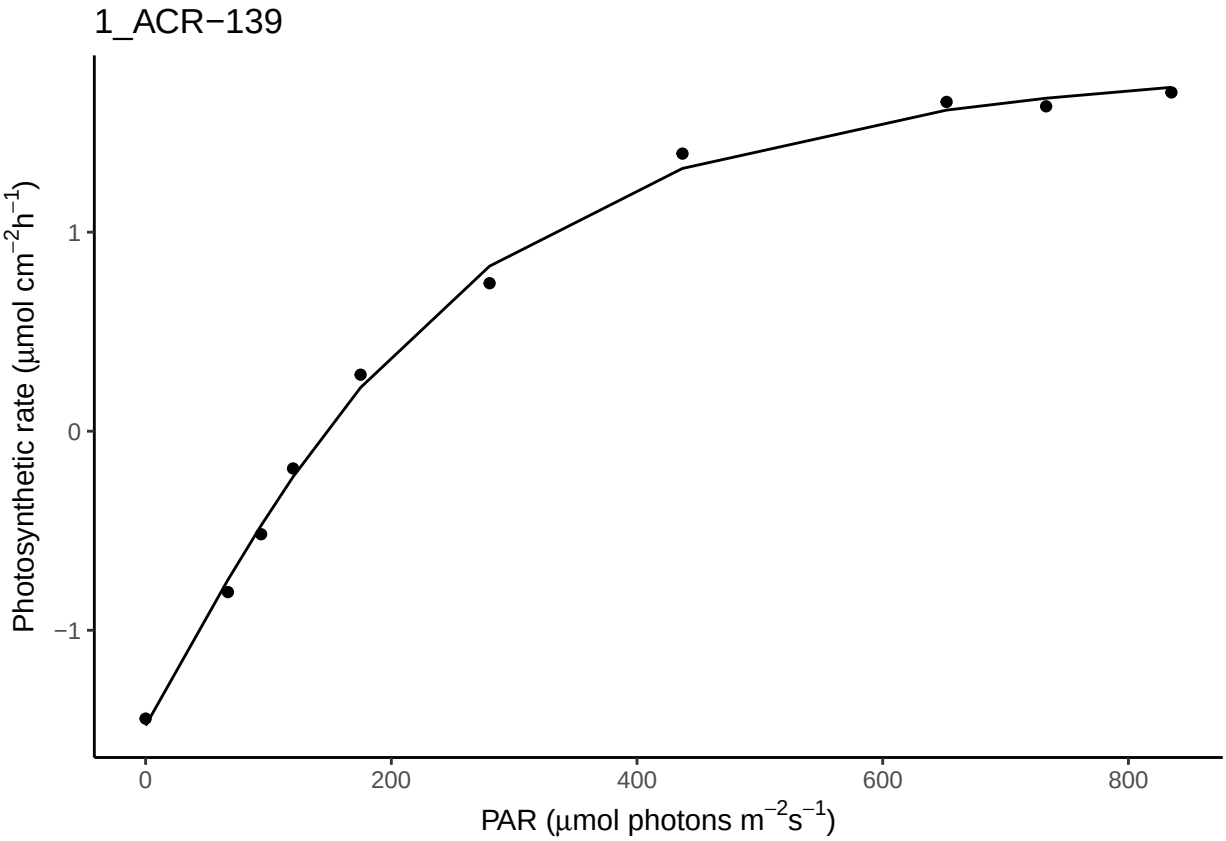

```
## ------------------------------------------------------------
## augmented$colony_id: POR-367
```



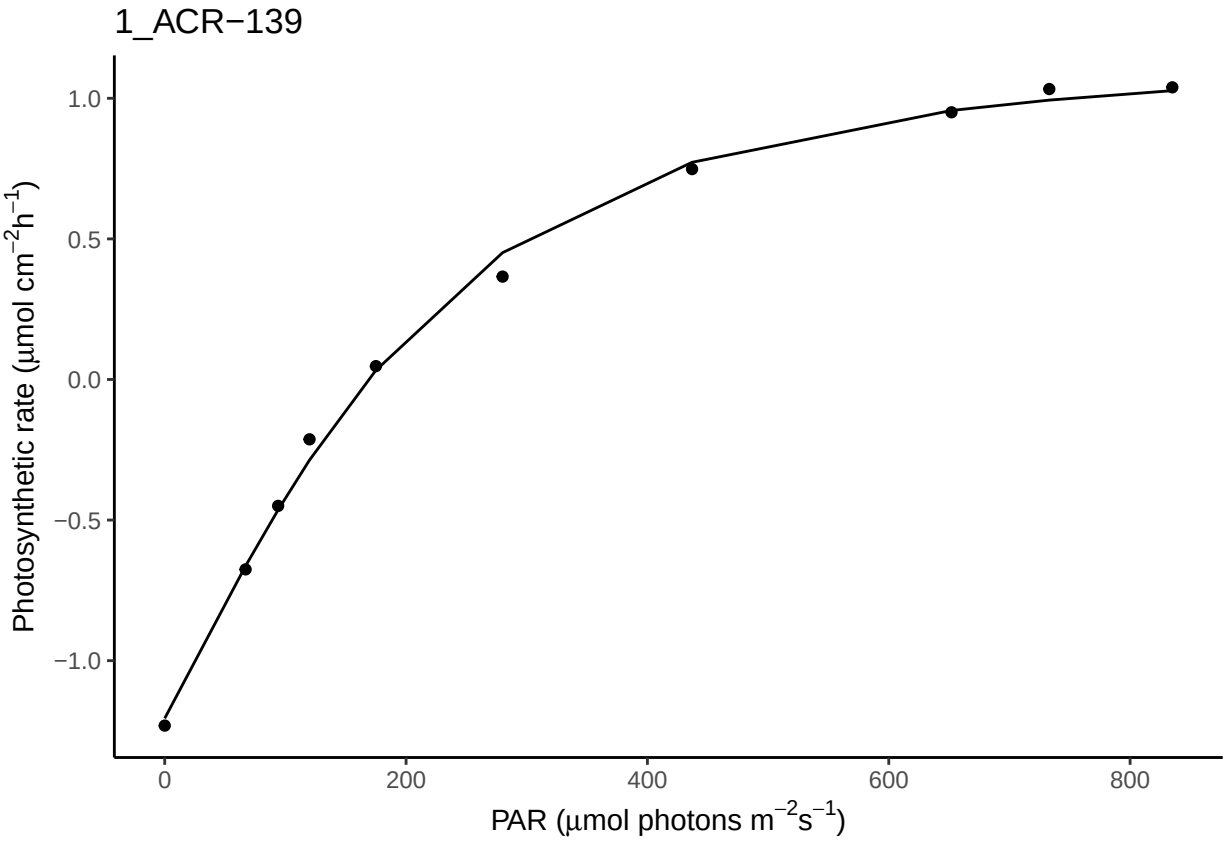

```
## ------------------------------------------------------------
## augmented$colony_id: POR-381
```



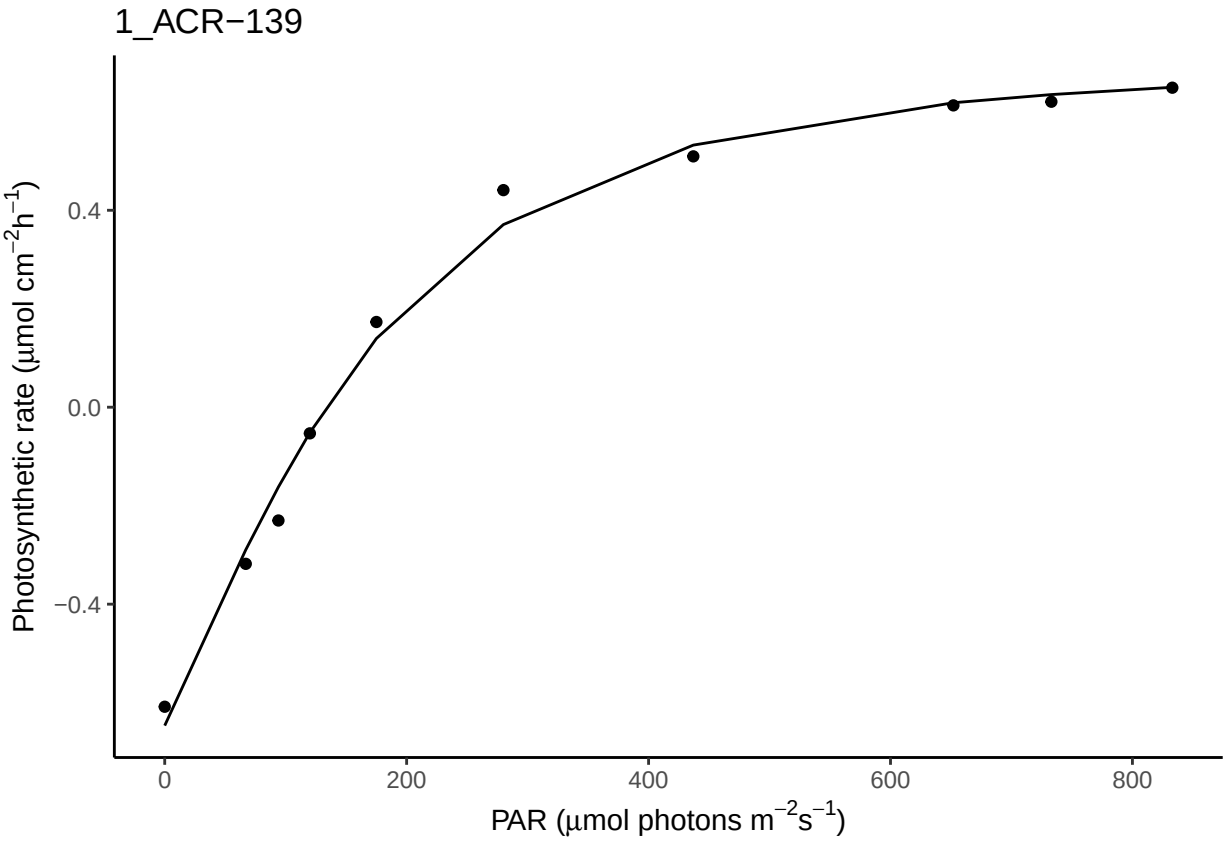

```
## ------------------------------------------------------------
## augmented$colony_id: POR-383
```



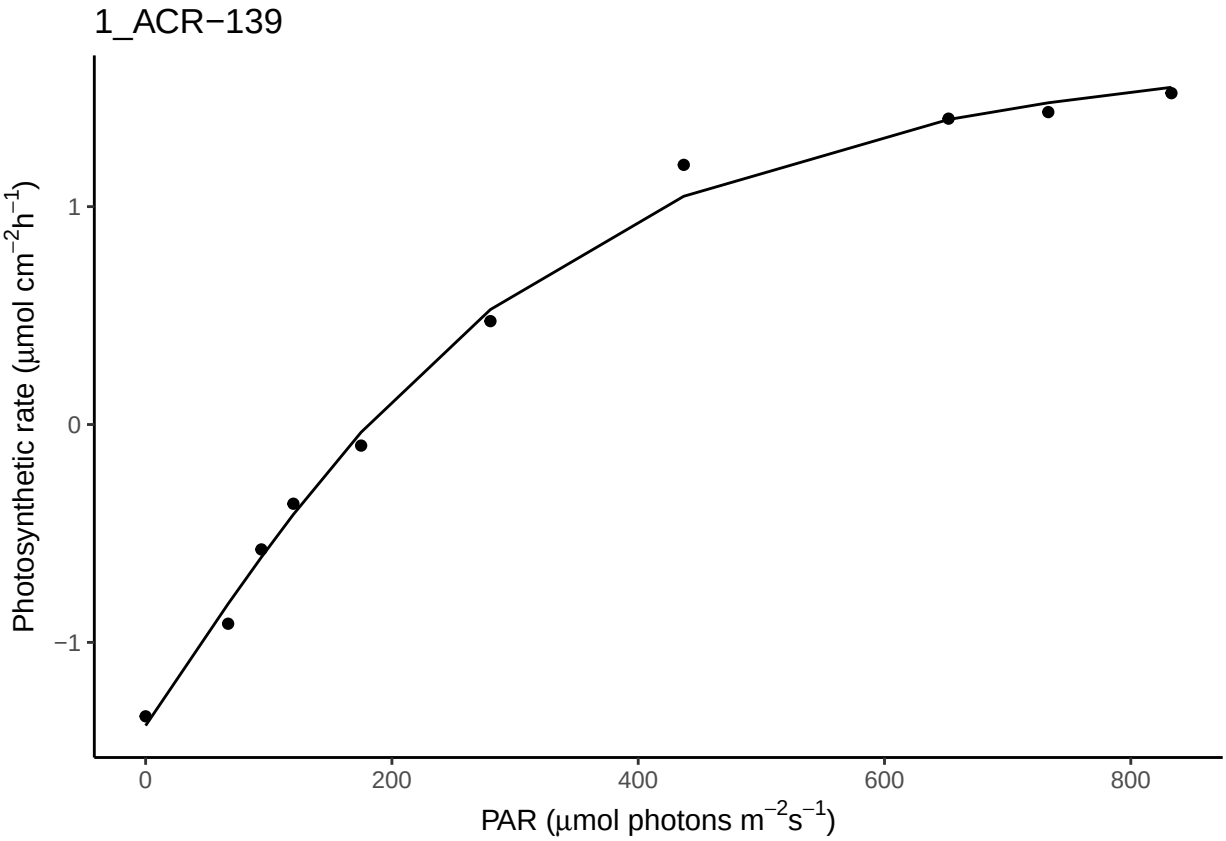

```
## ------------------------------------------------------------
## augmented$colony_id: POR-384
```



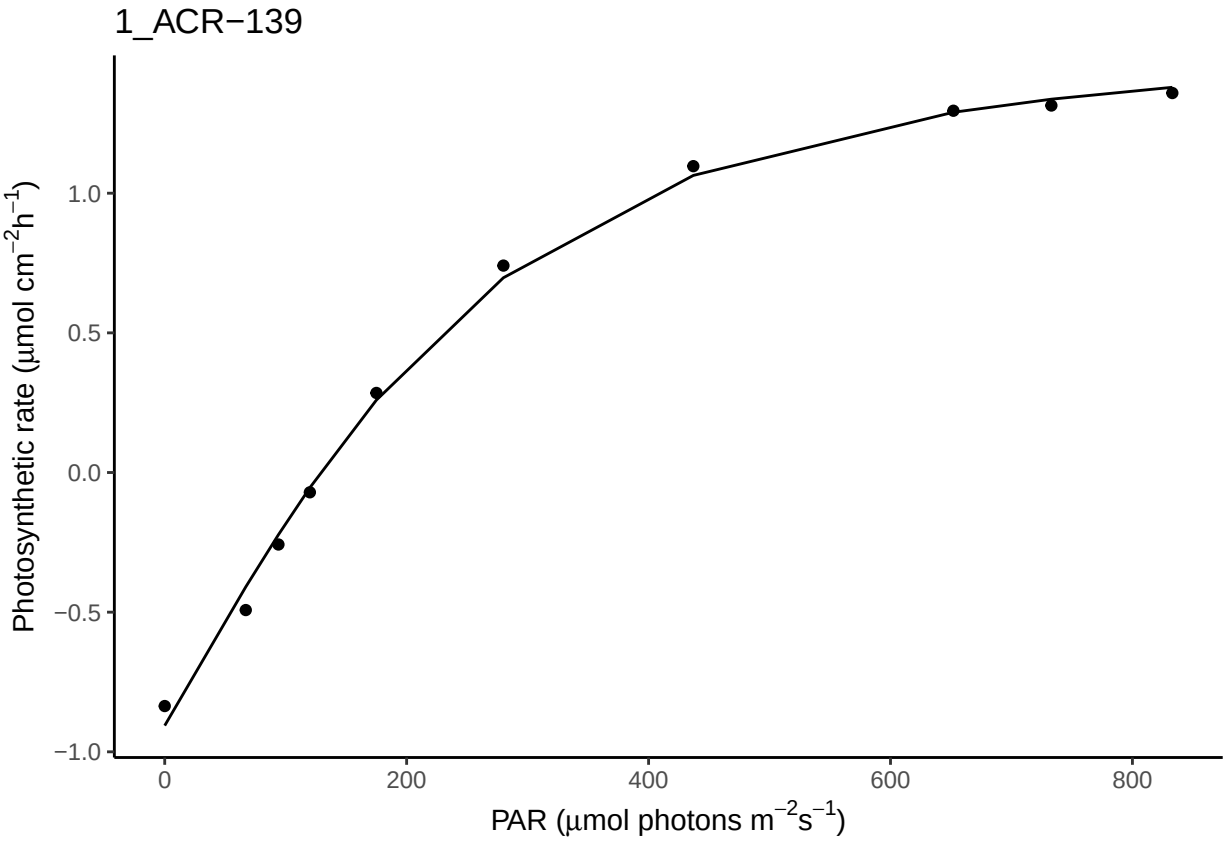

```
## ------------------------------------------------------------
## augmented$colony_id: POR-385
```



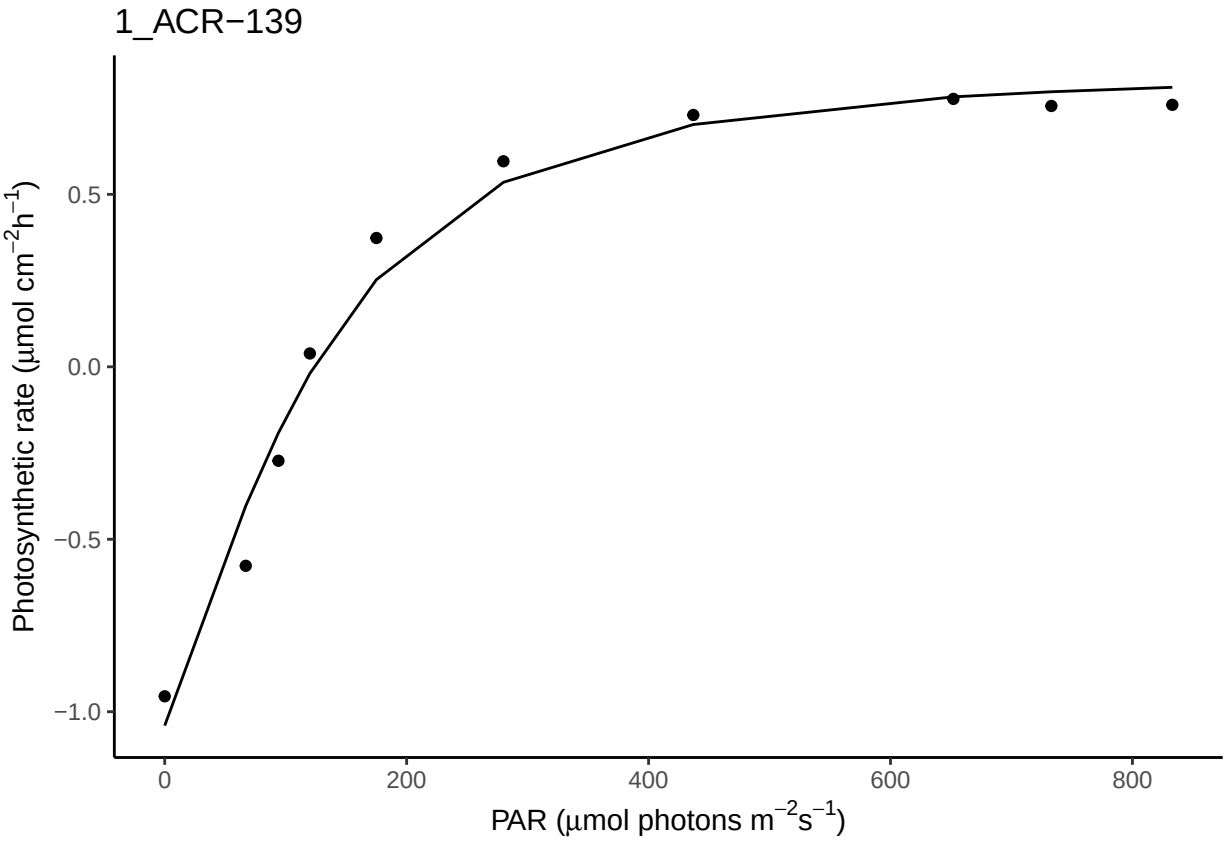

```
## ------------------------------------------------------------
## augmented$colony_id: POR-69
```



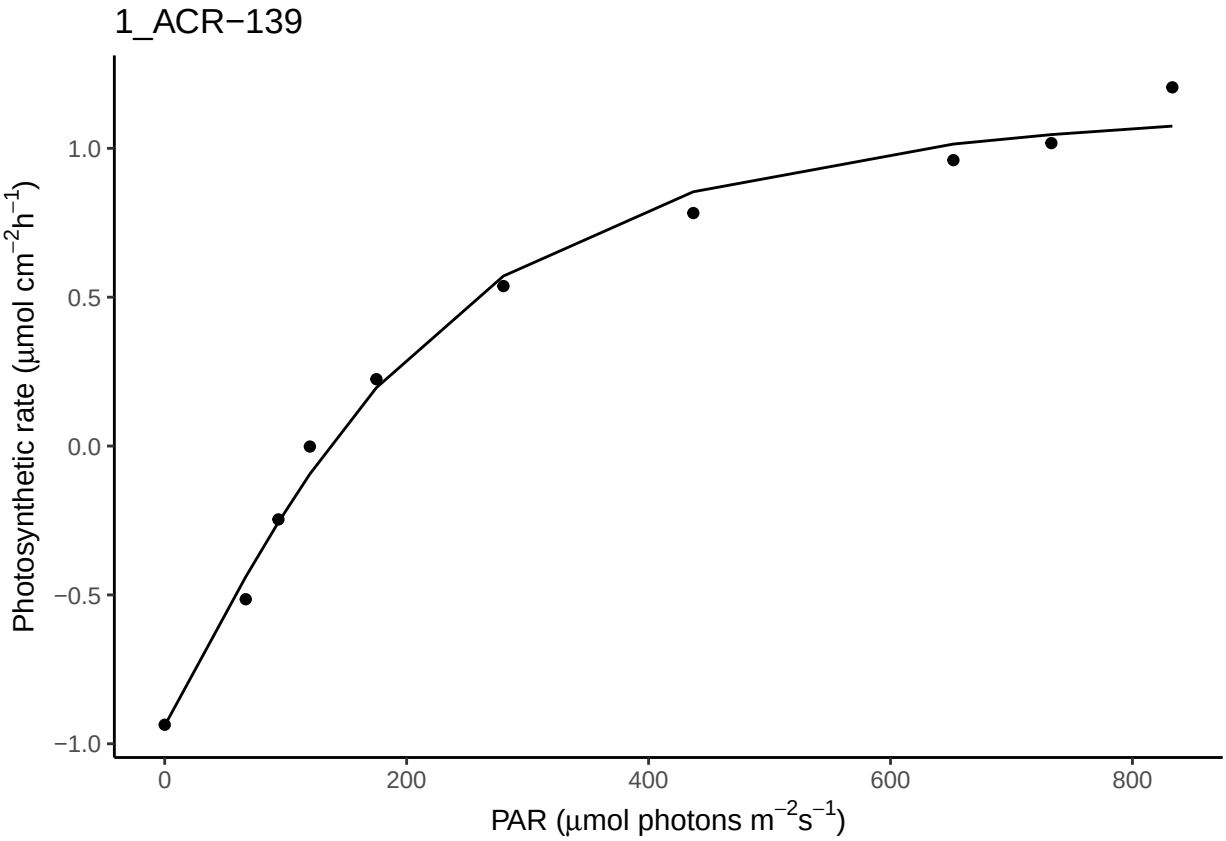

```
## ------------------------------------------------------------
## augmented$colony_id: POR-70
```



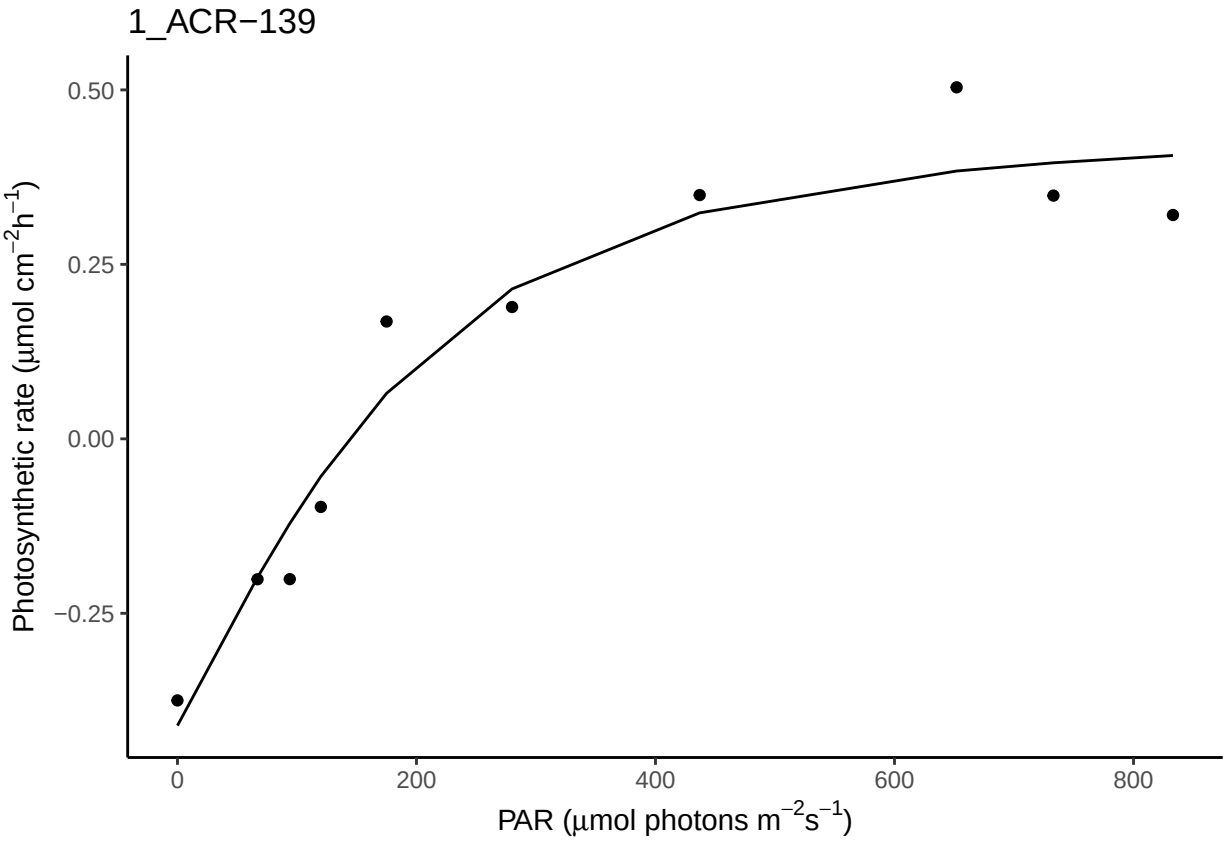

```
## ------------------------------------------------------------
## augmented$colony_id: POR-71
```



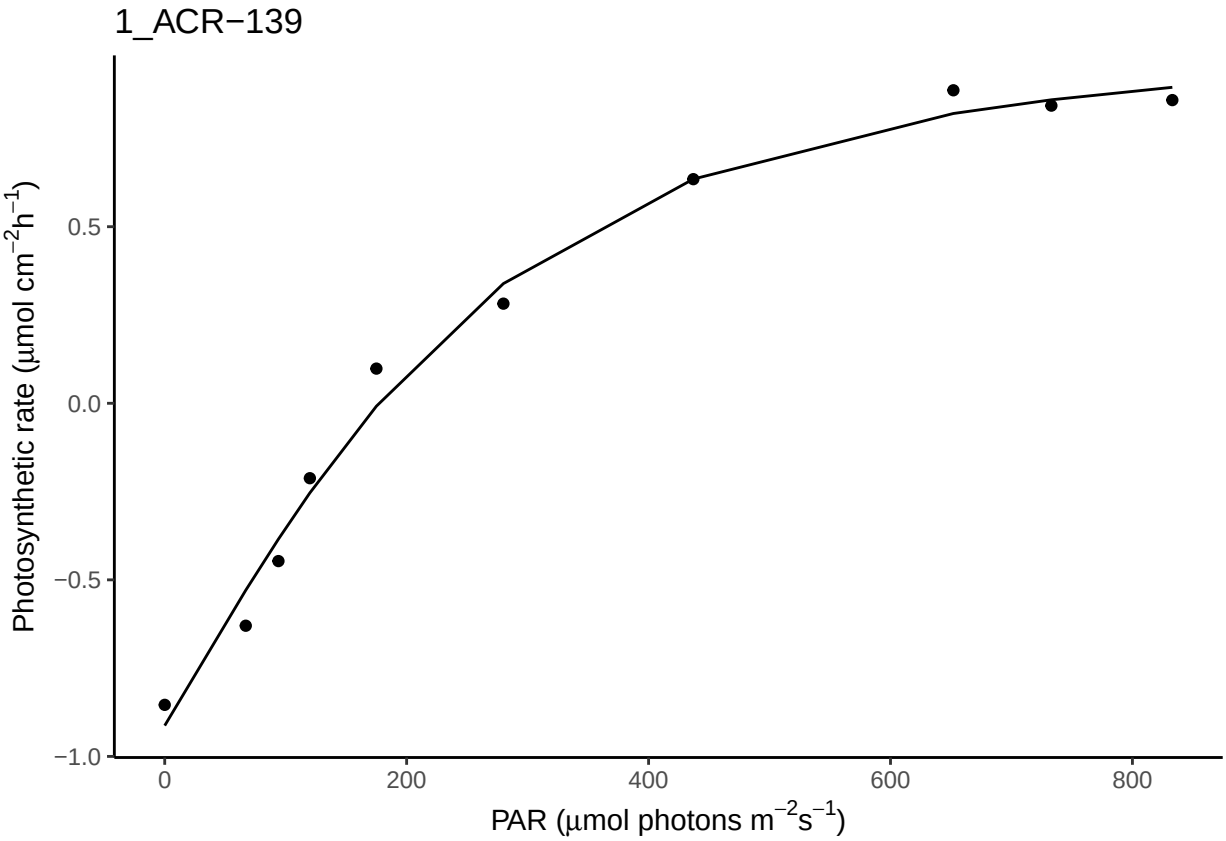

```
## ------------------------------------------------------------
## augmented$colony_id: POR-72
```



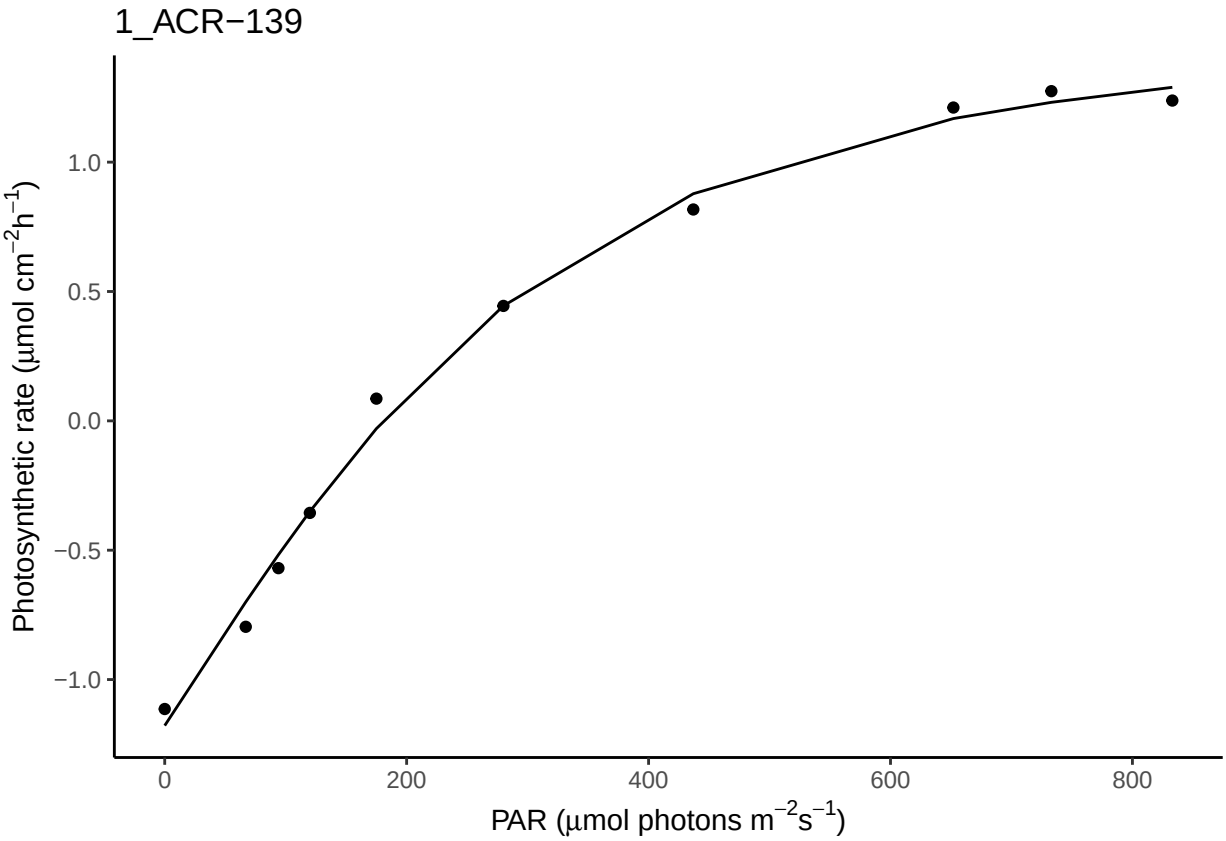

```
## ------------------------------------------------------------
## augmented$colony_id: POR-73
```



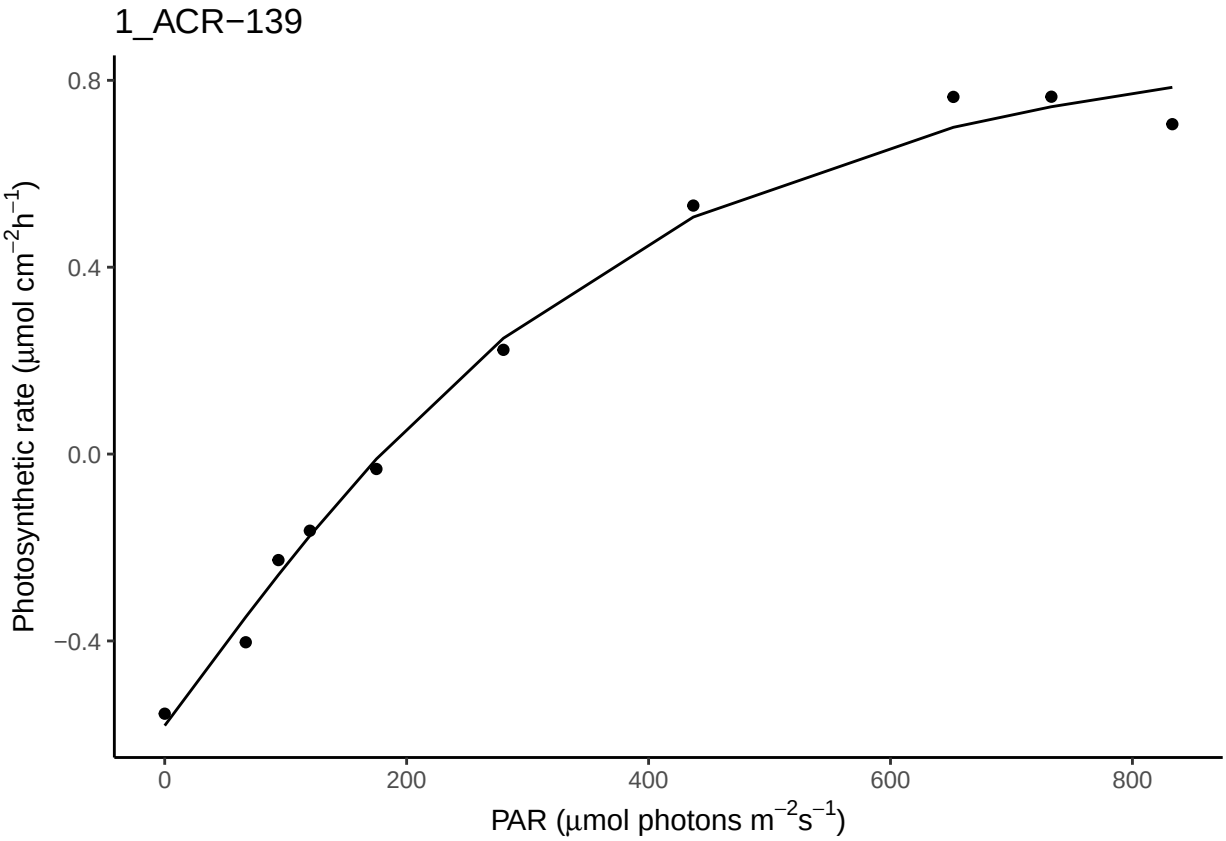

```
## ------------------------------------------------------------
## augmented$colony_id: POR-74
```



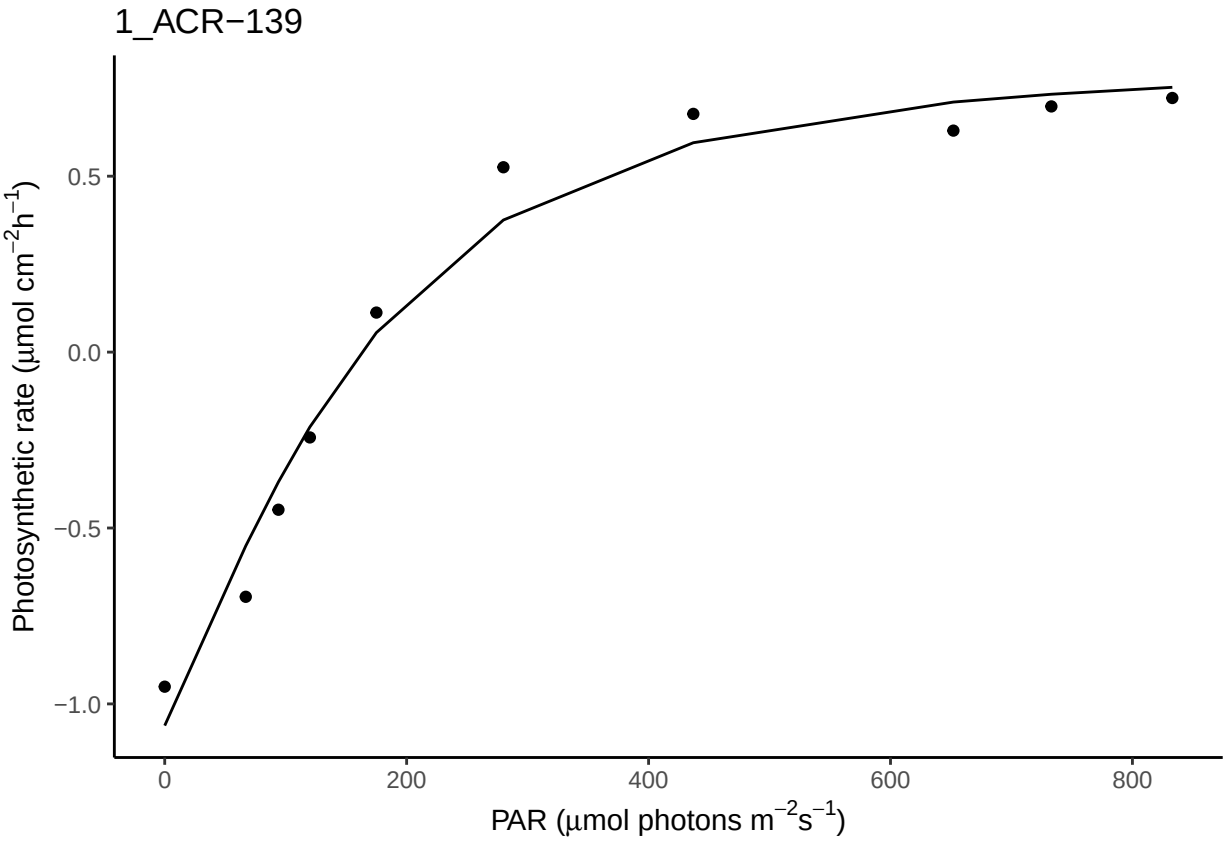

```
## ------------------------------------------------------------
## augmented$colony_id: POR-75
```



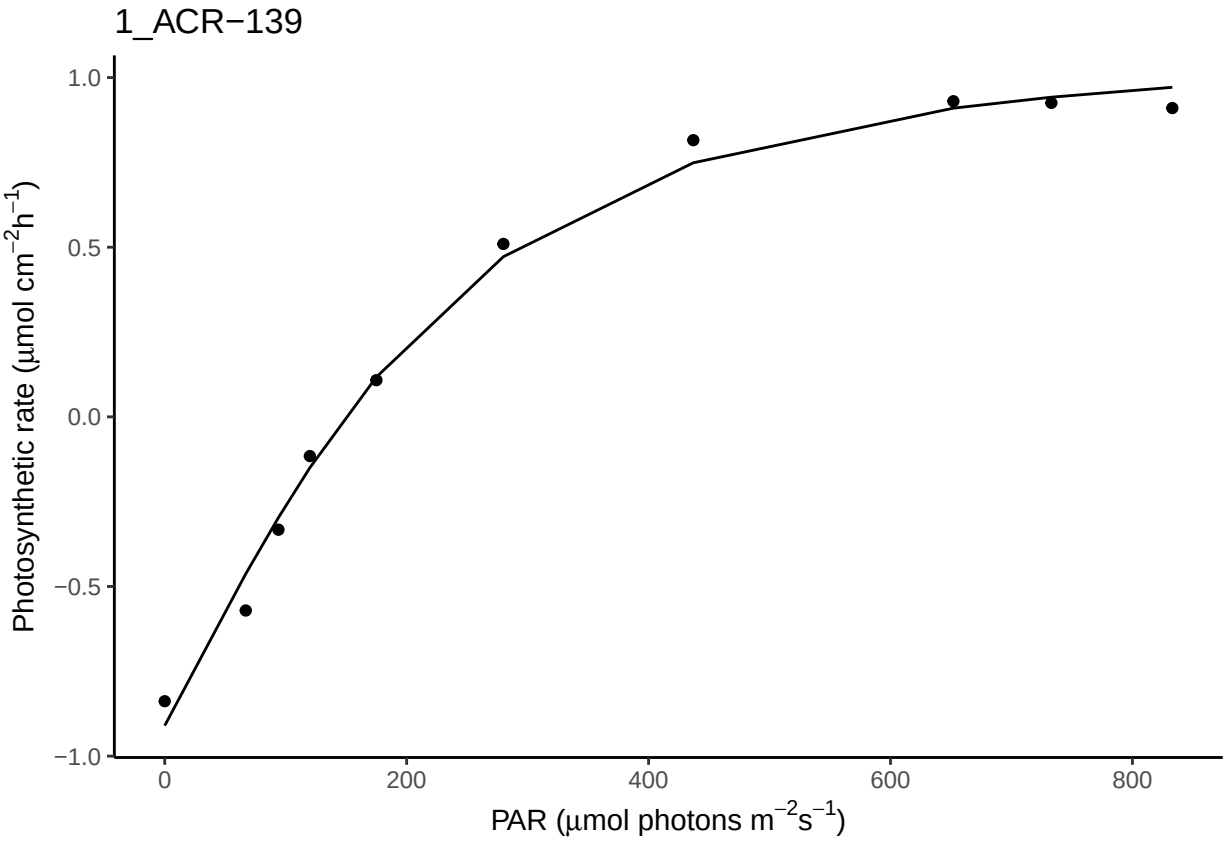

```
## ------------------------------------------------------------
## augmented$colony_id: POR-76
```



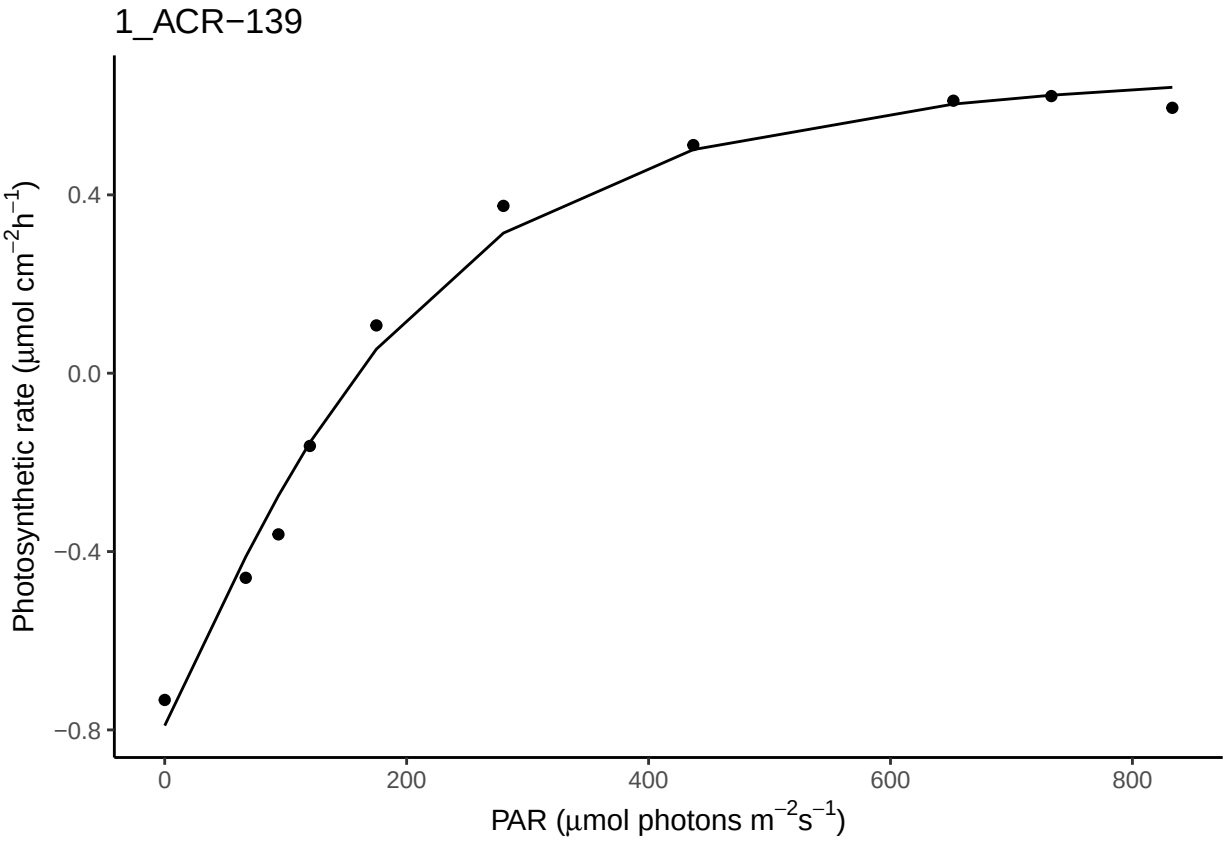

```
## ------------------------------------------------------------
## augmented$colony_id: POR-77
```



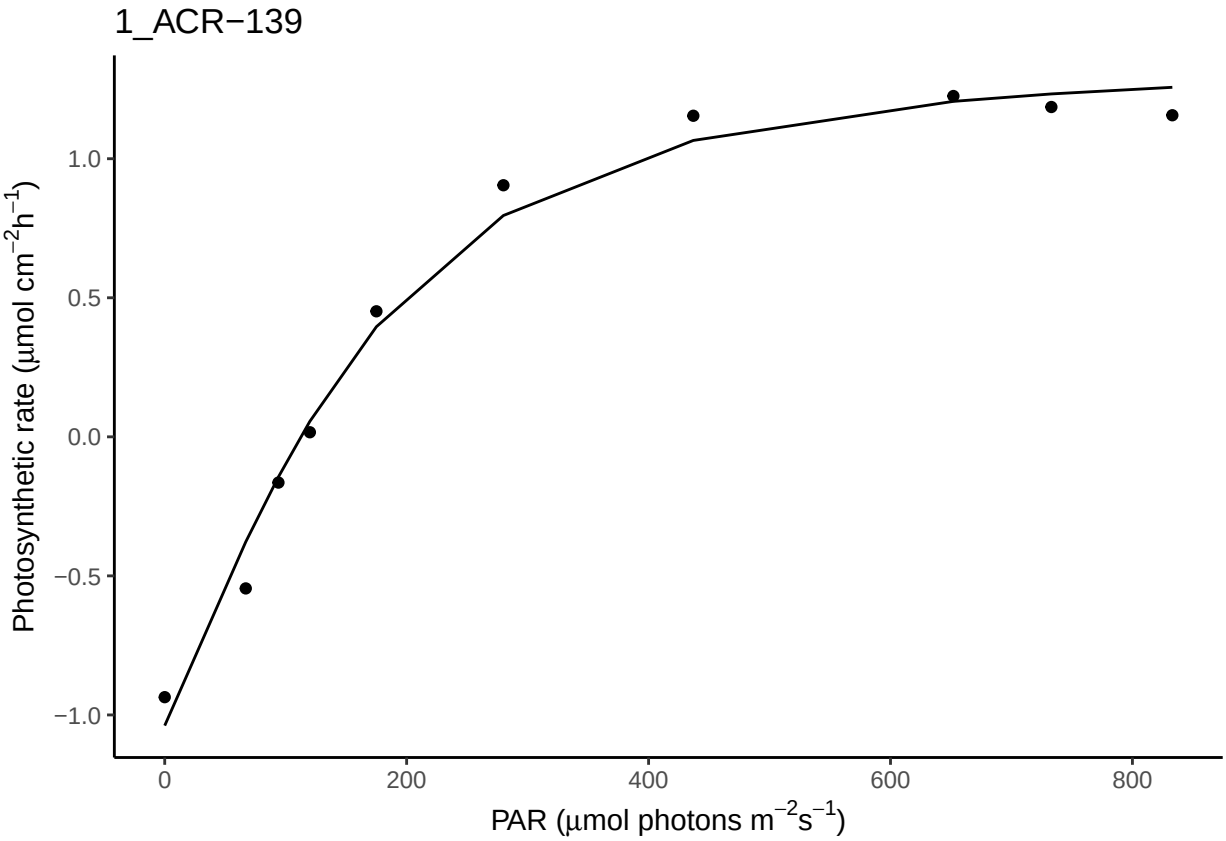

```
## ------------------------------------------------------------
## augmented$colony_id: POR-78
```



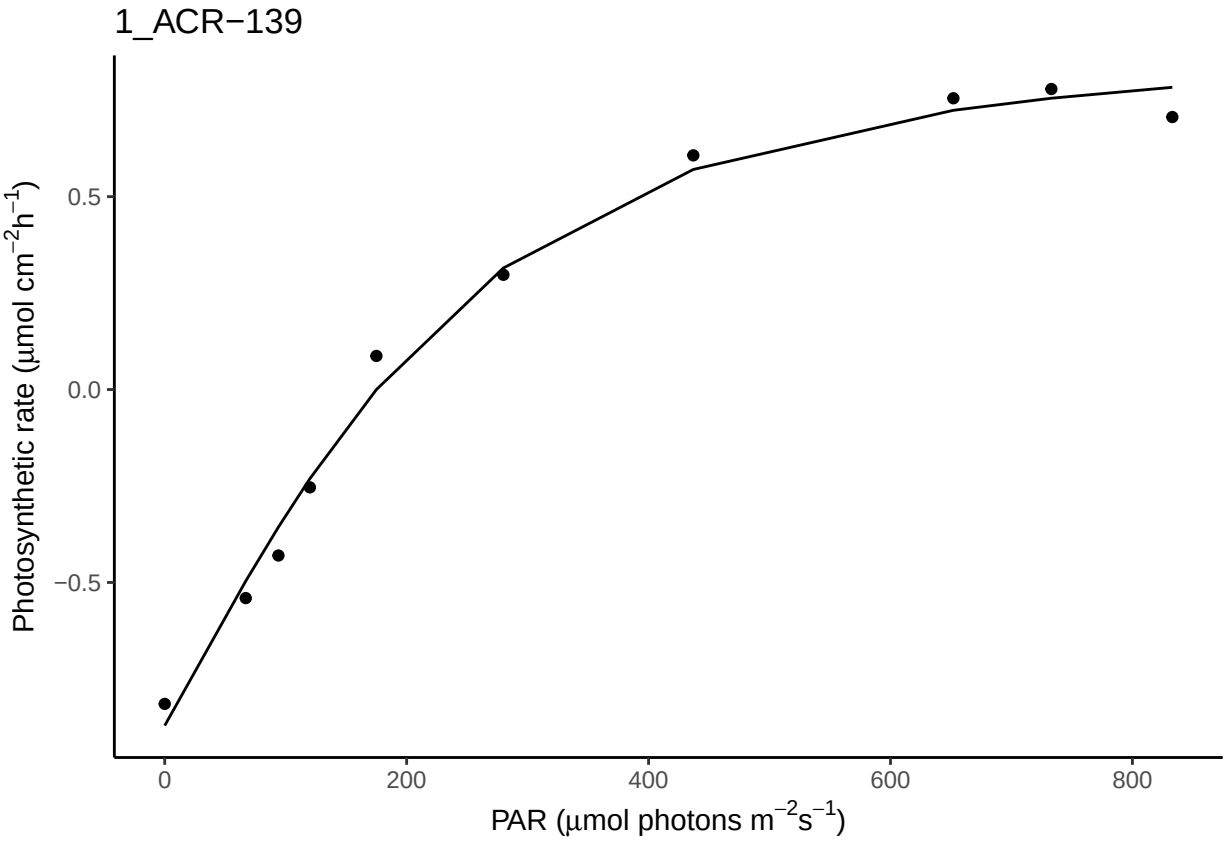

```
## ------------------------------------------------------------
## augmented$colony_id: POR-79
```



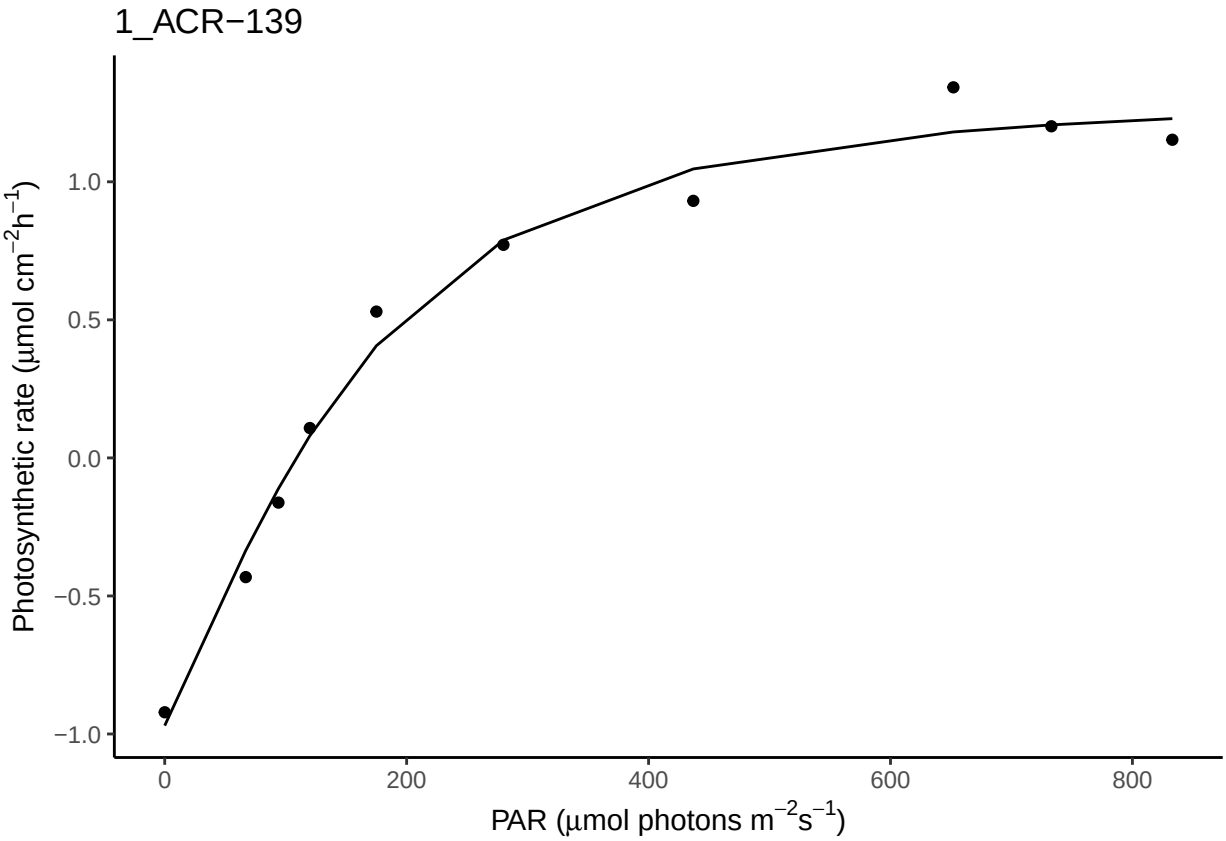

```
## ------------------------------------------------------------
## augmented$colony_id: POR-80
```



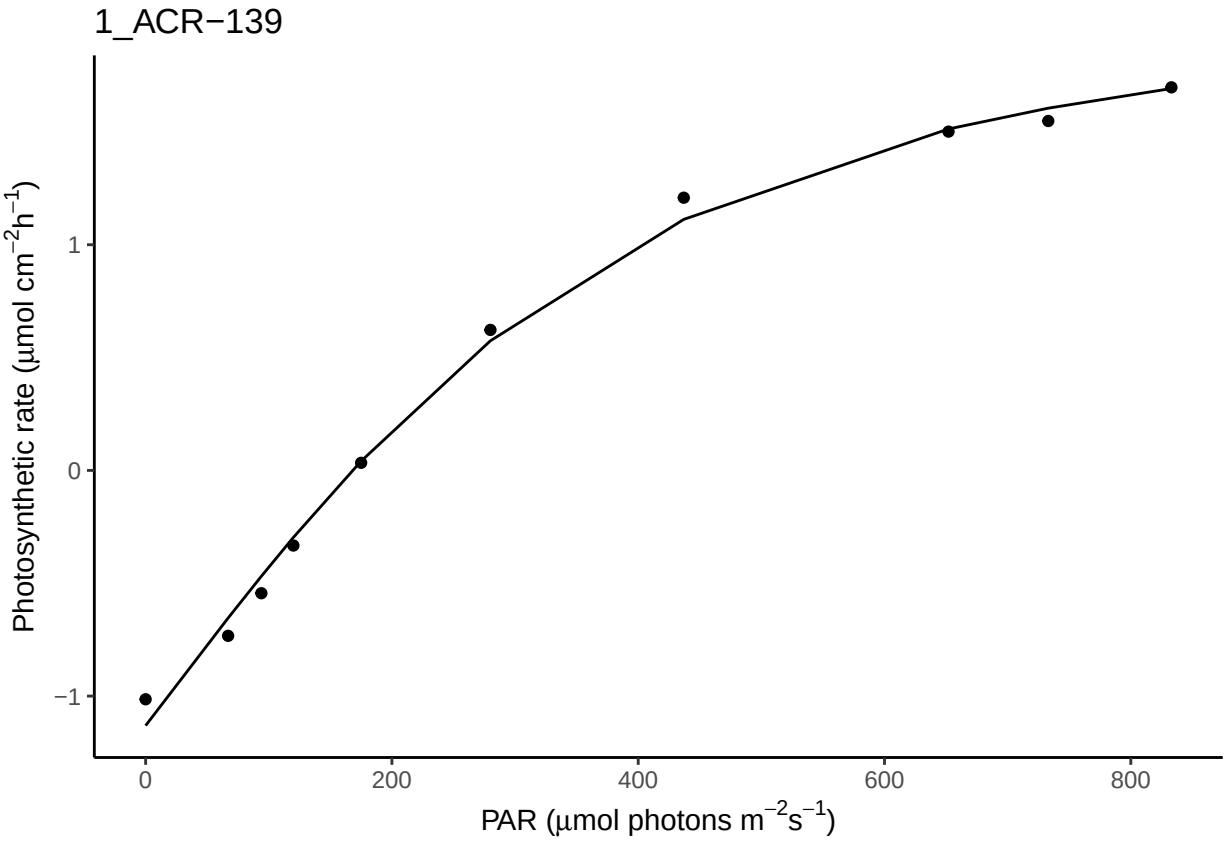

```
## ------------------------------------------------------------
## augmented$colony_id: POR-81
```




```
## ------------------------------------------------------------
## augmented$colony_id: POR-82
```




```
## ------------------------------------------------------------
## augmented$colony_id: POR-83
```




```
#NEED TO FIND A WAY TO SAVE INDIVIDUALS
```