

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/4_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)
Data<-Data%>%
  filter(!Pc=="NA")
```

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 yield (AKA AQY from Bayesian script)

I/E = irradiance (AKA PAR from Bayesian script)

Rd = dark respiration

Run models

Using fixed initial values:

```
#nls_data <- Data %>%
  #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="timepoint4")%>%
  #write_csv(., "output/4_pi_curve_pars_NLS.csv")
```

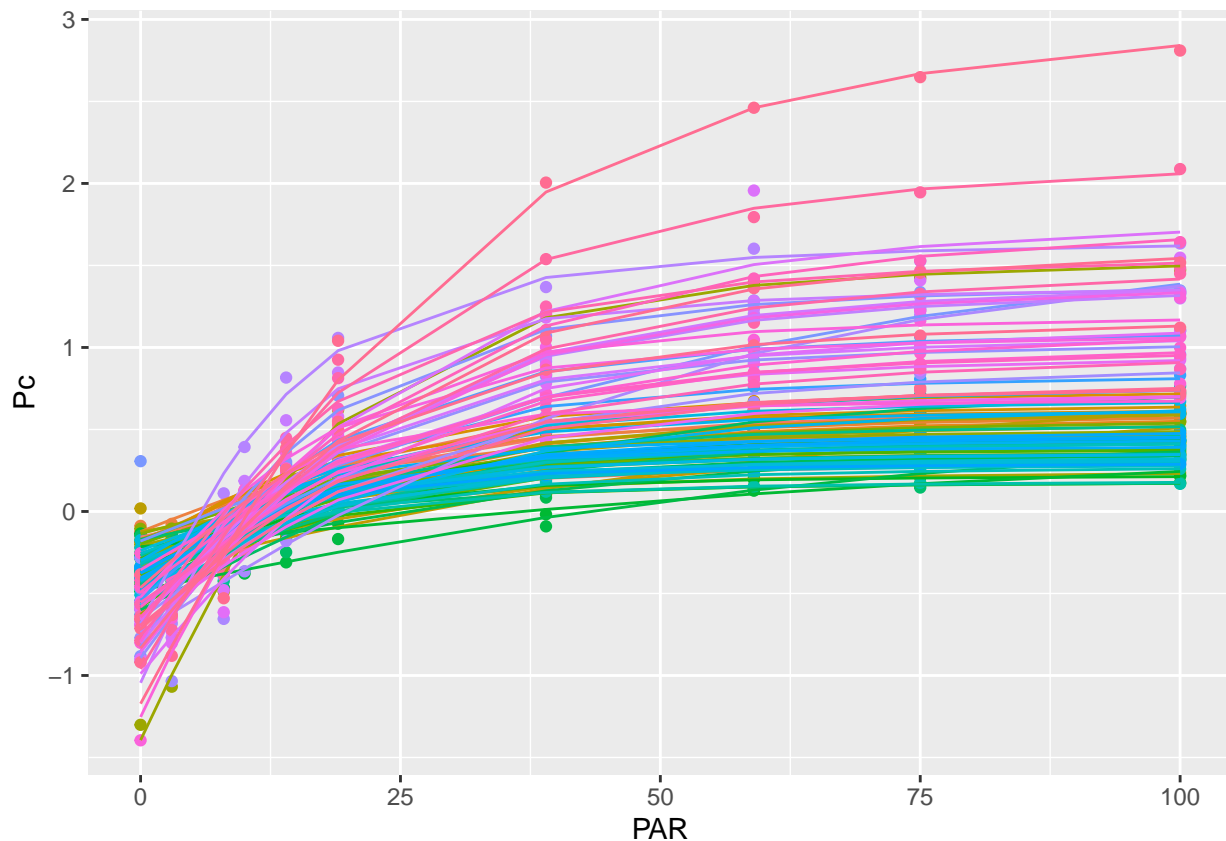
Using flexible initial values based on input data:

```
nls_data <- Data %>%
  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=
    #nls(Pc ~ (Am*((AQY*PAR)/(sqrt(Am^2 + (AQY*PAR)^2)))-Rd), data=., start=list(
    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="timepoint4")%>%
  write_csv(., "output/4_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=1
    augmented = map(fit, augment),
  ) %>%
  unnest(augmented)

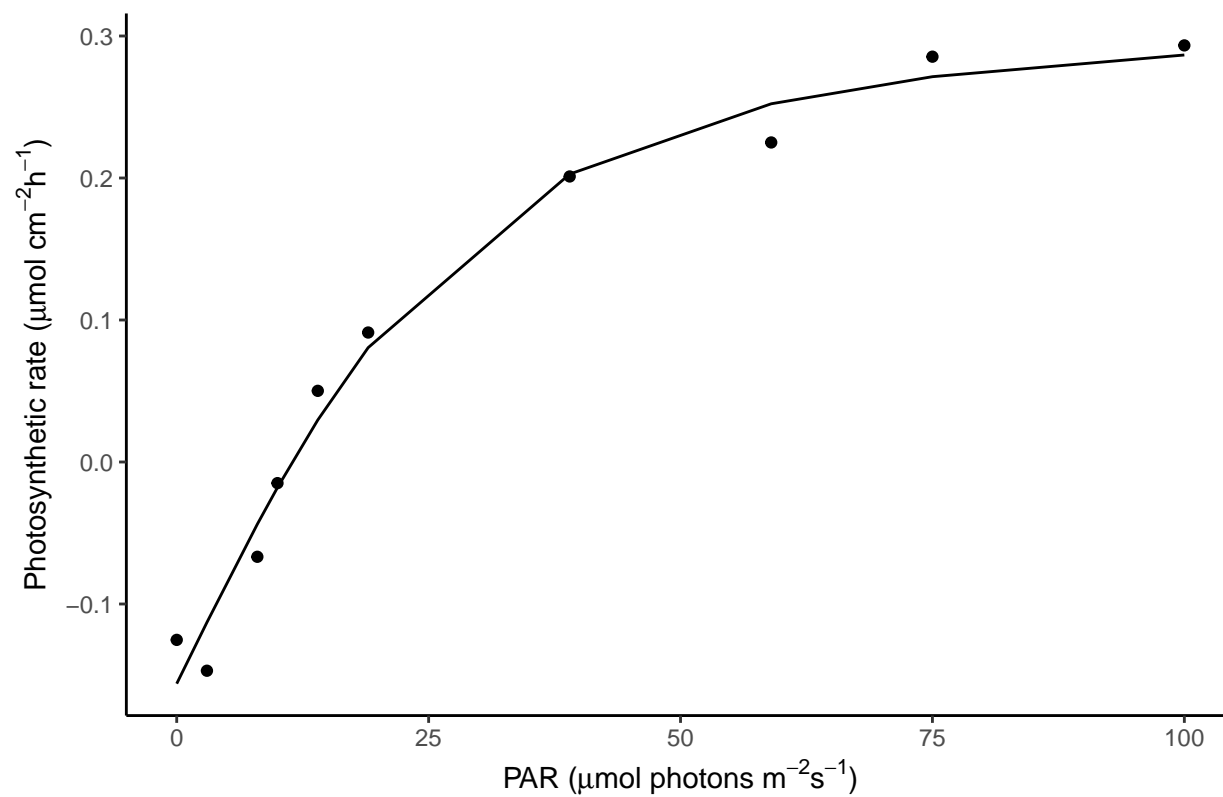
#all colonies together
augmented %>%
  group_by(colony_id)%>%
  qplot(PAR, Pc, data = ., geom = 'point', colour = colony_id) +
  geom_line(aes(y=.fitted))+
  theme(legend.position="none")
```



```
#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))
})
```

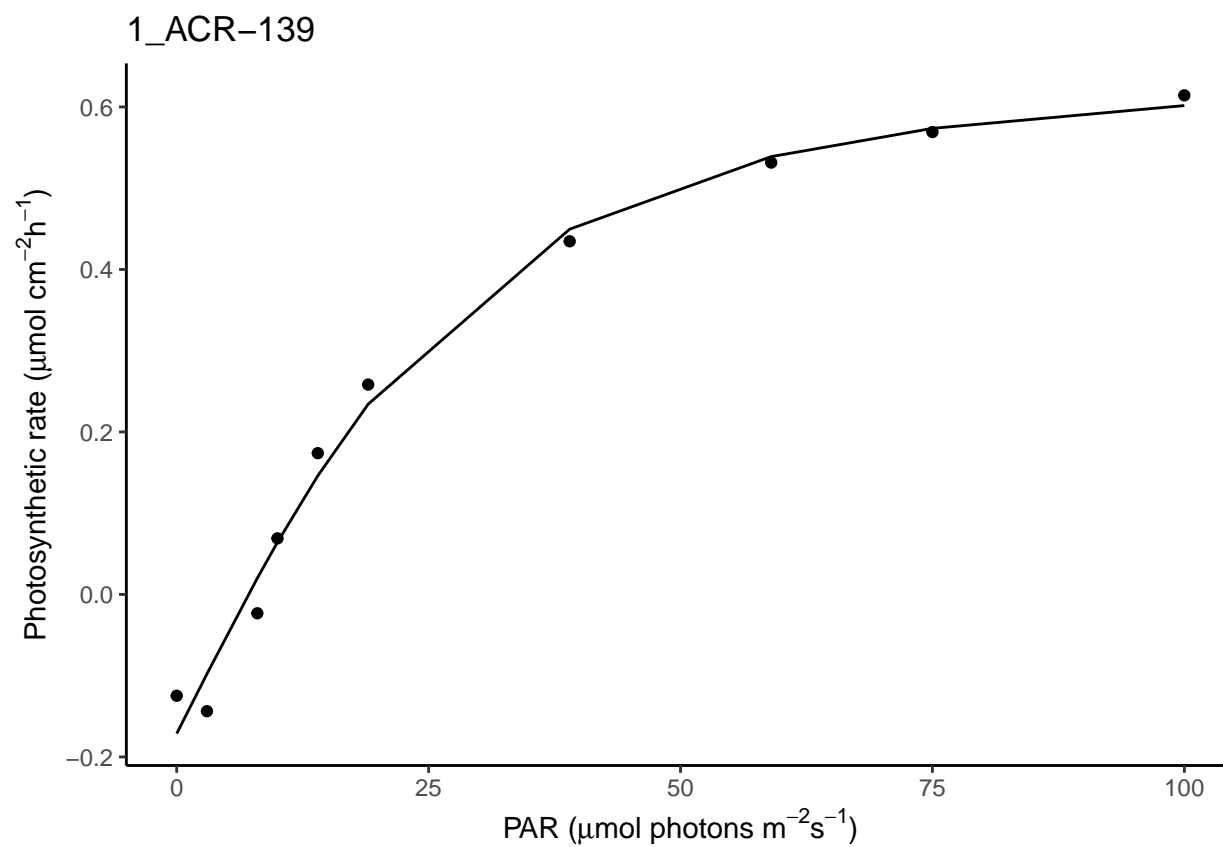
```
## augmented$colony_id: ACR-139
```

1_ACR-139

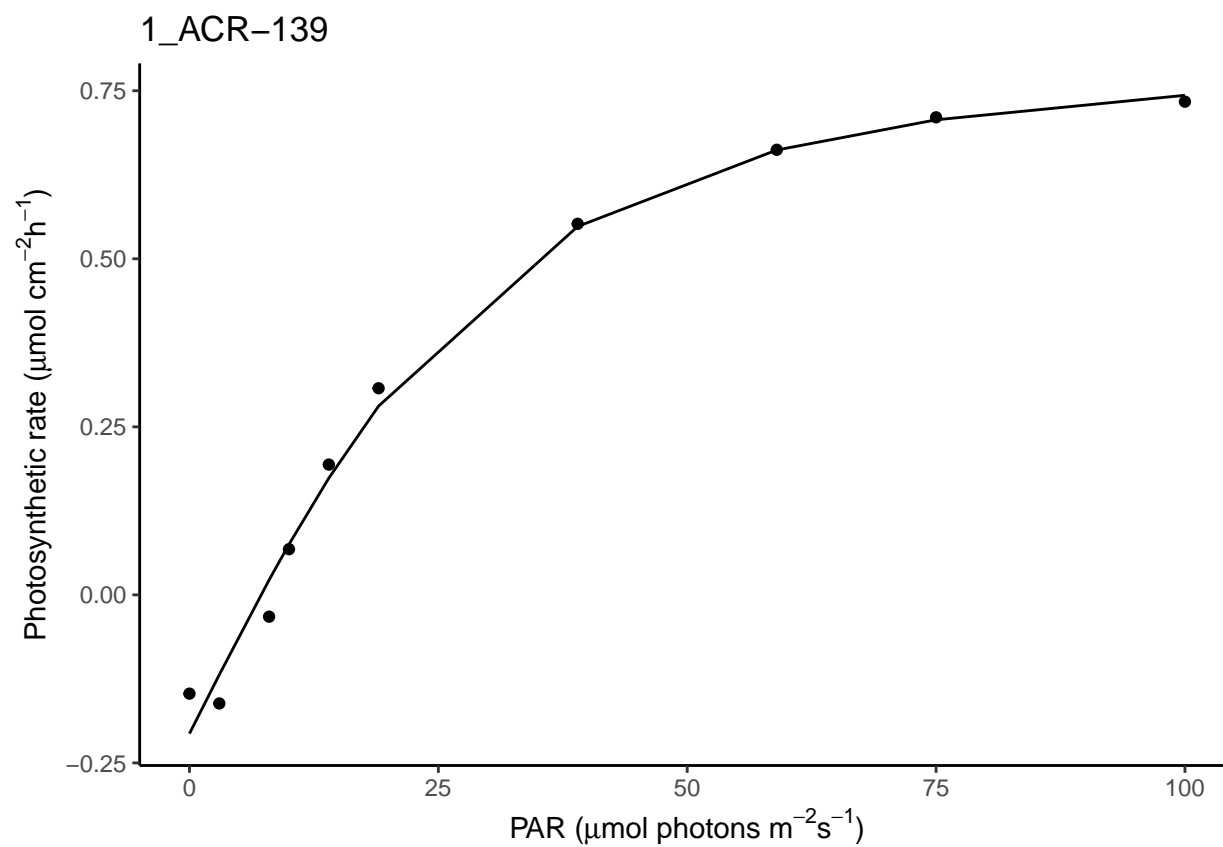


```
## -----
```

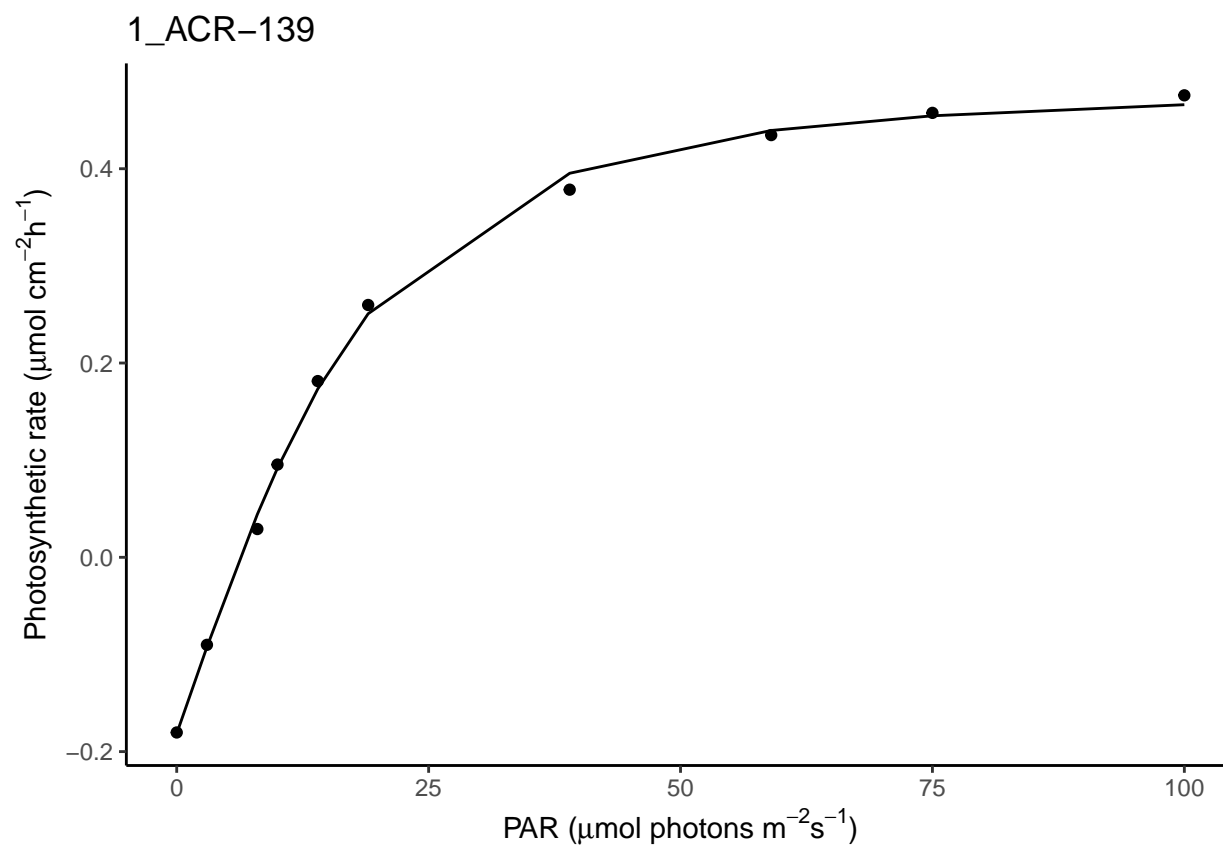
```
## augmented$colony_id: ACR-145
```



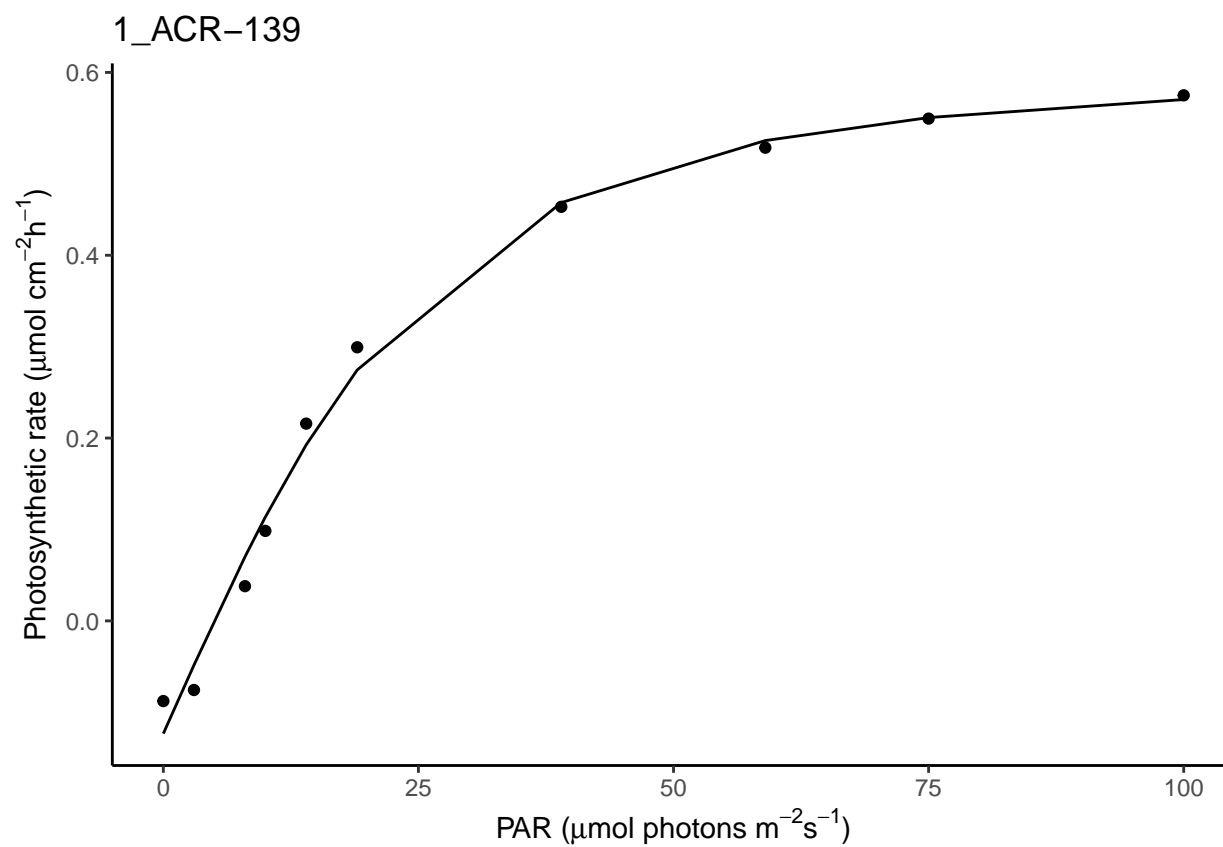
augmented\$colony_id: ACR-150



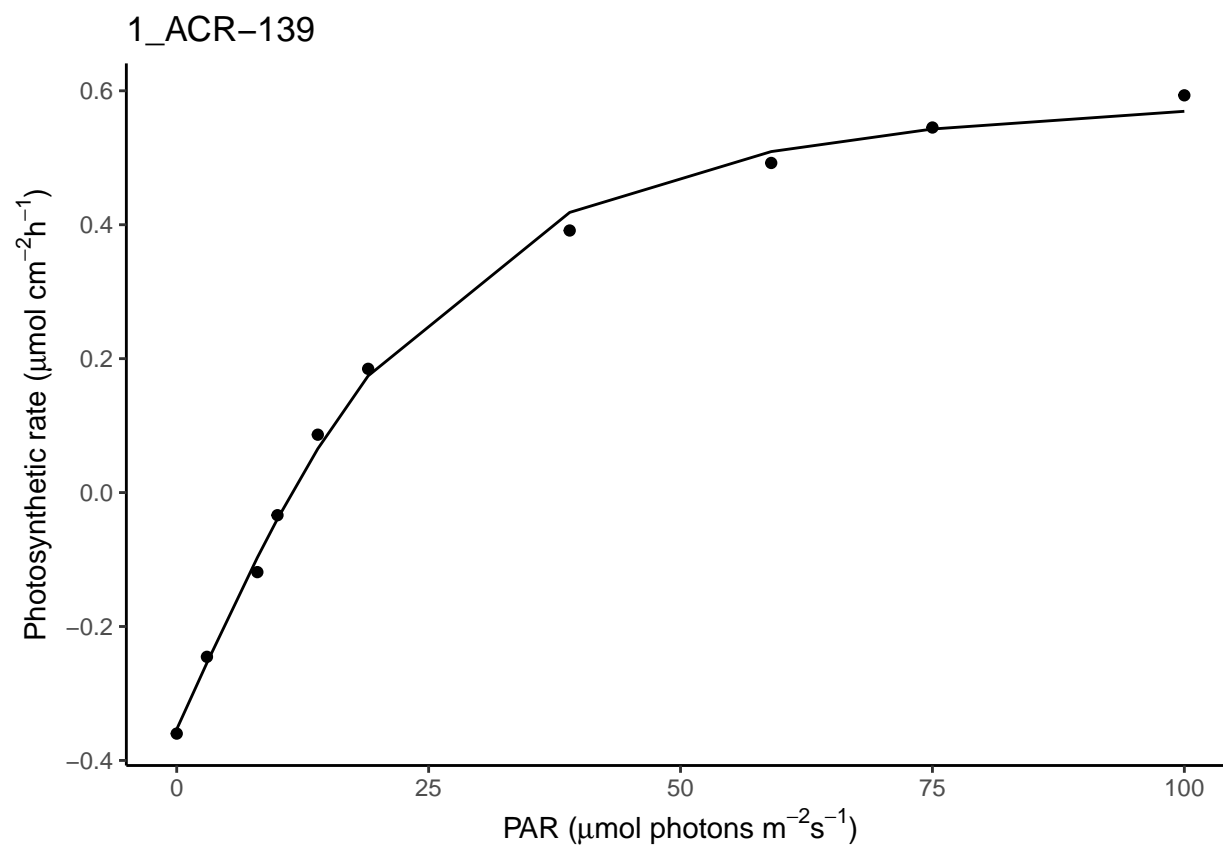
```
## -----  
## augmented$colony_id: ACR-173
```



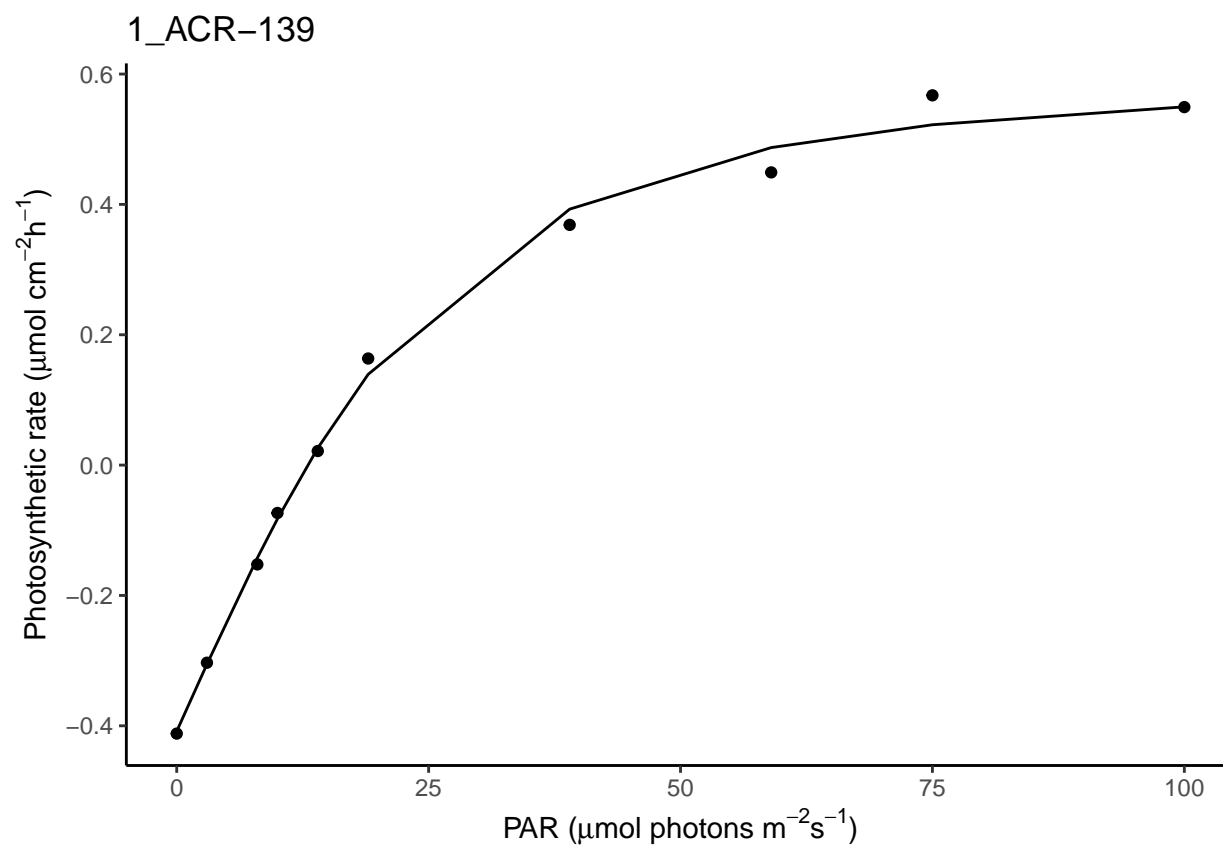
augmented\$colony_id: ACR-175



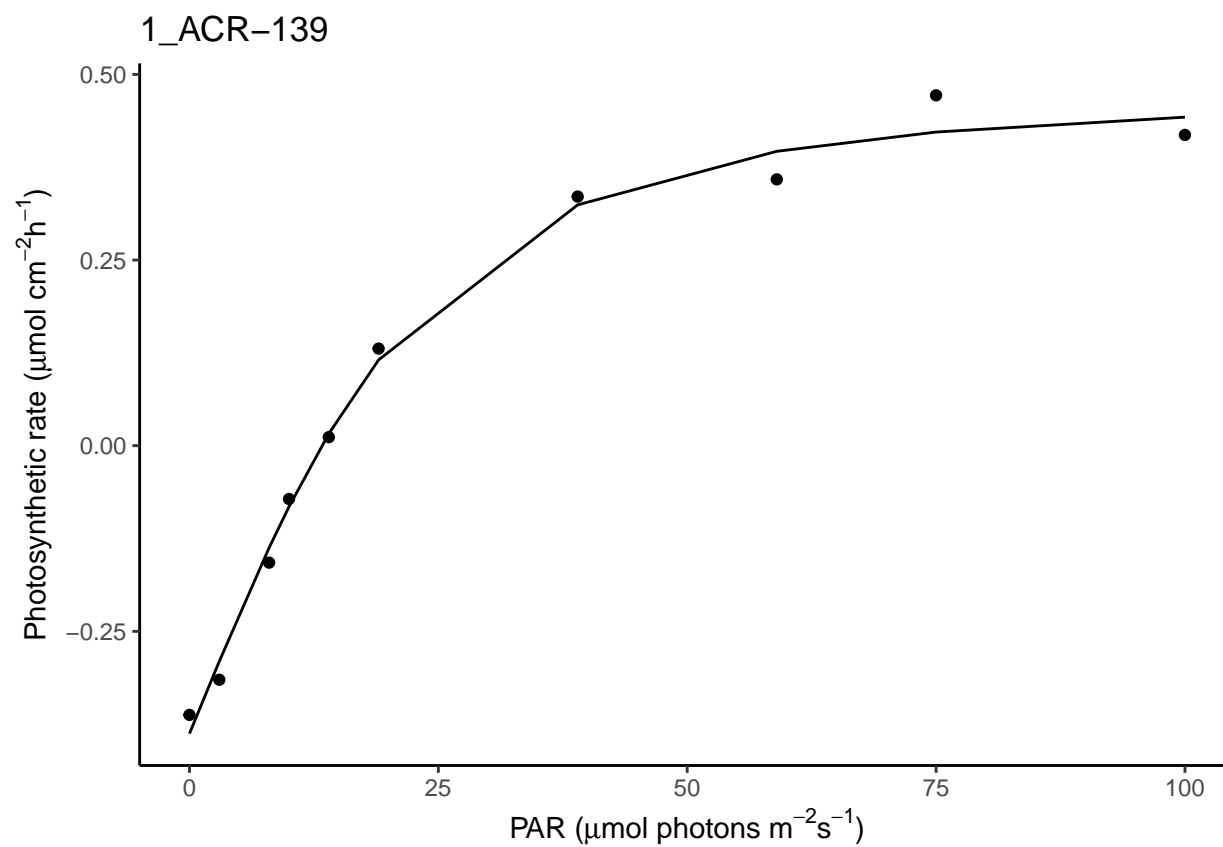
```
## -----  
## augmented$colony_id: ACR-176
```

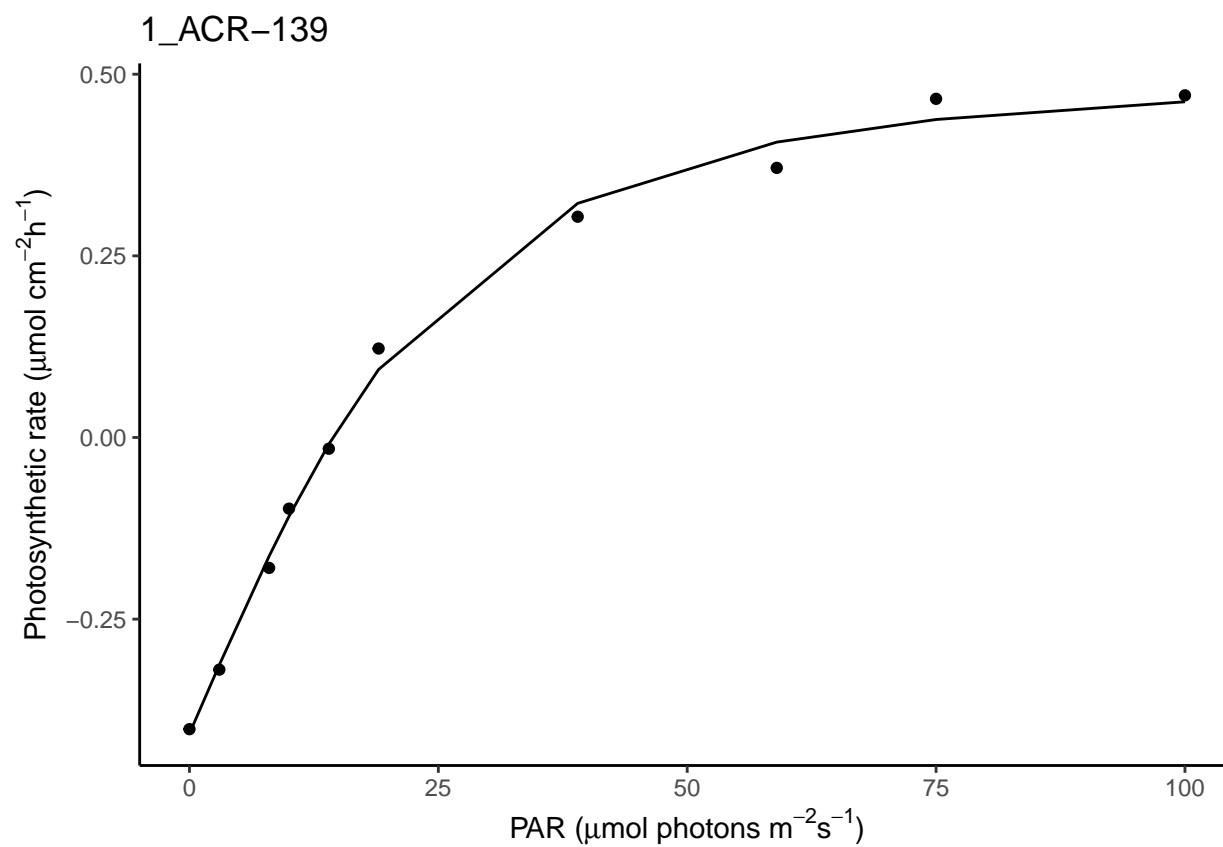
augmented\$colony_id: ACR-178



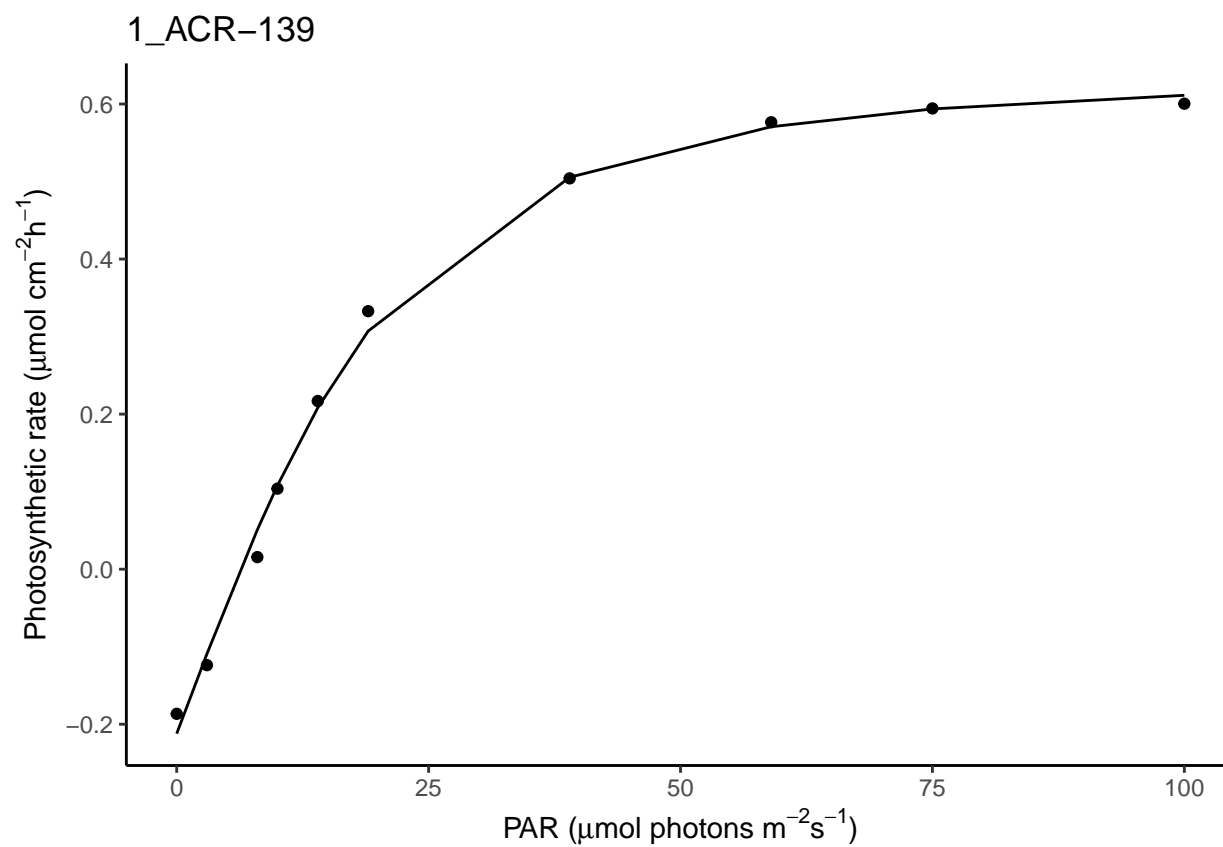
```
## -----  
## augmented$colony_id: ACR-180
```



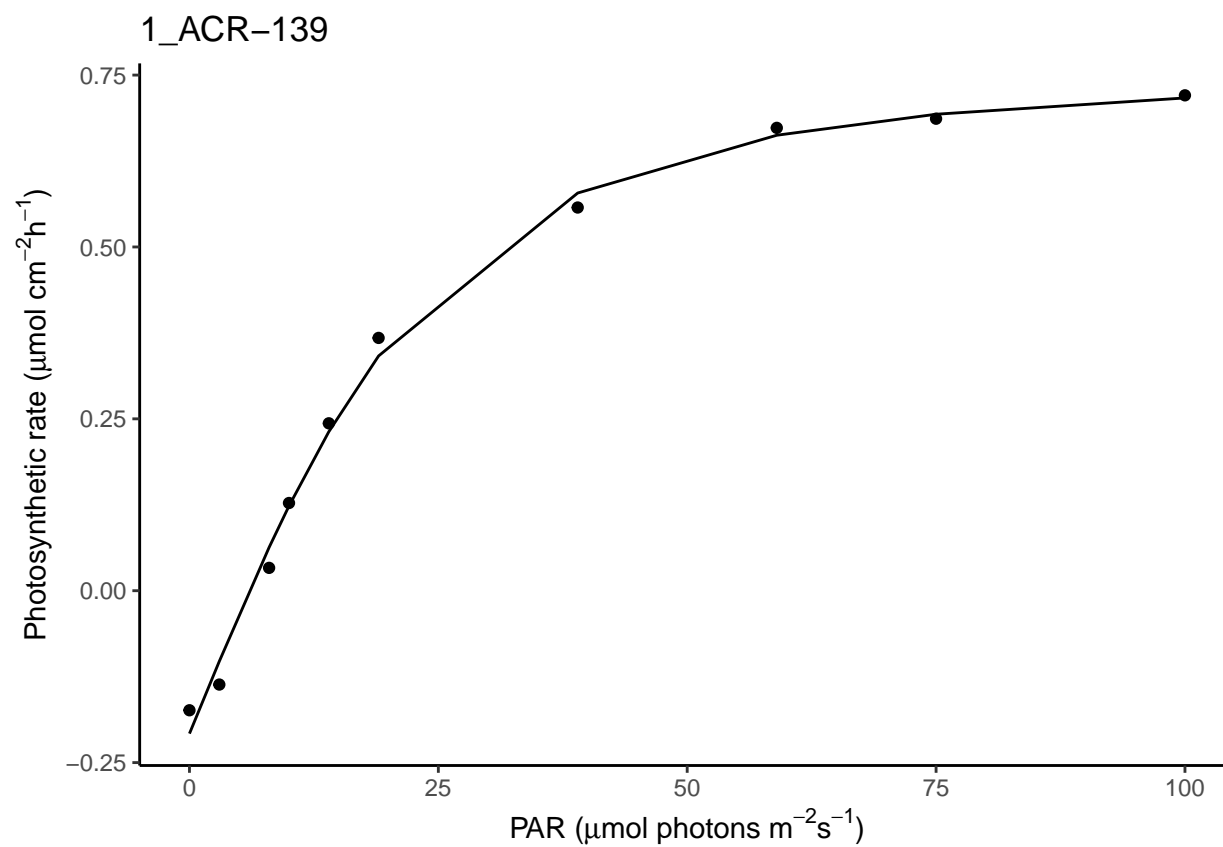
```
## -----  
## augmented$colony_id: ACR-185
```



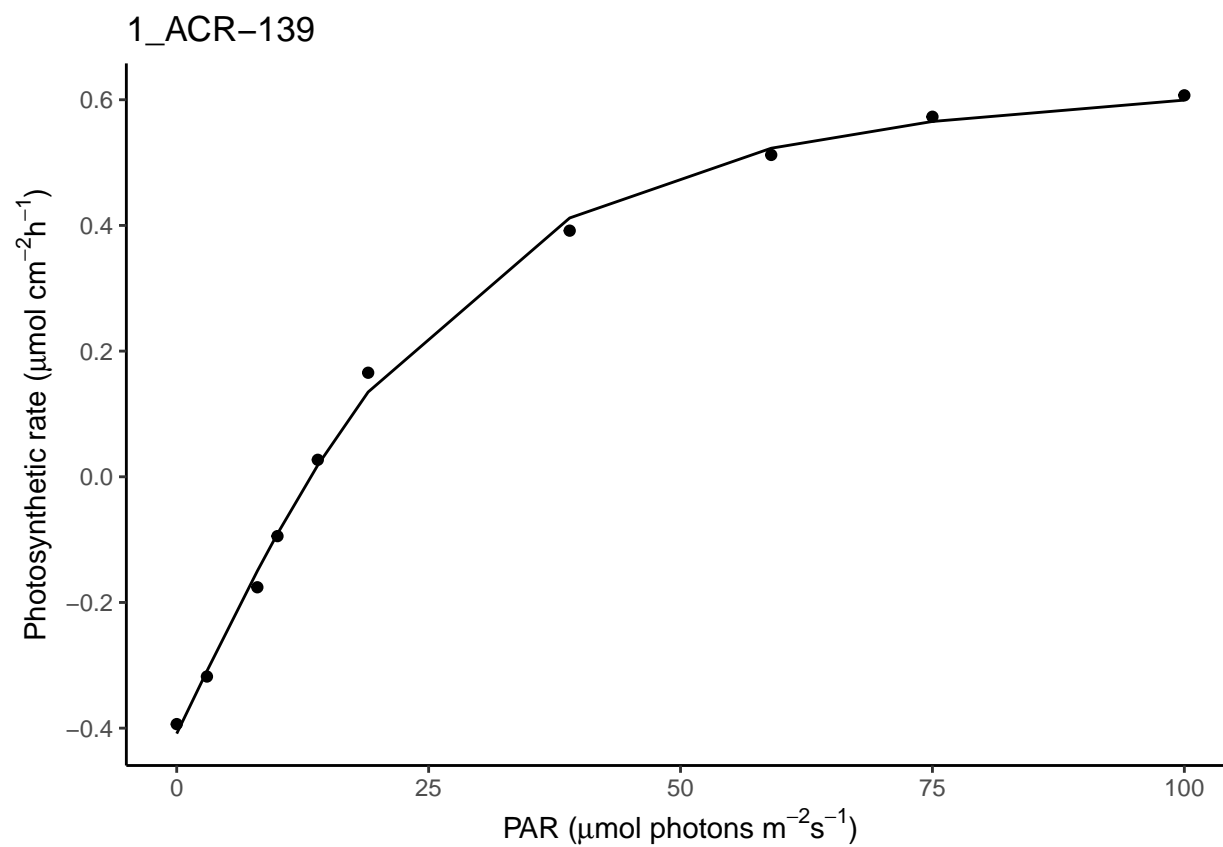
```
## -----  
## augmented$colony_id: ACR-186
```



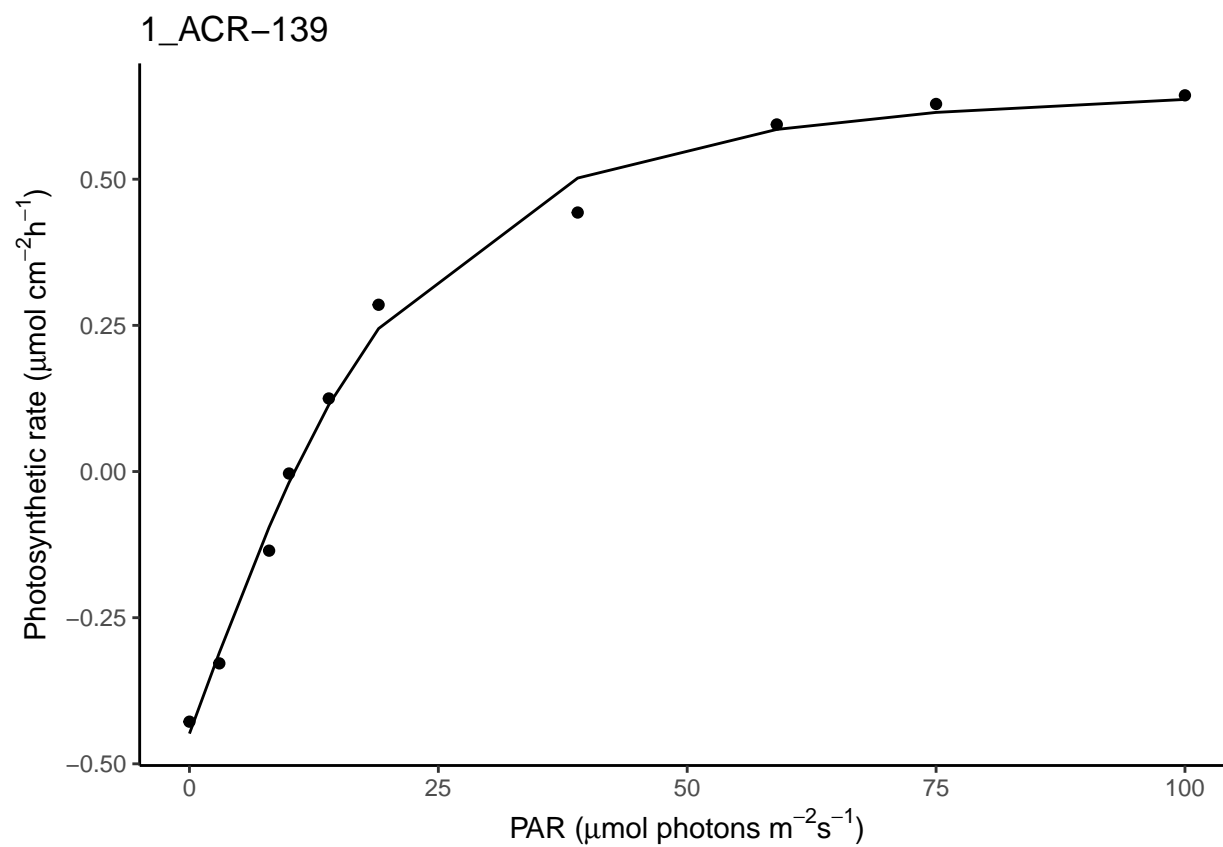
```
## -----  
## augmented$colony_id: ACR-187
```



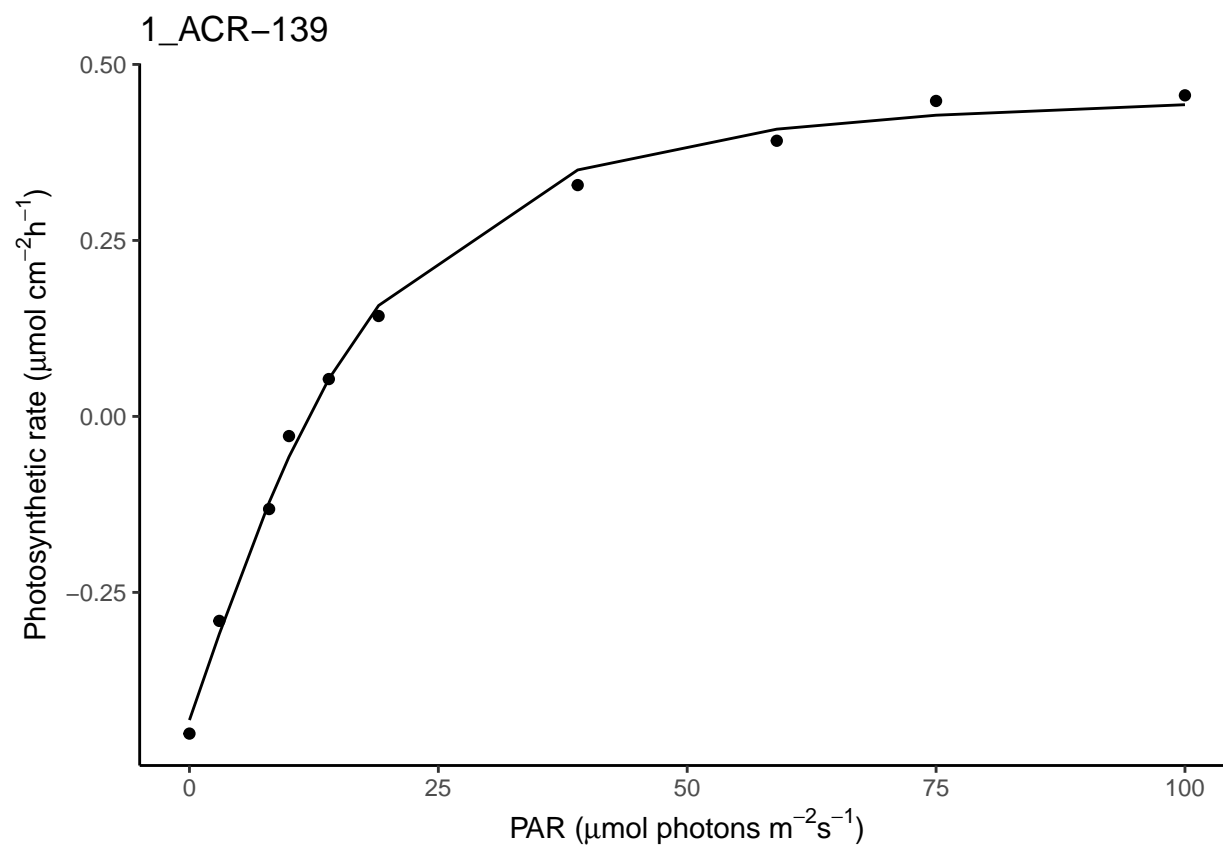
```
## -----  
## augmented$colony_id: ACR-210
```



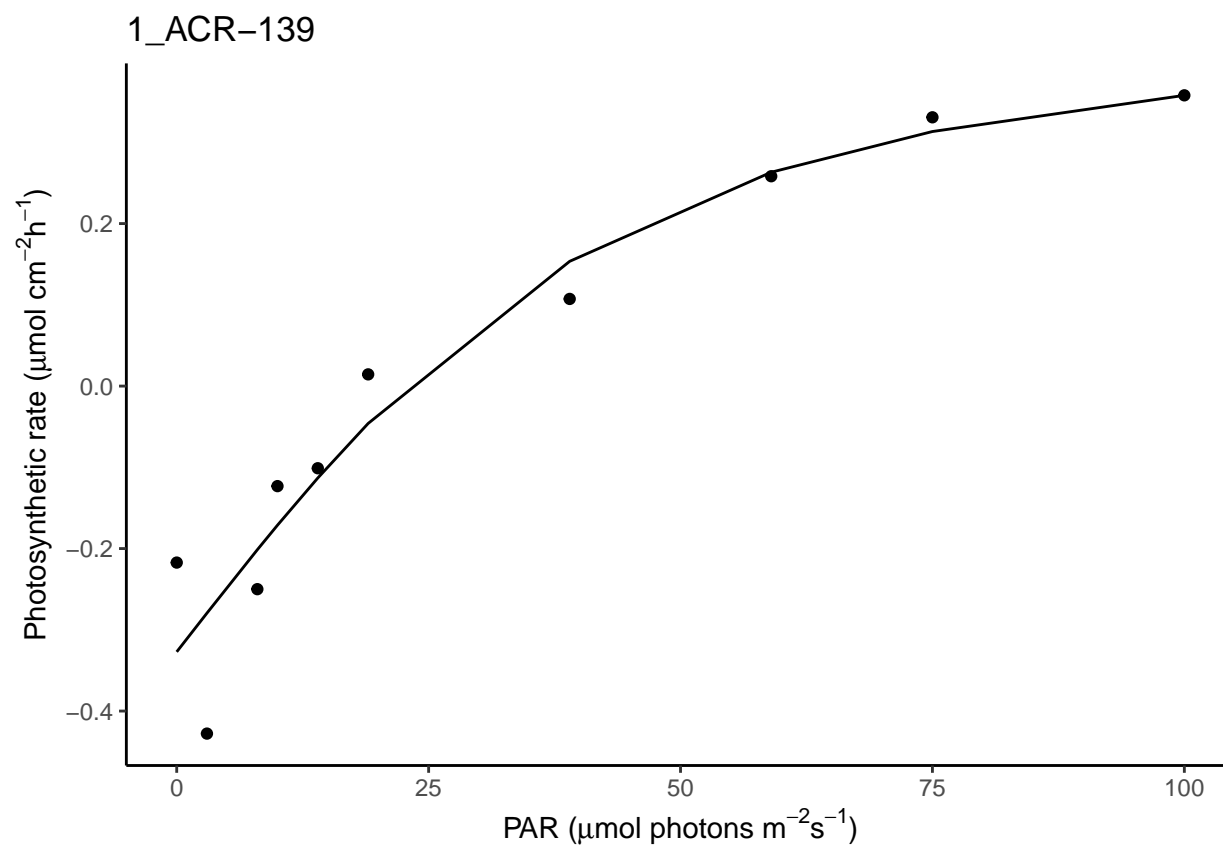
```
## -----  
## augmented$colony_id: ACR-213
```



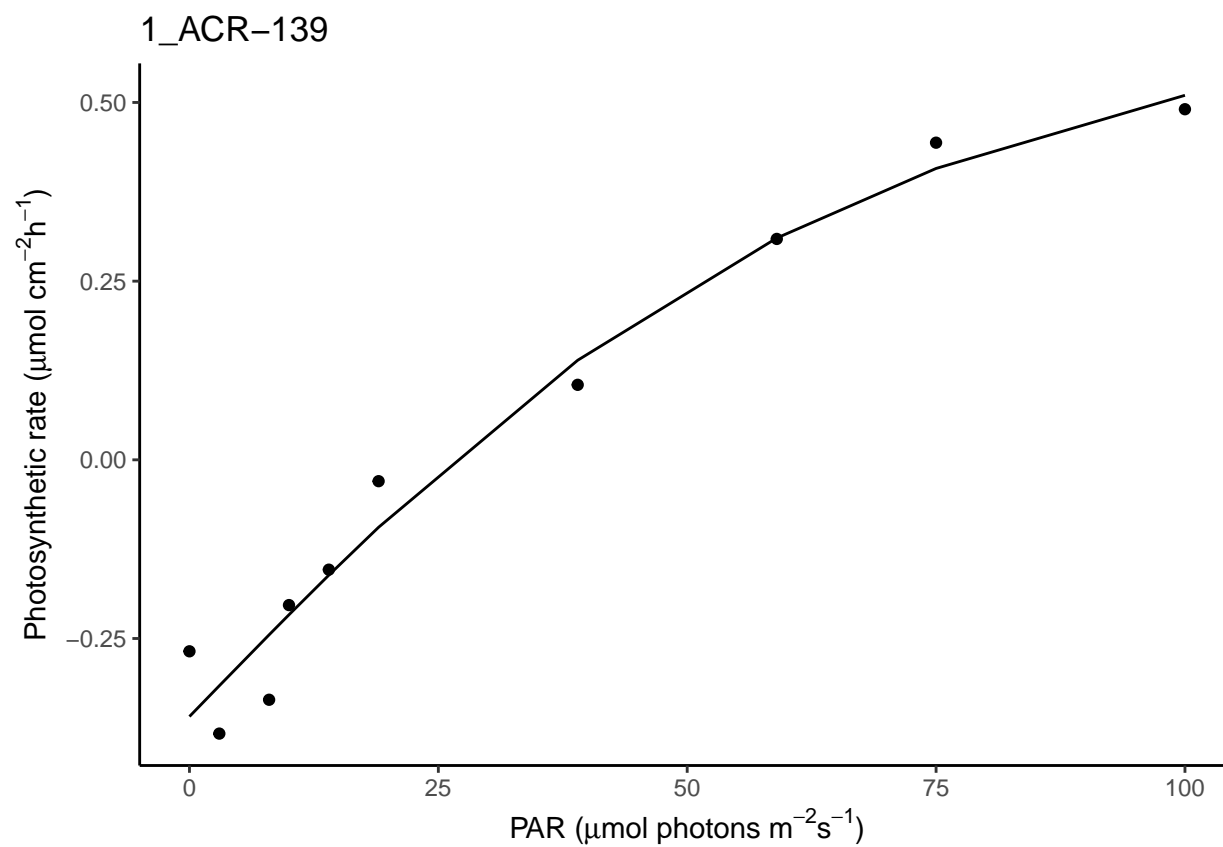
```
## -----  
## augmented$colony_id: ACR-218
```

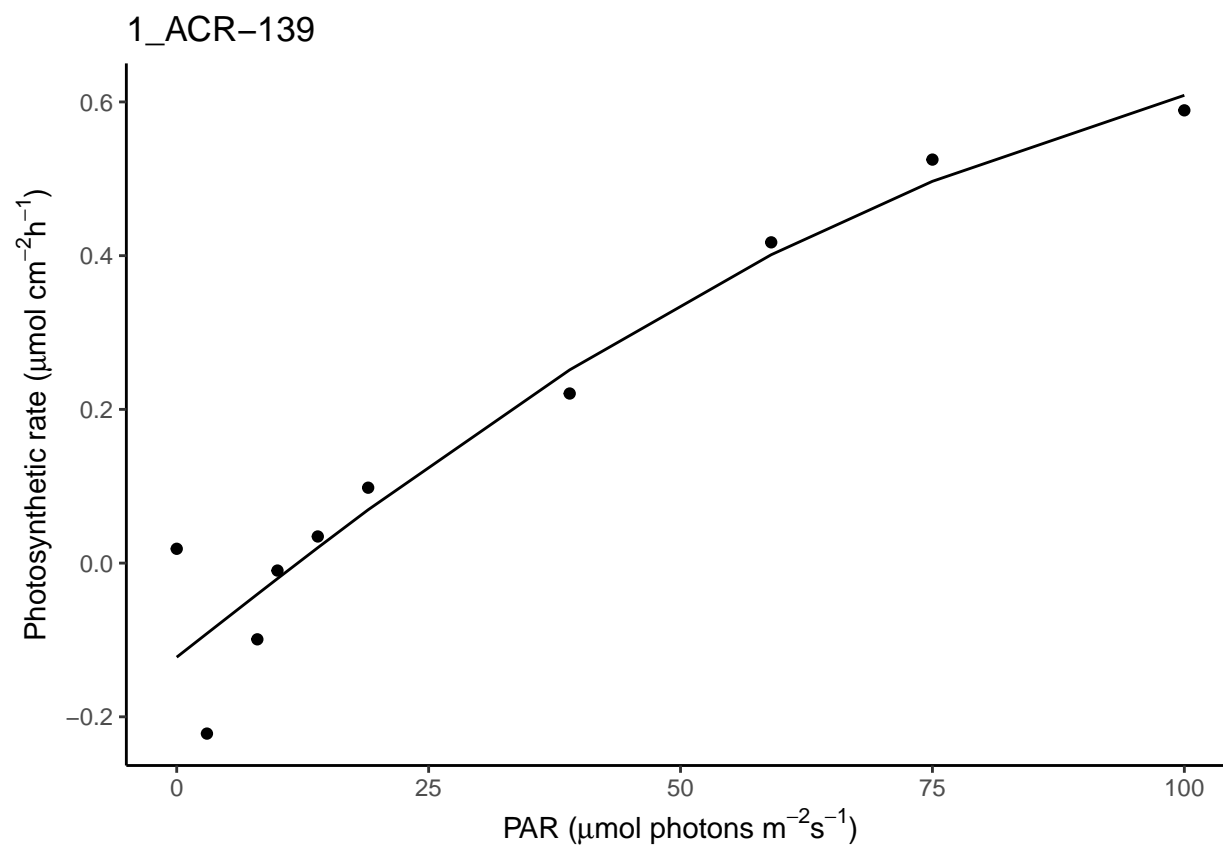
```
## -----  
## augmented$colony_id: ACR-220
```



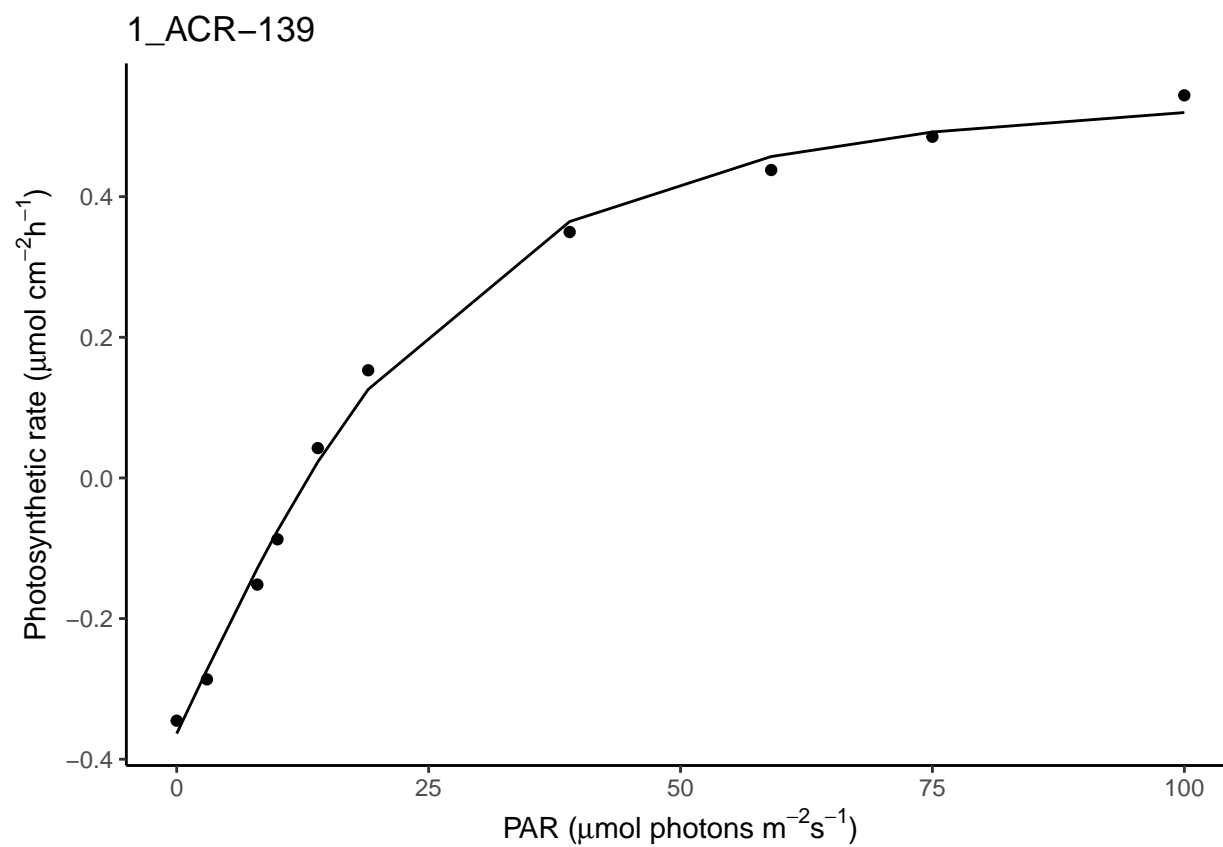
```
## -----  
## augmented$colony_id: ACR-225
```



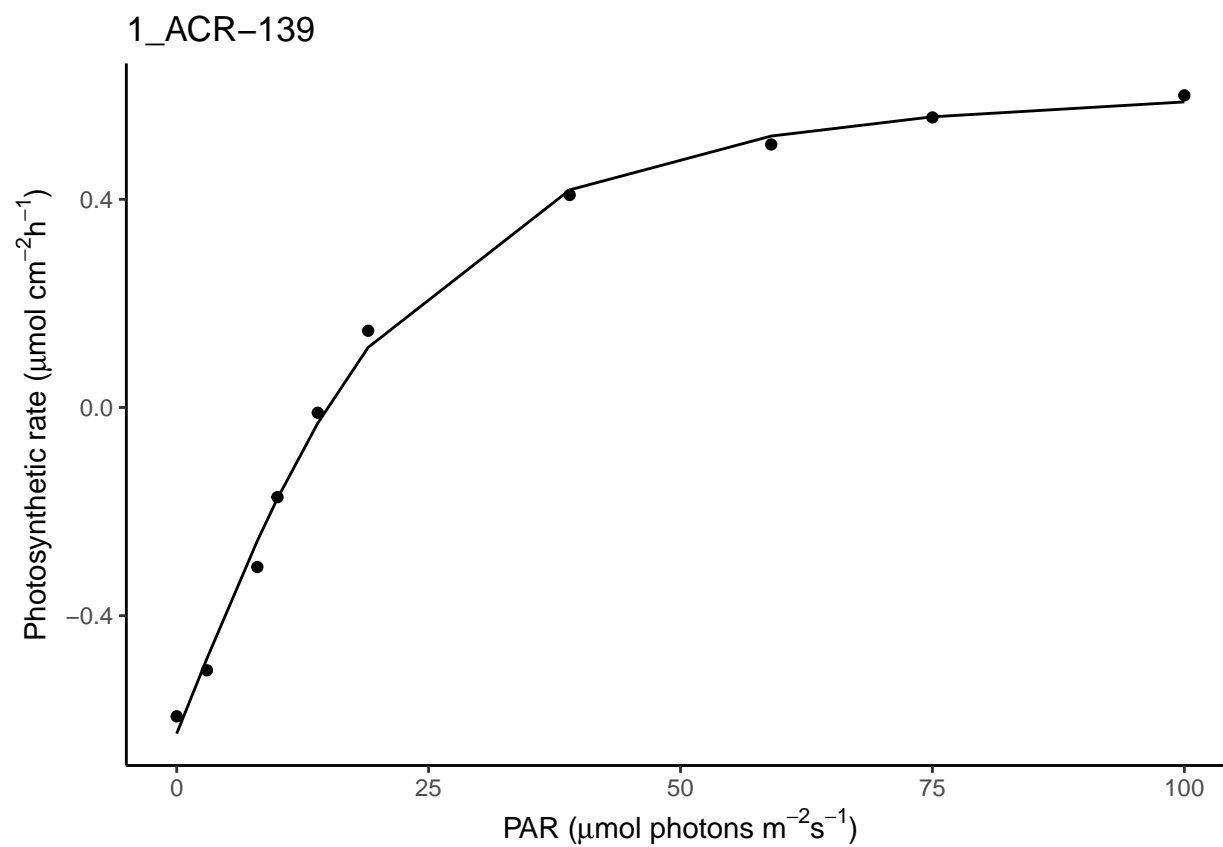
```
## -----  
## augmented$colony_id: ACR-229
```



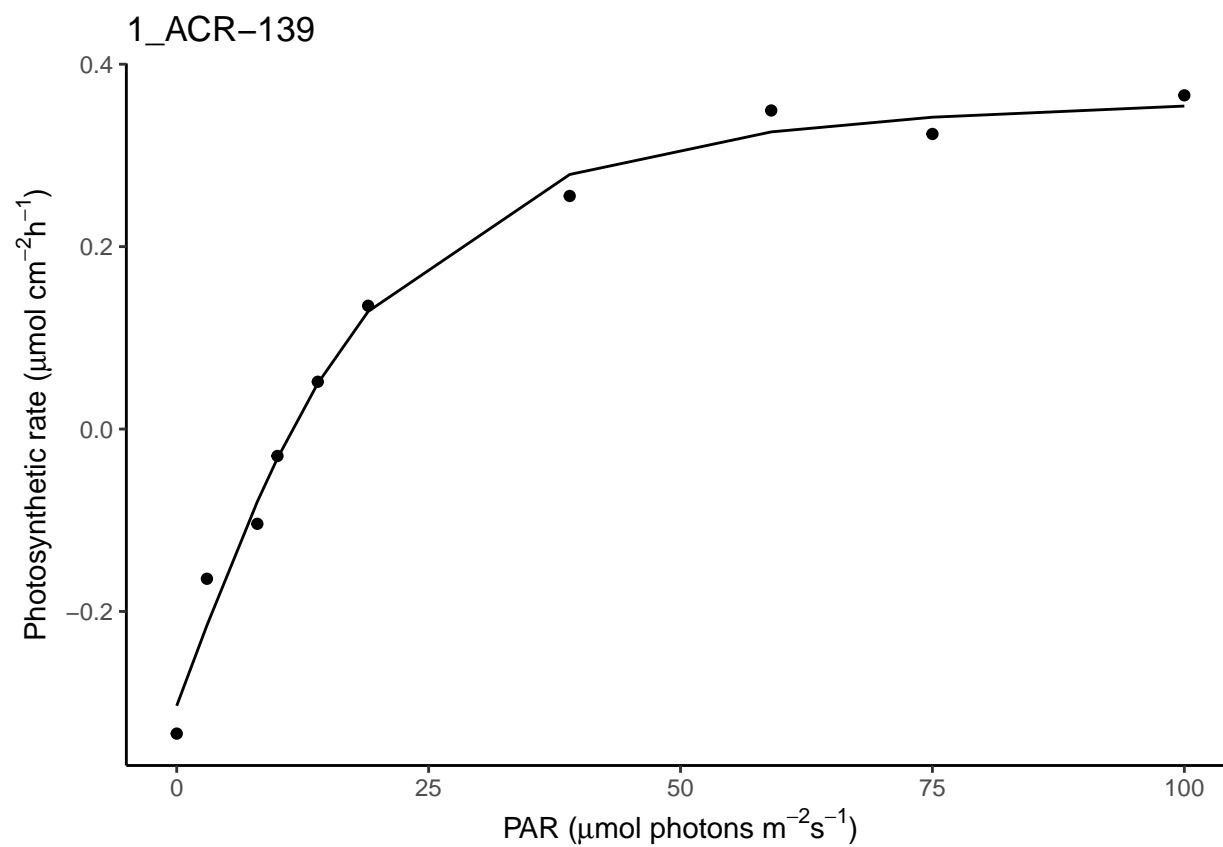
augmented\$colony_id: ACR-234



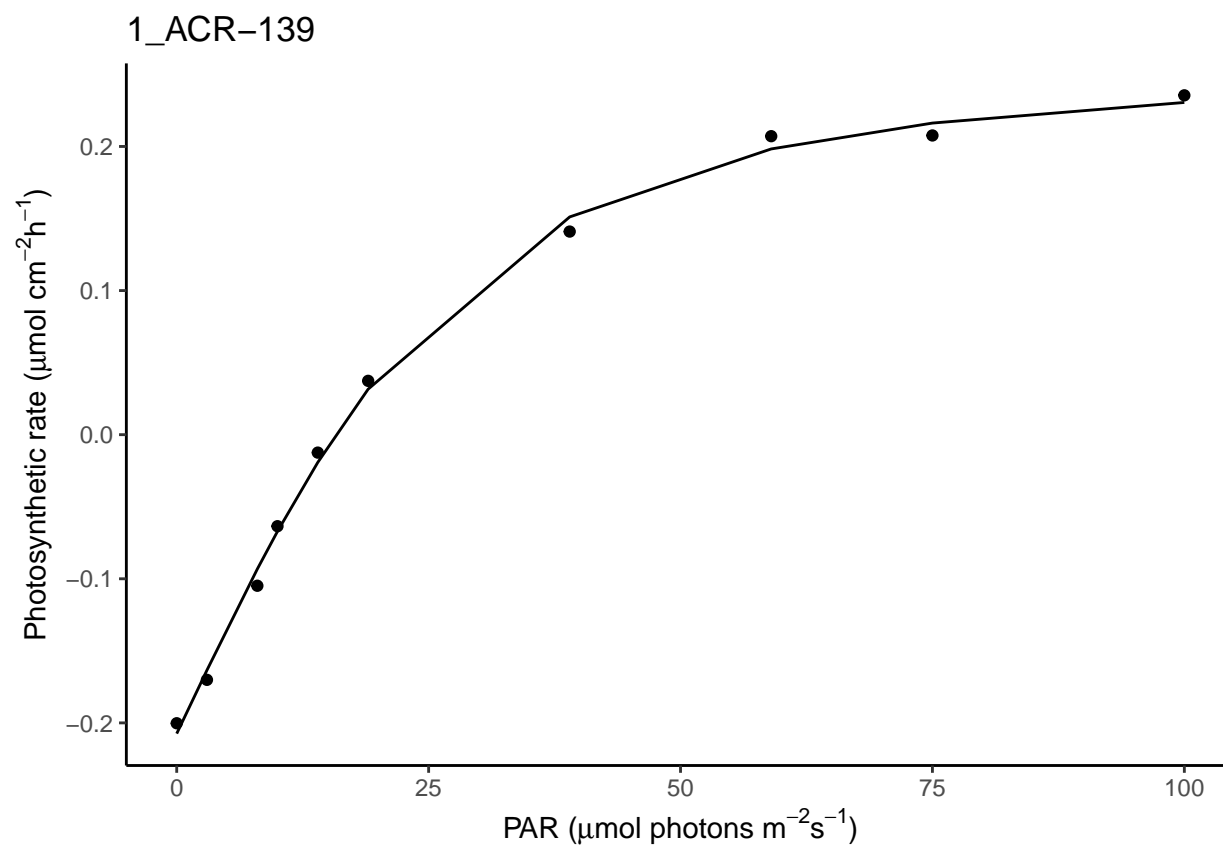
augmented\$colony_id: ACR-237



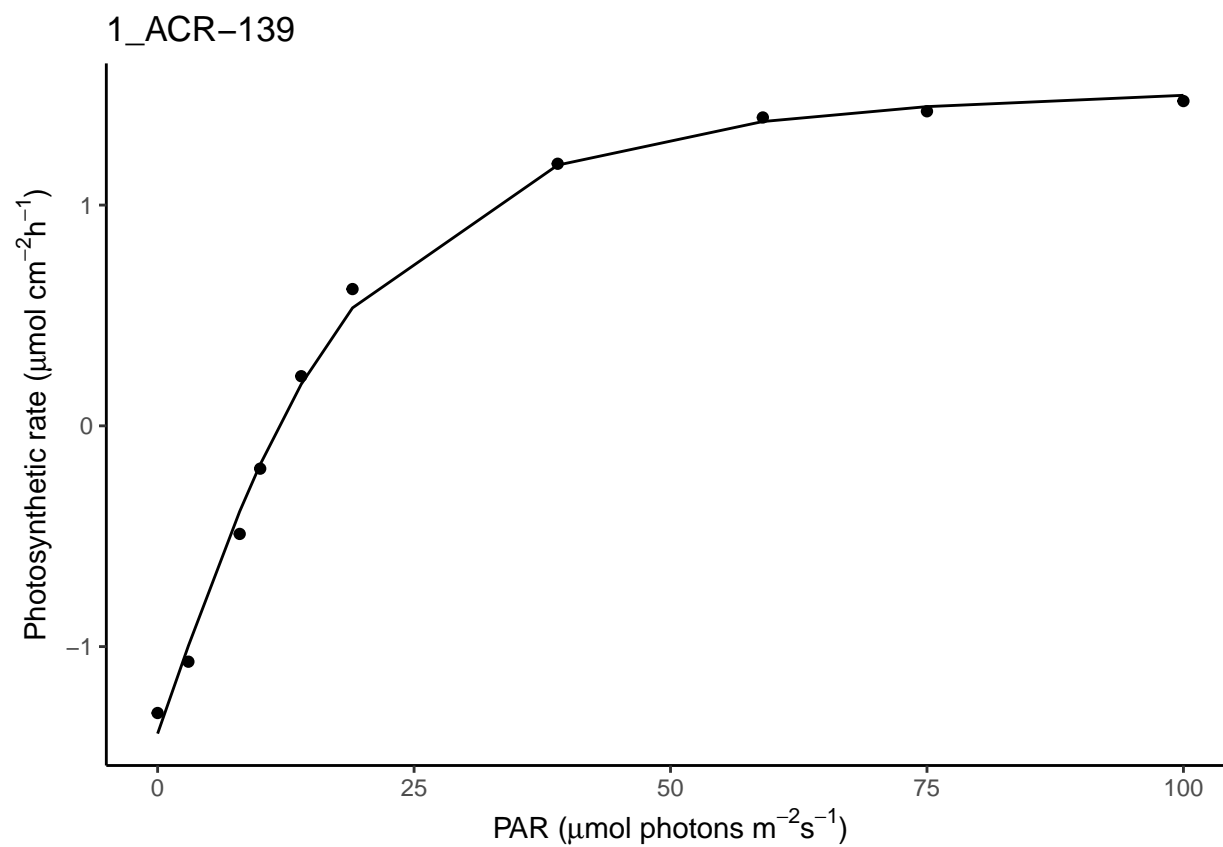
```
## -----  
## augmented$colony_id: ACR-241
```



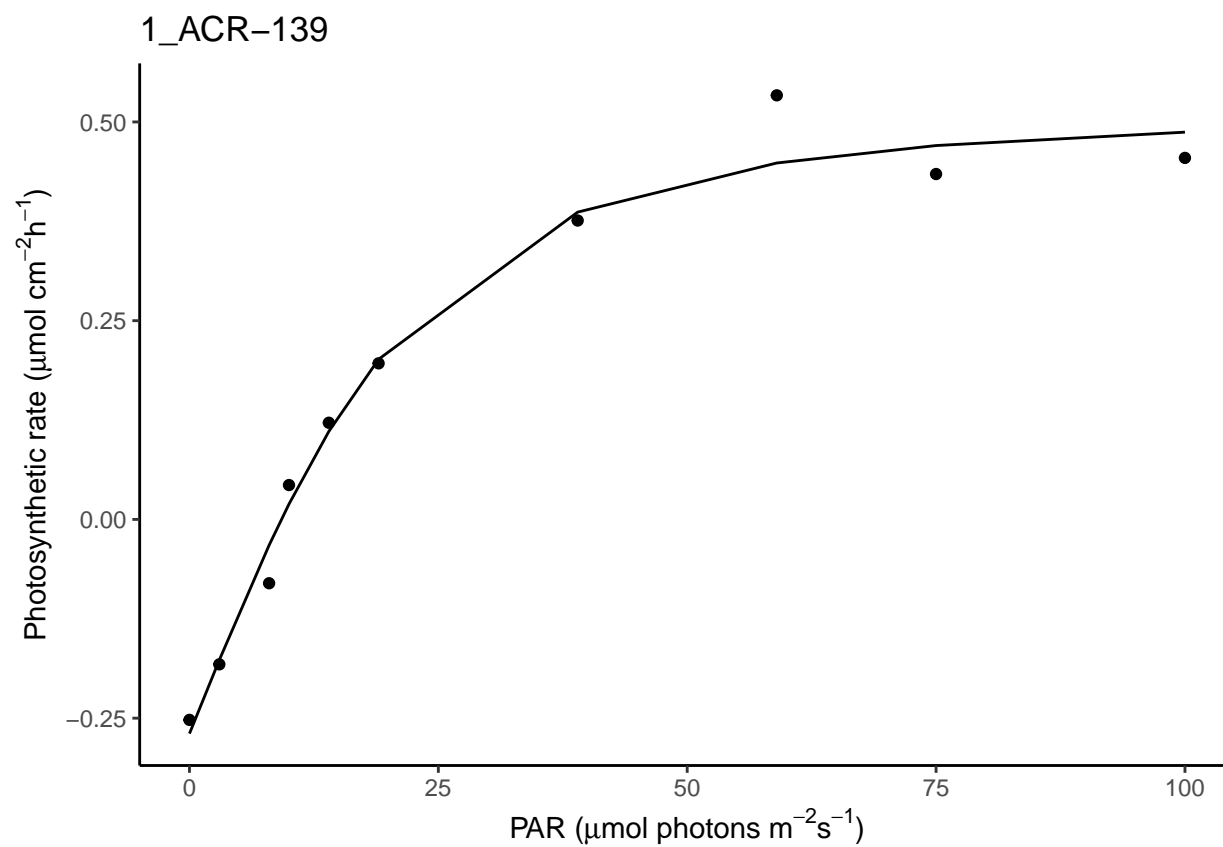
```
## -----
## augmented$colony_id: ACR-244
## NULL
## -----
## augmented$colony_id: ACR-256
```



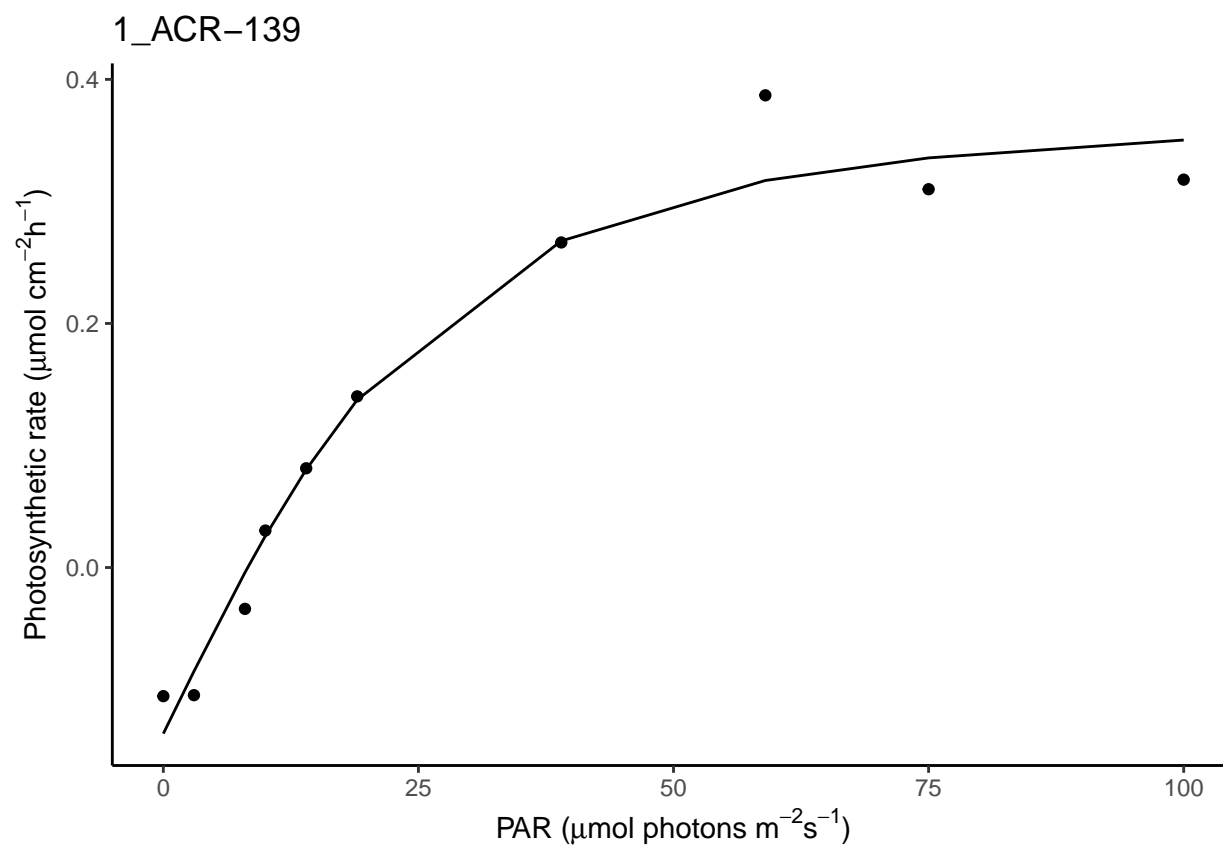
augmented\$colony_id: ACR-267



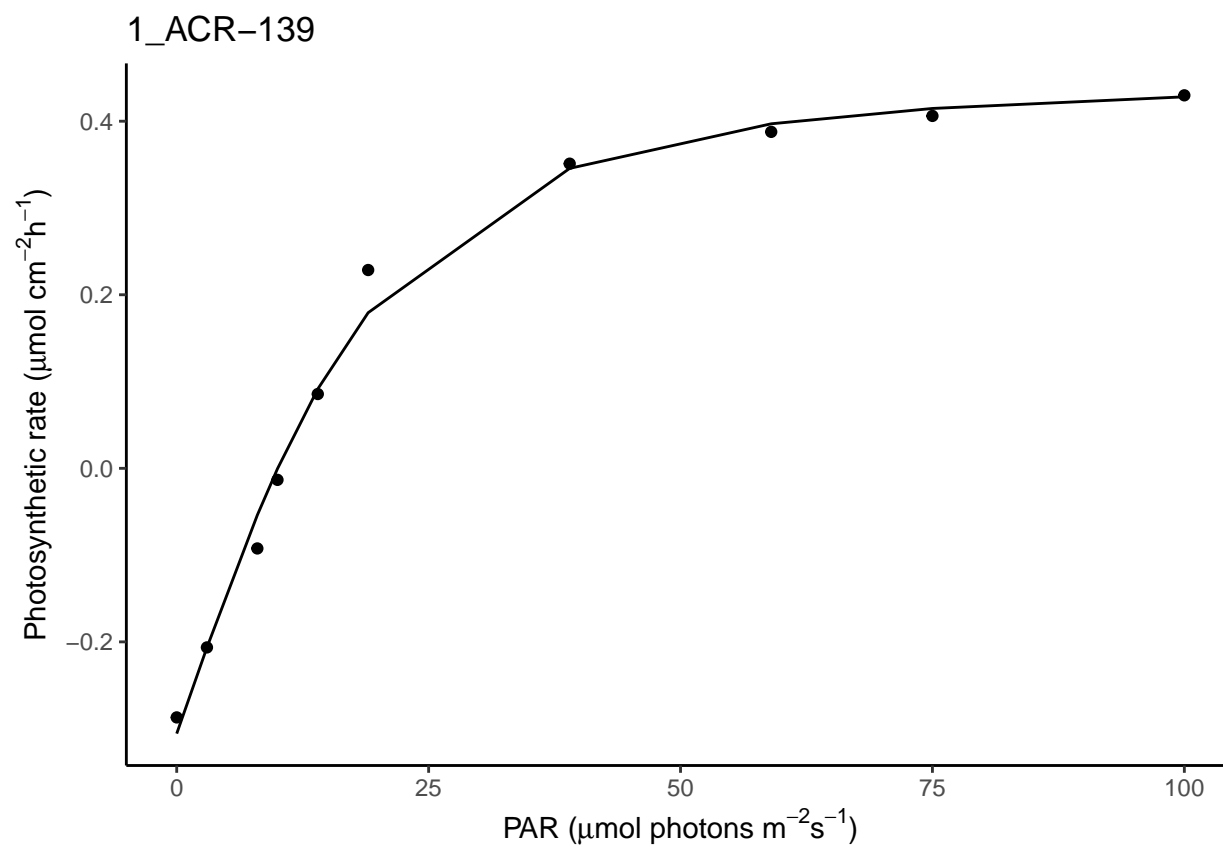
augmented\$colony_id: ACR-343



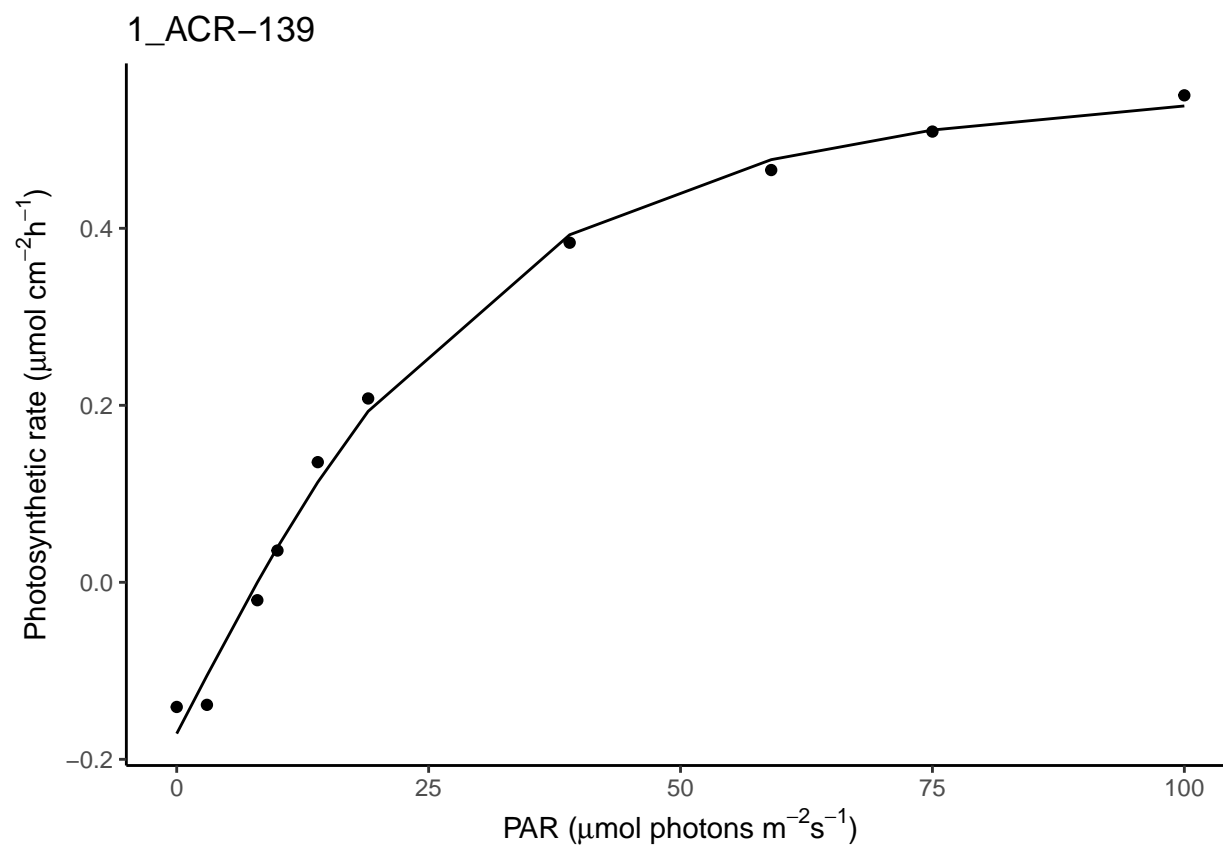
```
## -----  
## augmented$colony_id: ACR-368
```



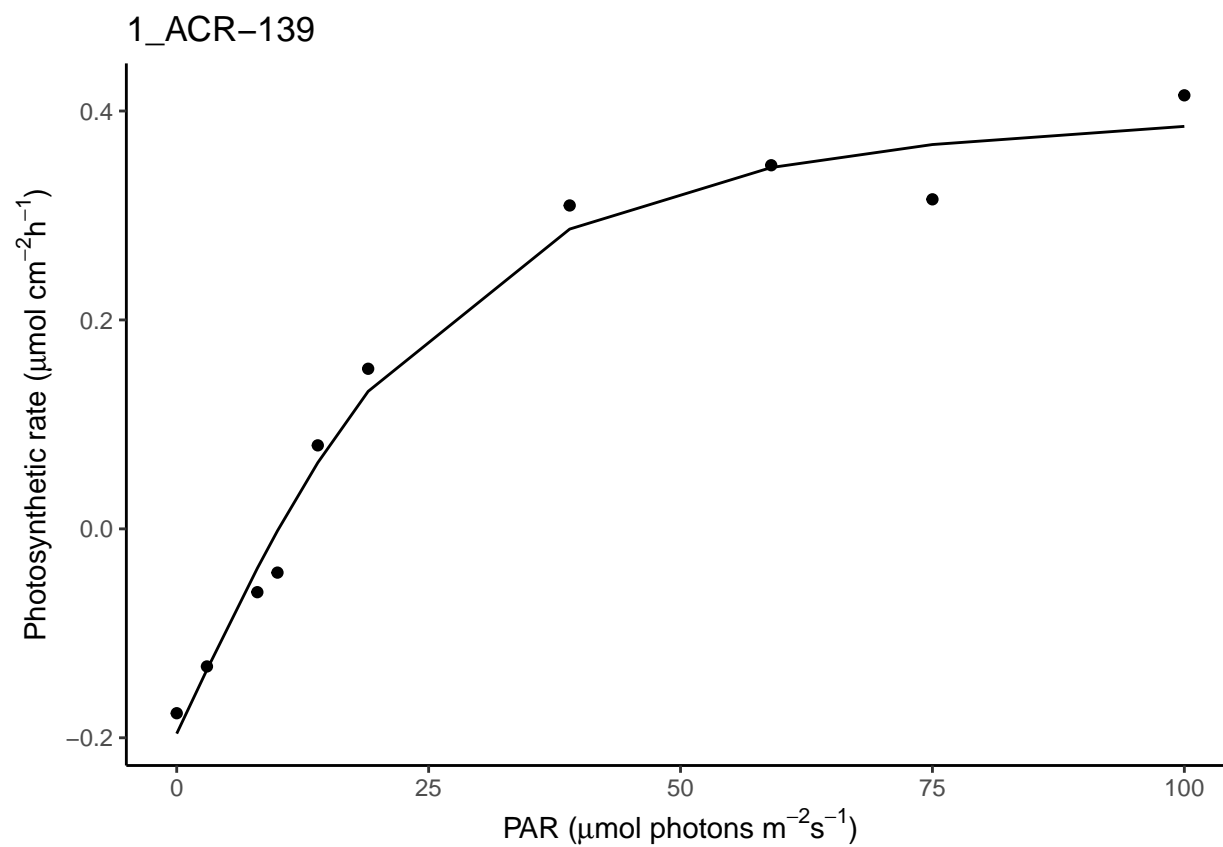
```
## -----  
## augmented$colony_id: ACR-389
```



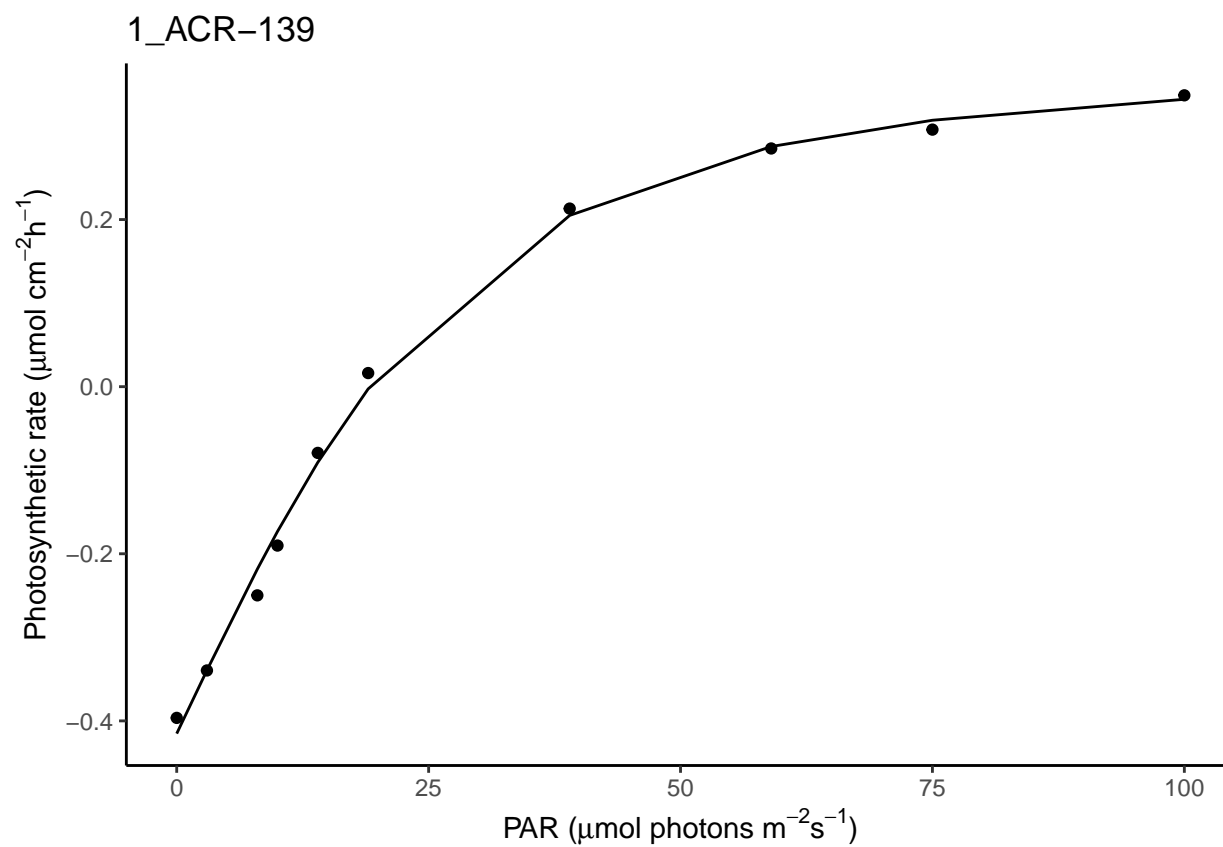
```
## -----  
## augmented$colony_id: ACR-390
```



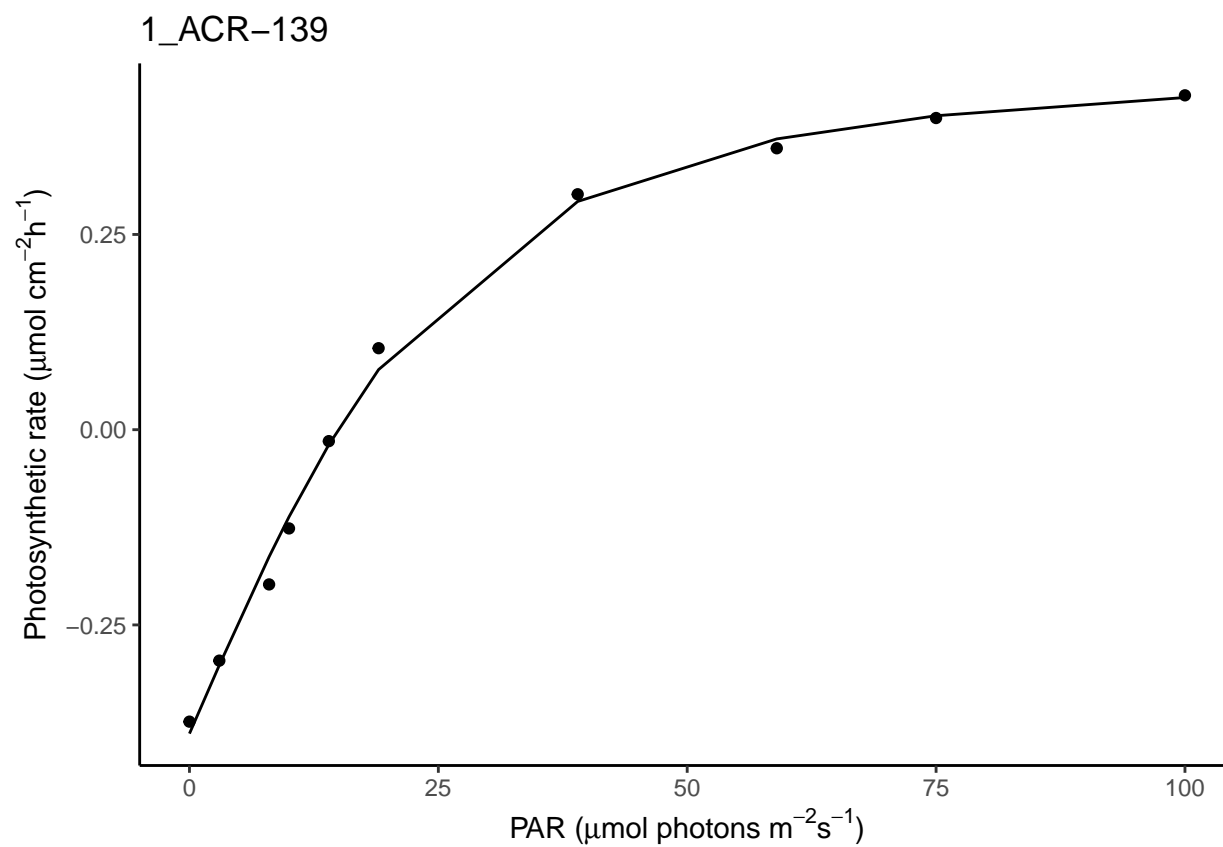
```
## -----  
## augmented$colony_id: ACR-393
```



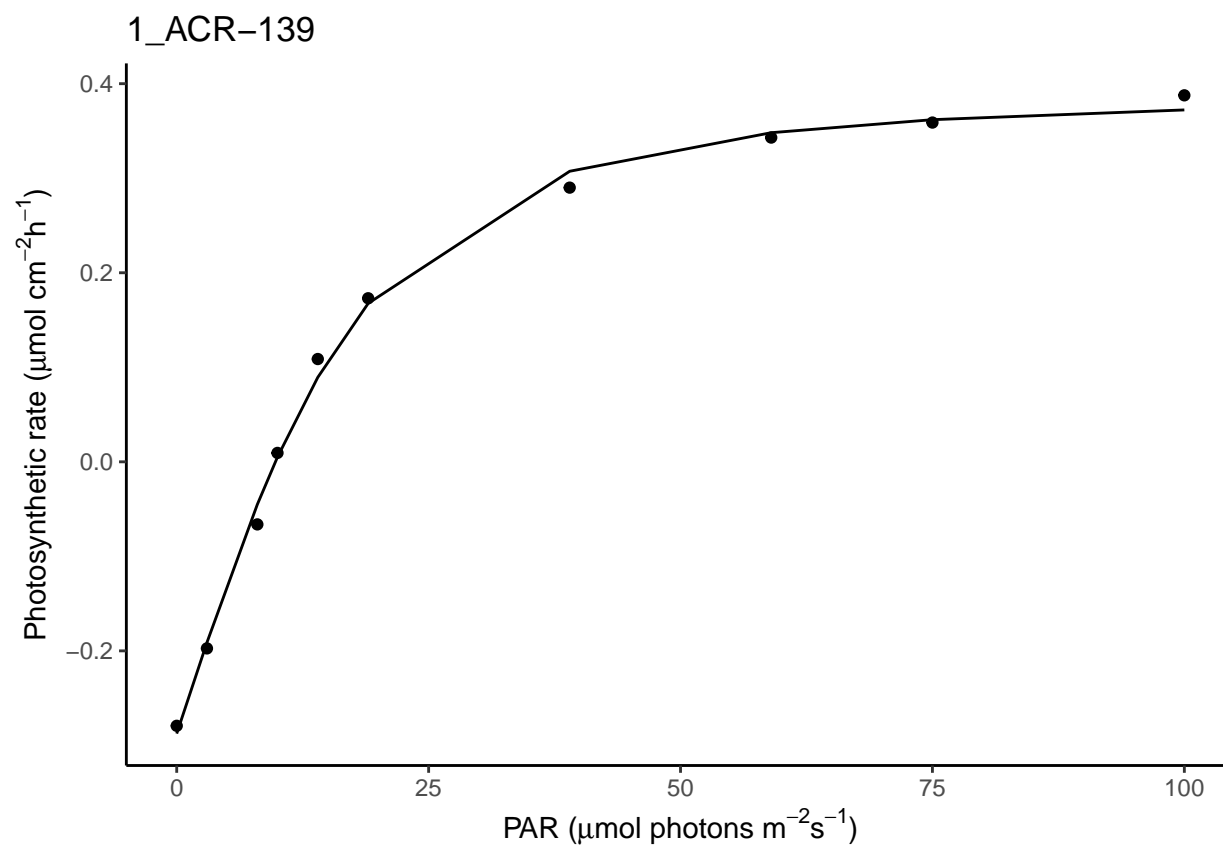
```
## -----  
## augmented$colony_id: ACR-398  
## NULL  
## -----  
## augmented$colony_id: POC-200
```



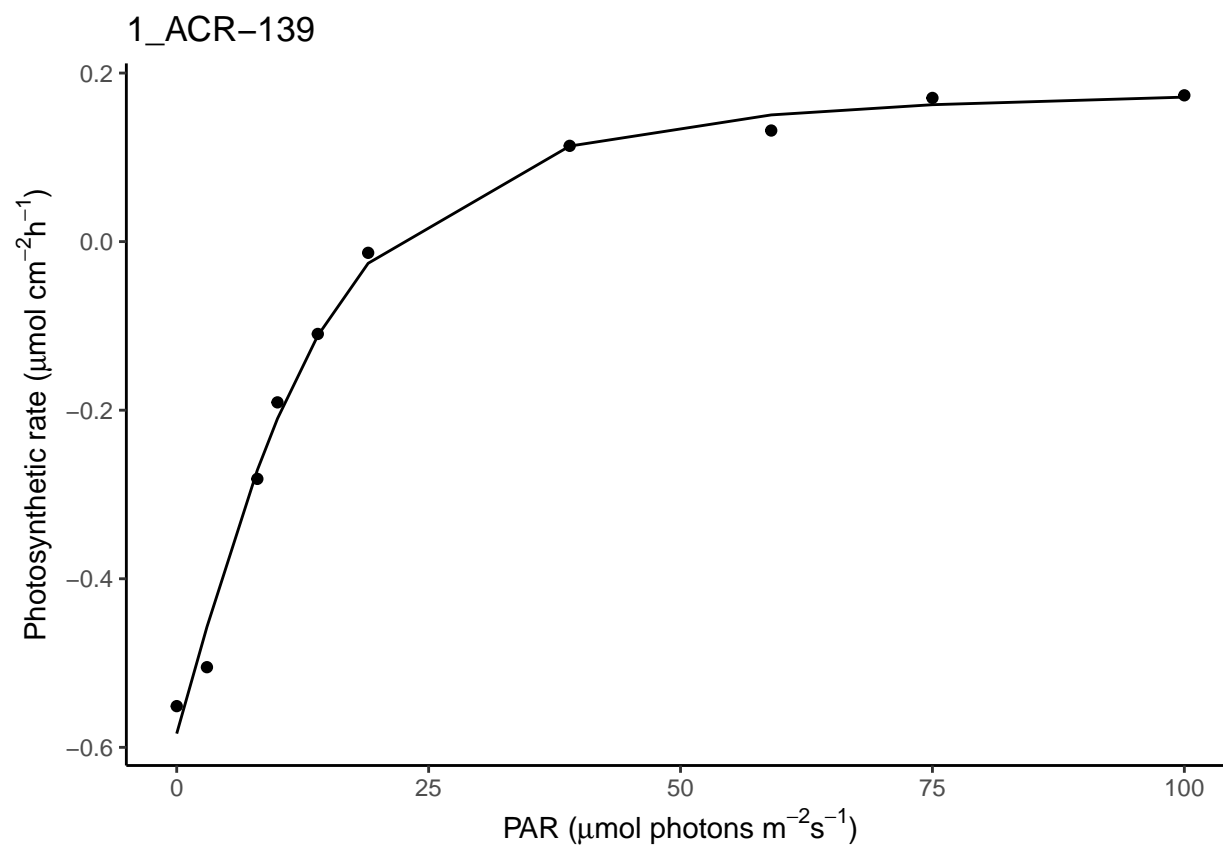
augmented\$colony_id: POC-205



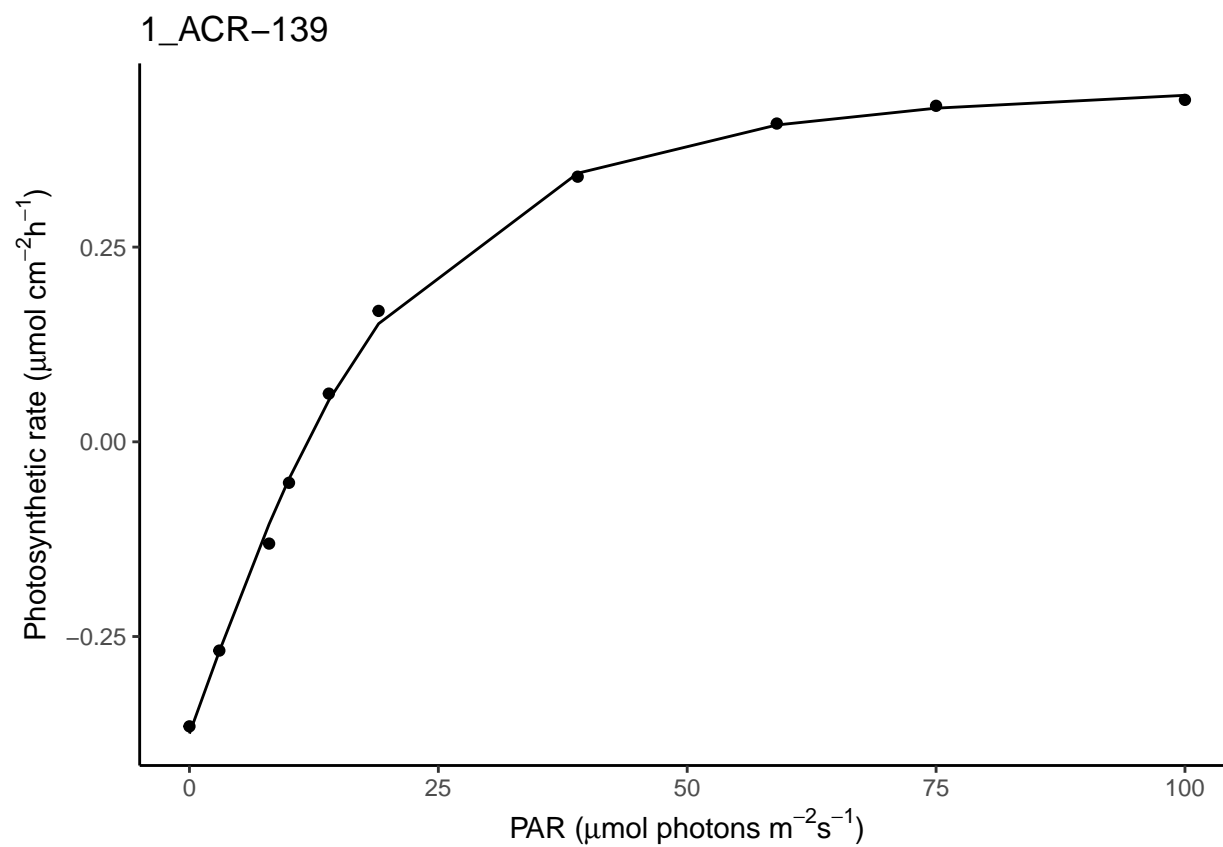
augmented\$colony_id: POC-207



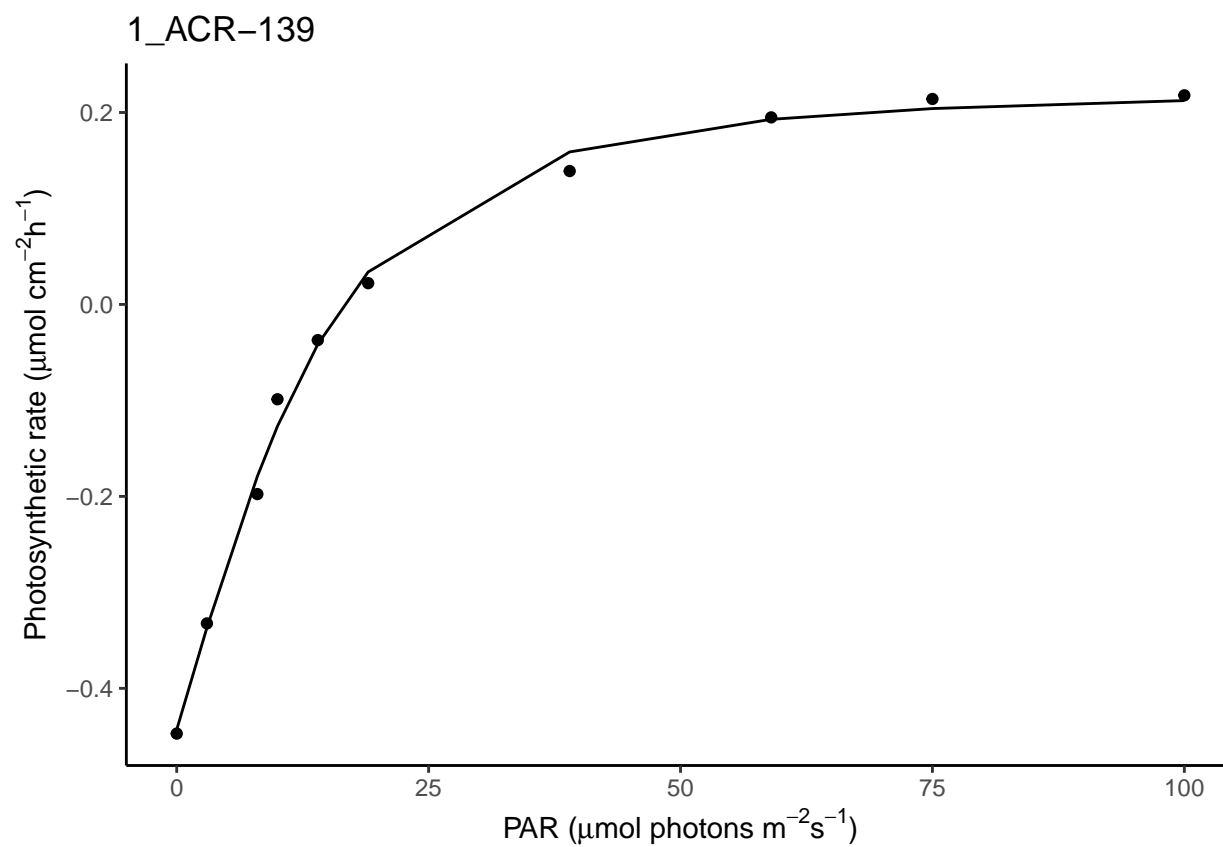
```
## -----  
## augmented$colony_id: POC-219
```



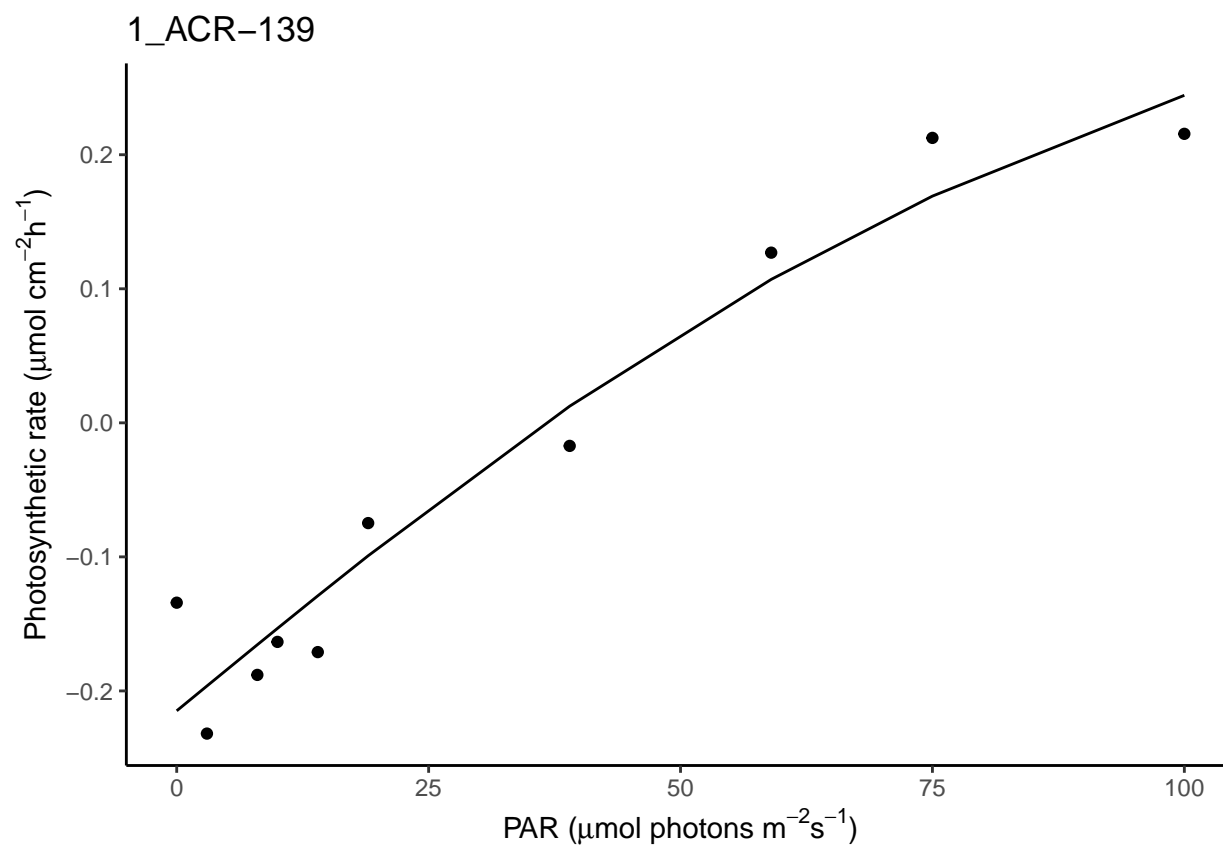
```
## -----  
## augmented$colony_id: POC-222
```



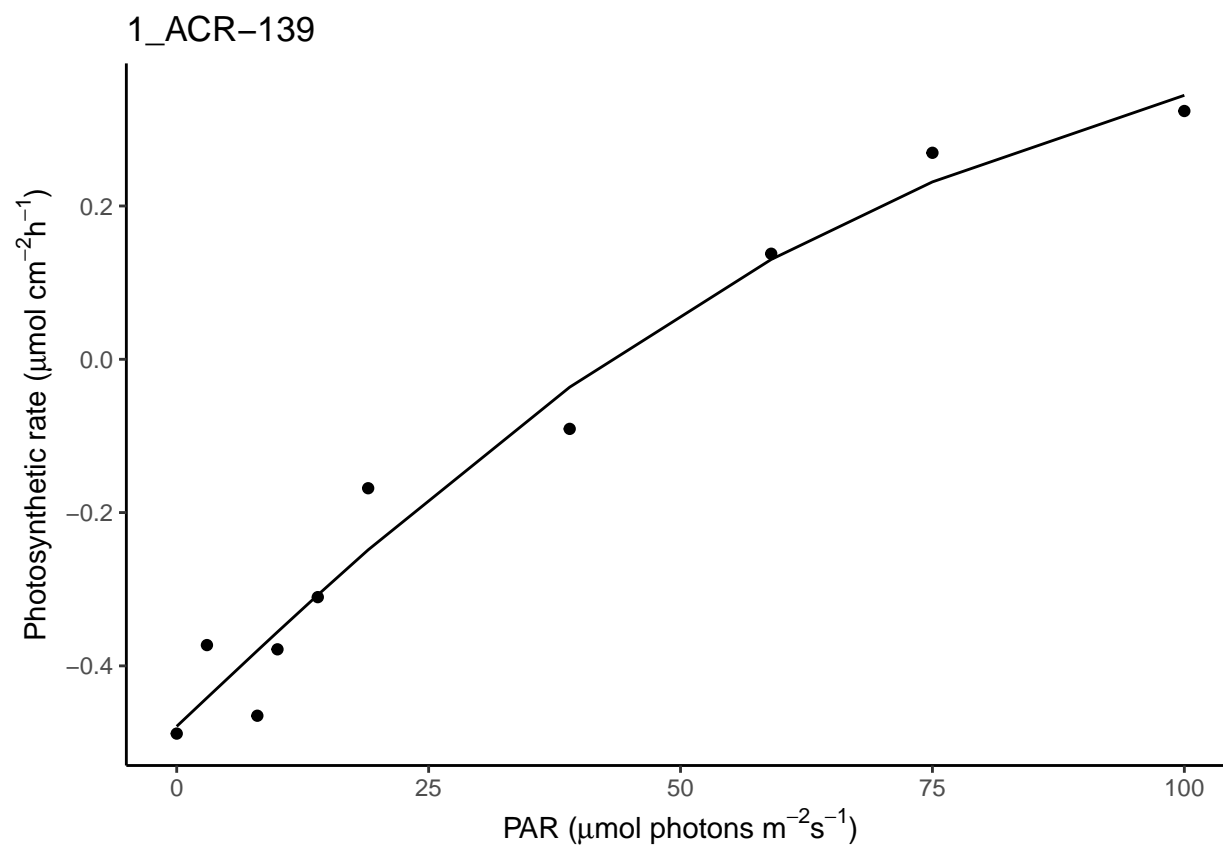
augmented\$colony_id: POC-238



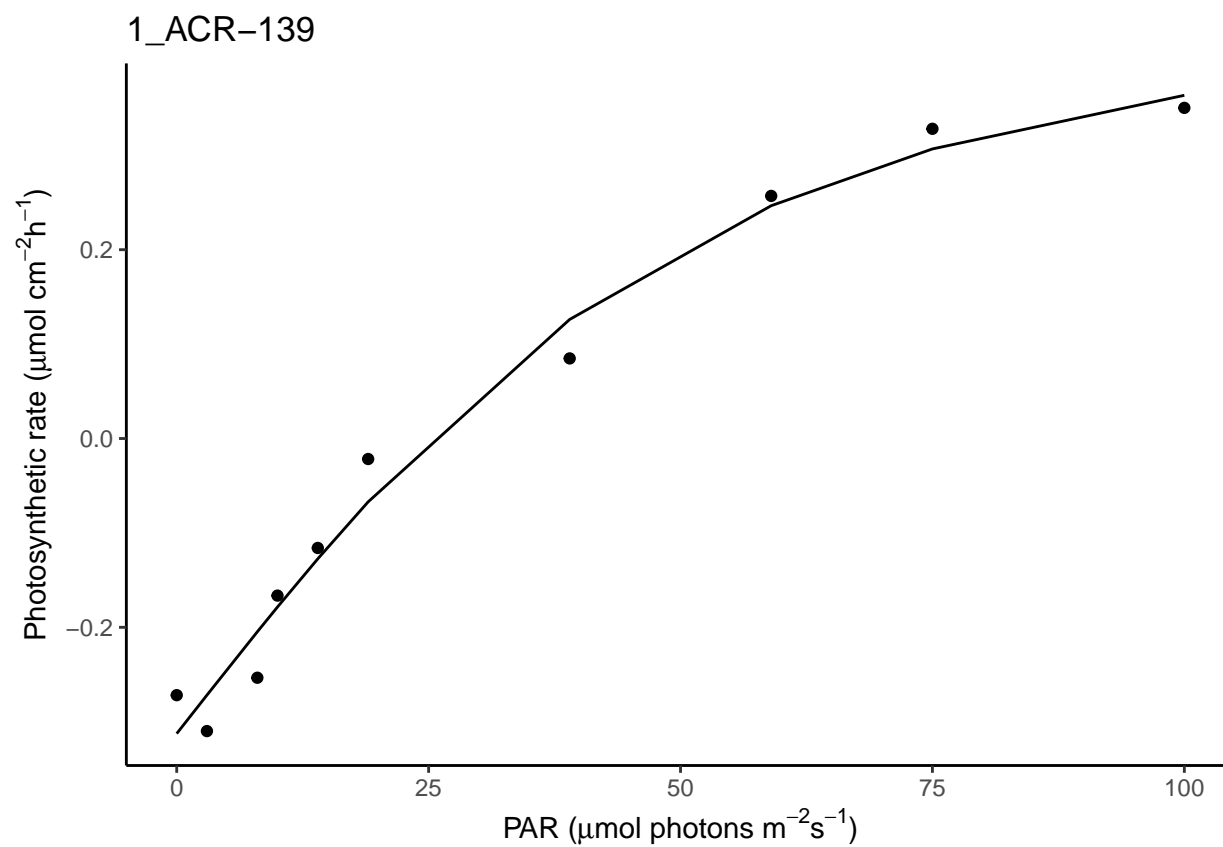
```
## -----  
## augmented$colony_id: P0C-239
```



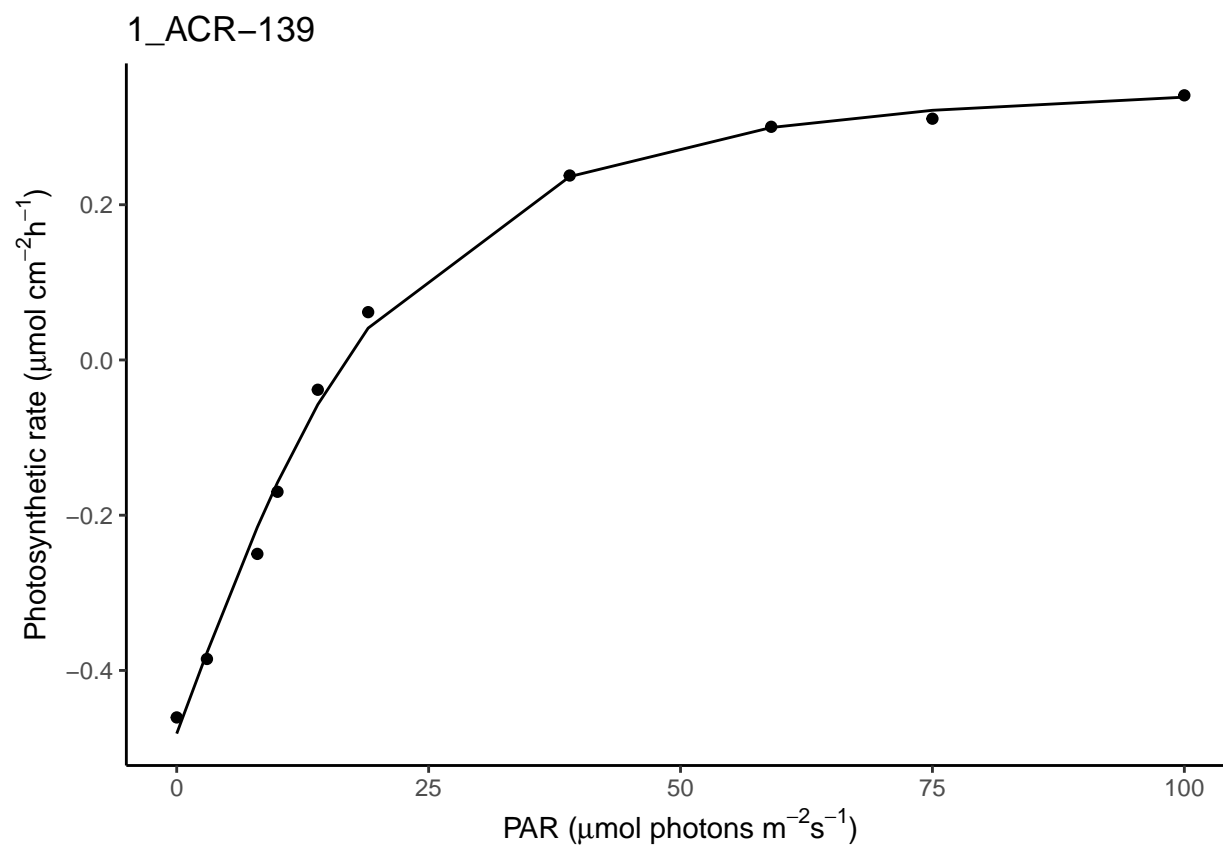
```
## -----  
## augmented$colony_id: POC-248
```



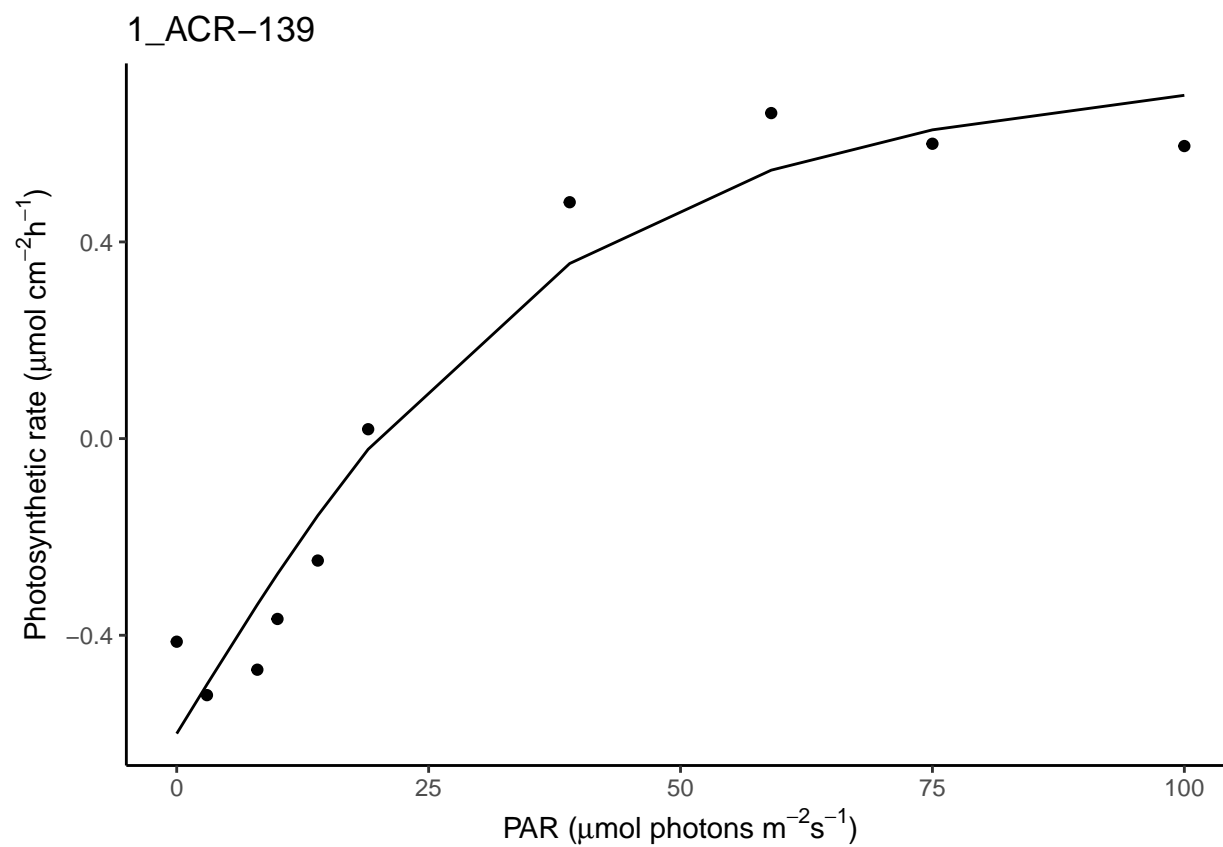
```
## -----  
## augmented$colony_id: POC-254
```



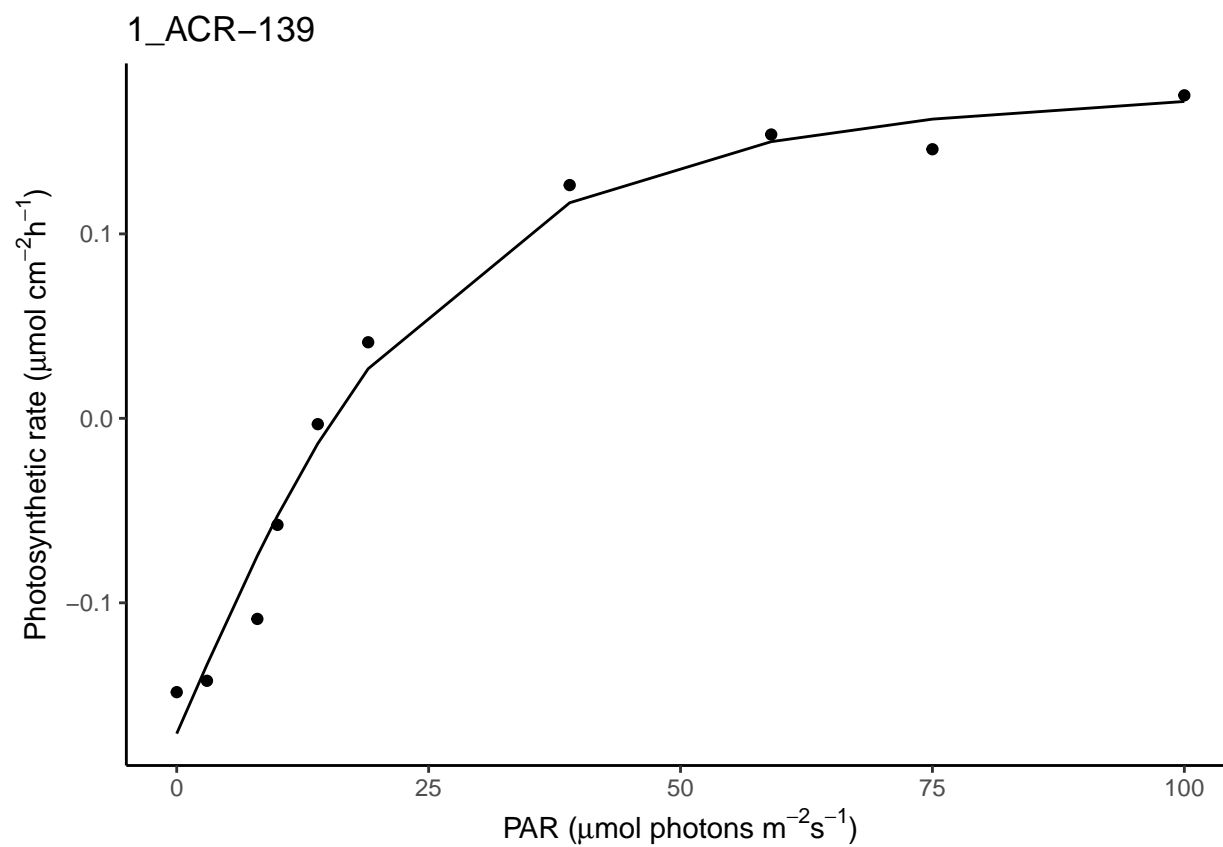
```
## -----  
## augmented$colony_id: POC-255
```



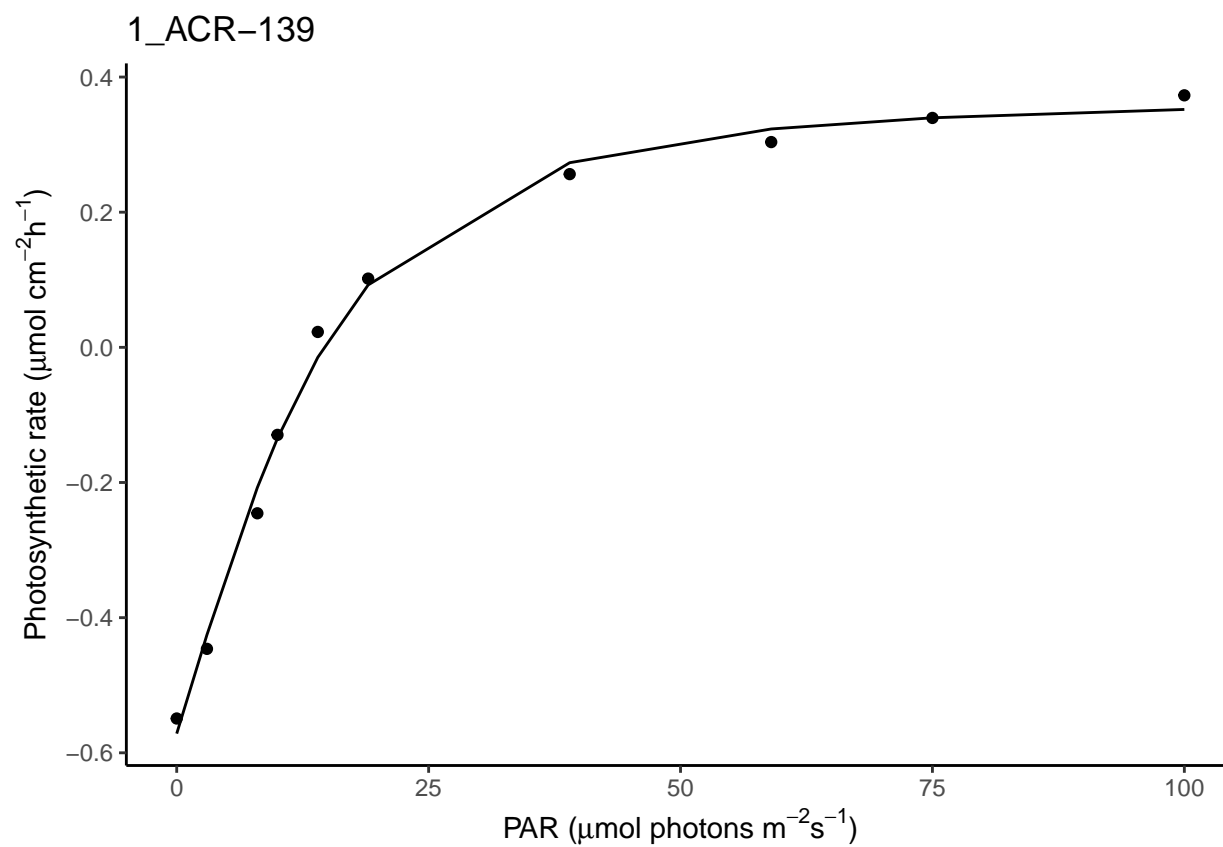
```
## -----  
## augmented$colony_id: POC-257
```

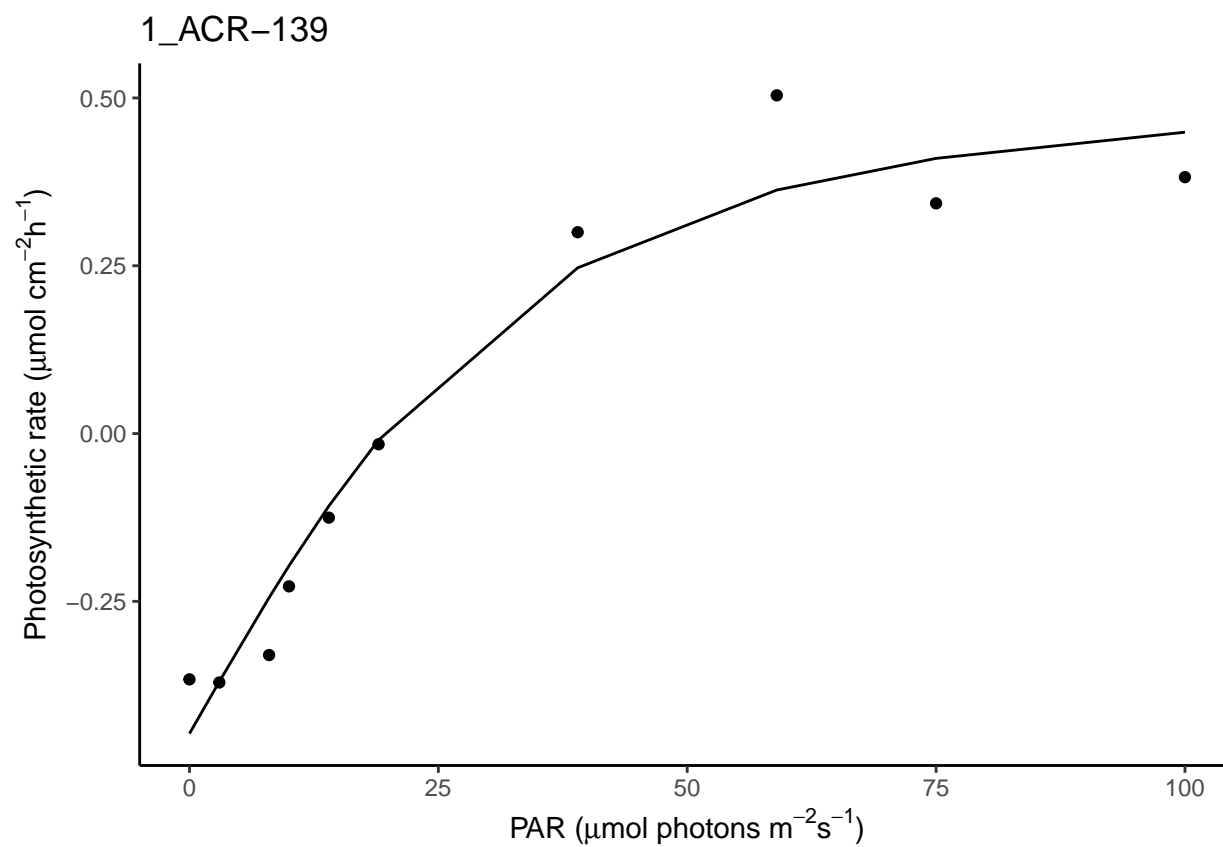
```
## -----  
## augmented$colony_id: P0C-259
```



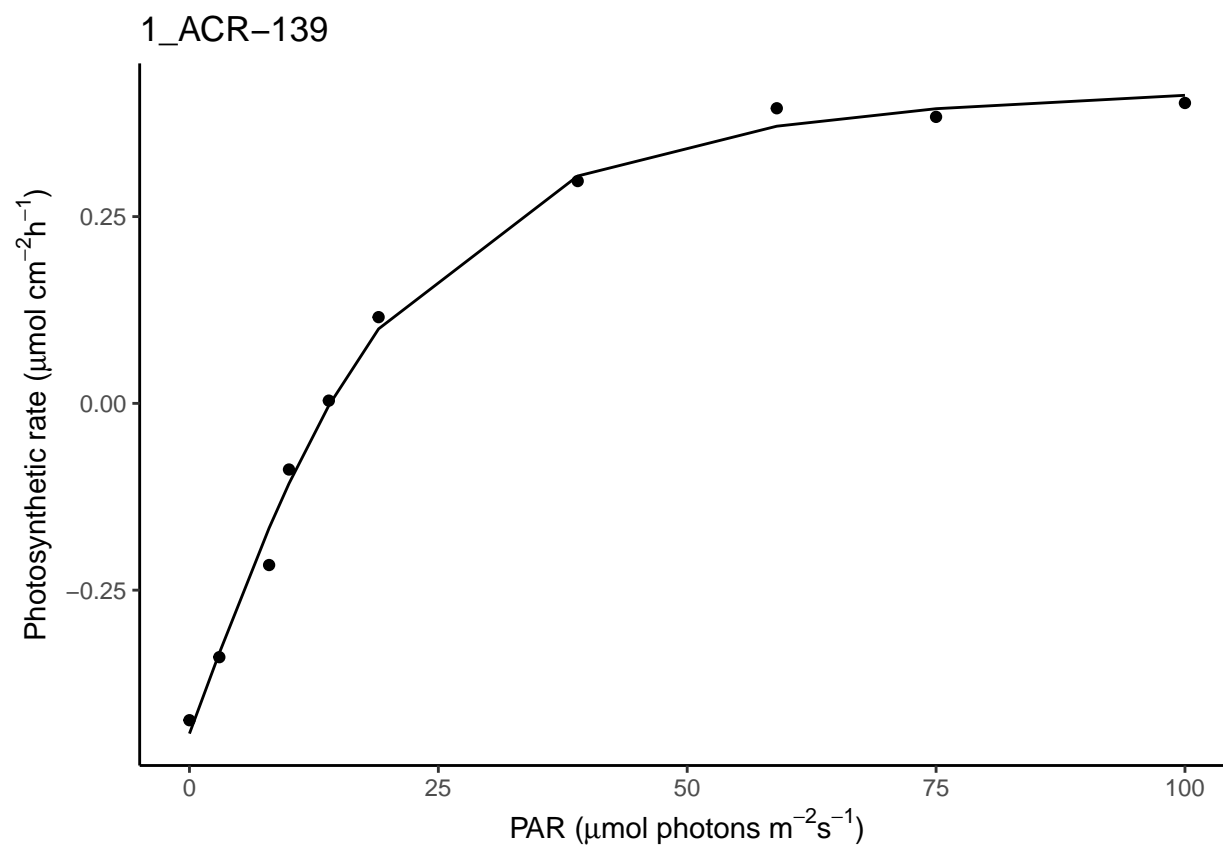
```
## -----  
## augmented$colony_id: POC-346
```



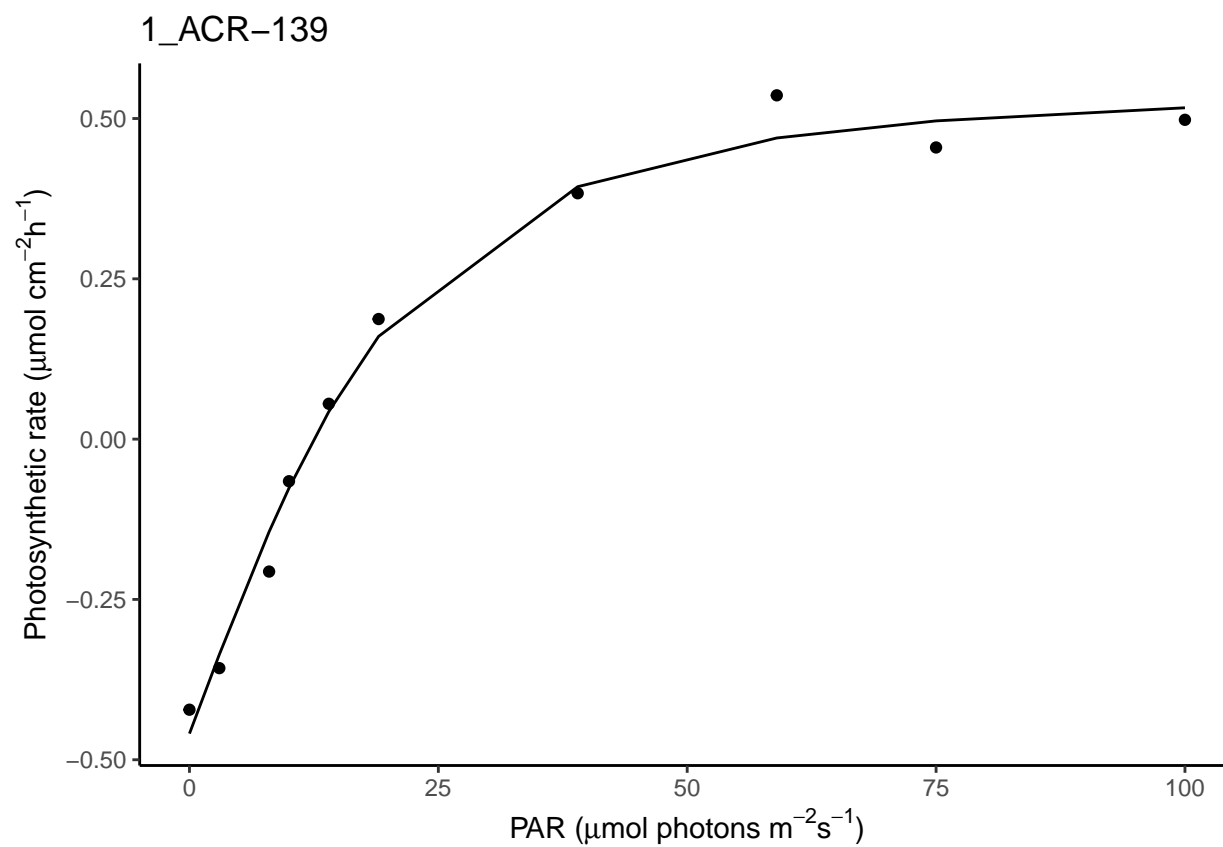
```
## -----  
## augmented$colony_id: POC-358
```



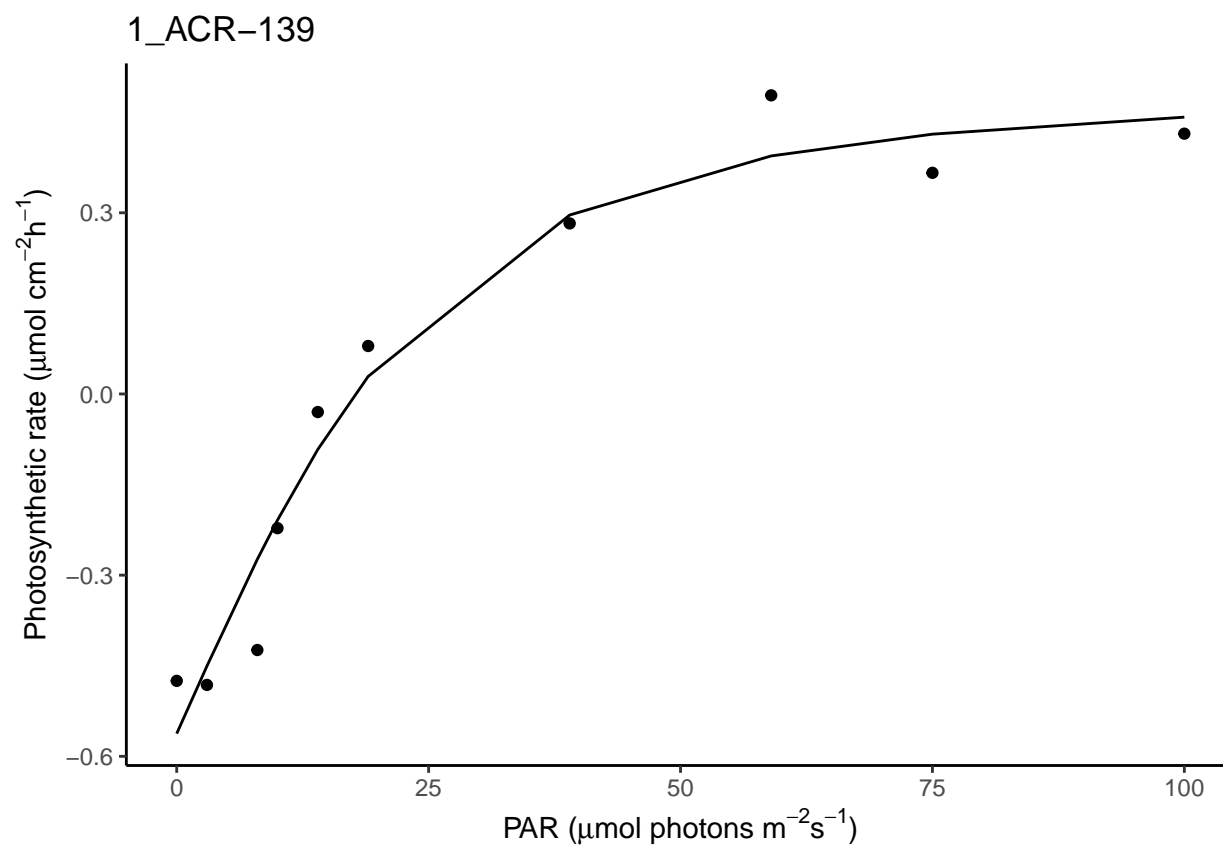
```
## -----  
## augmented$colony_id: P0C-359
```



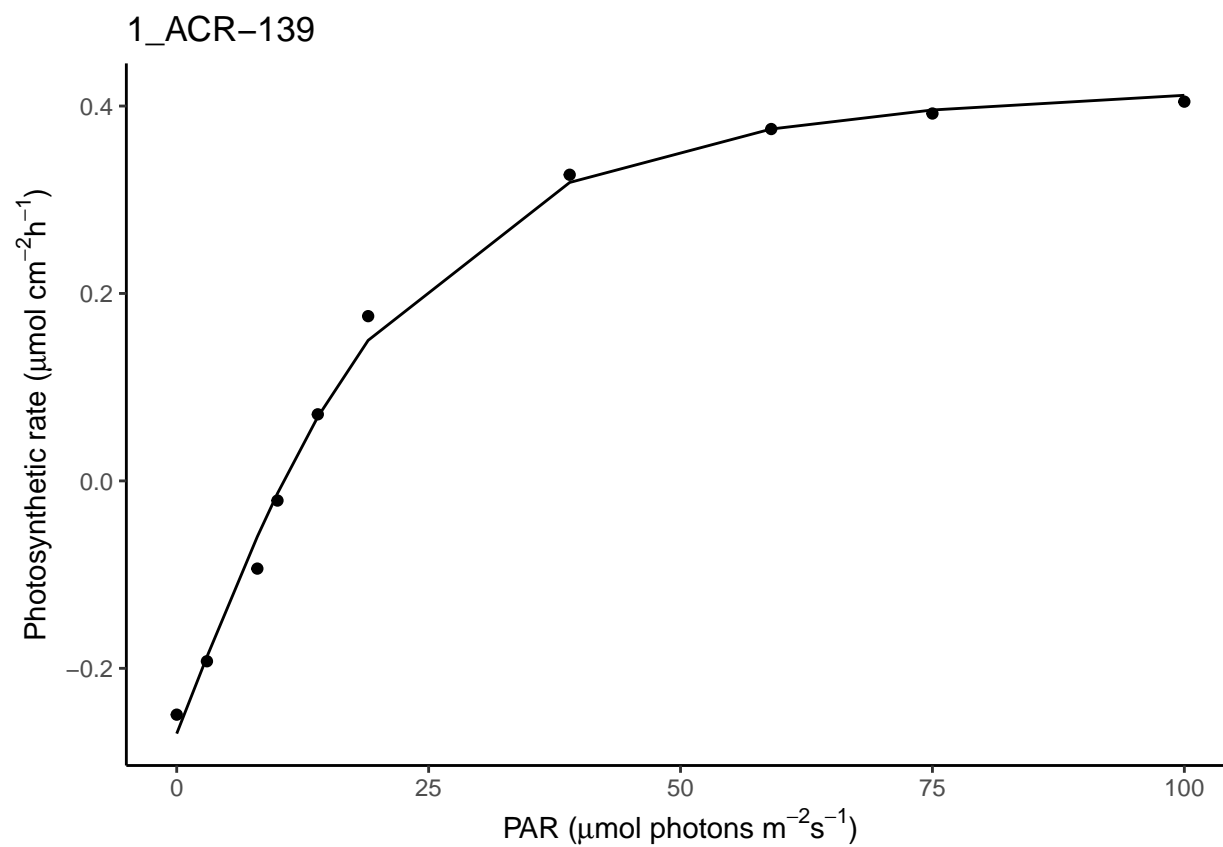
```
## -----  
## augmented$colony_id: POC-366
```



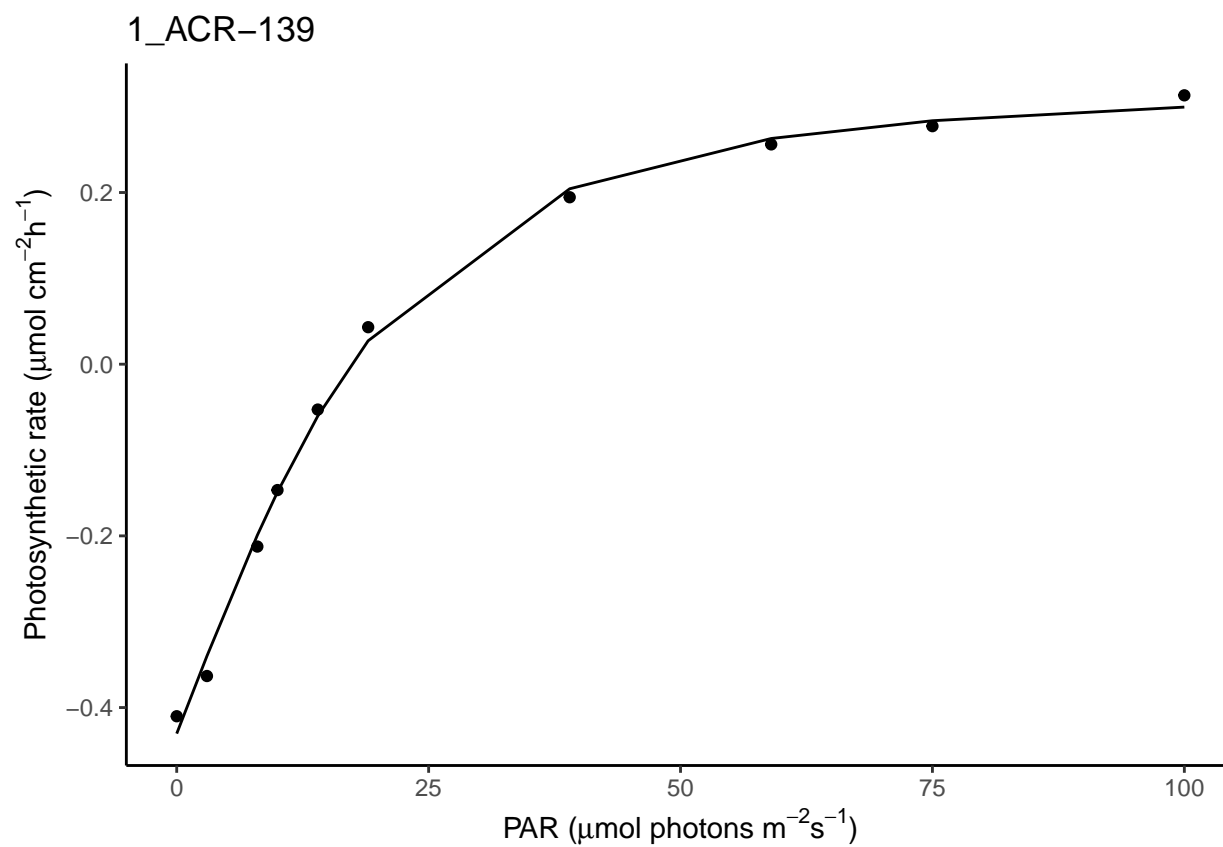
```
## -----  
## augmented$colony_id: P0C-369
```



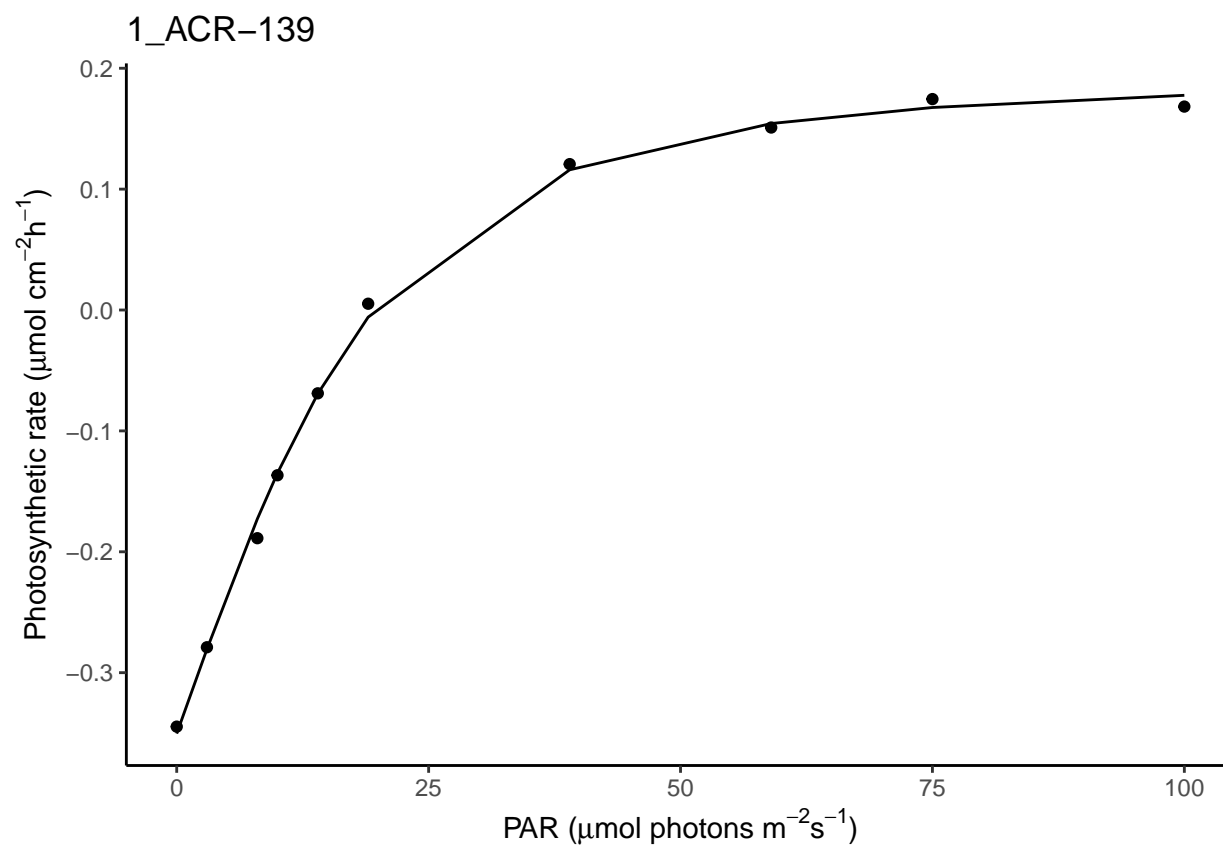
```
## -----  
## augmented$colony_id: POC-371
```



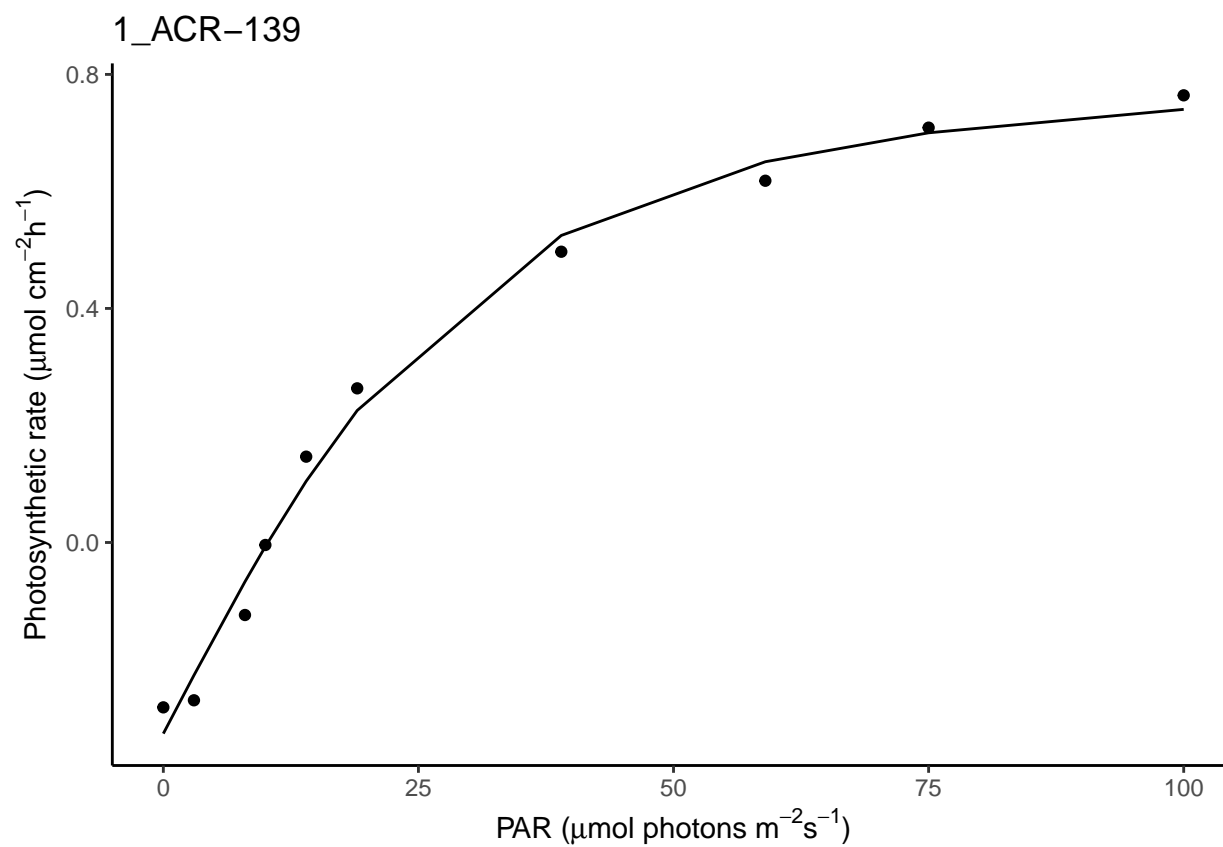
```
## -----  
## augmented$colony_id: POC-372
```

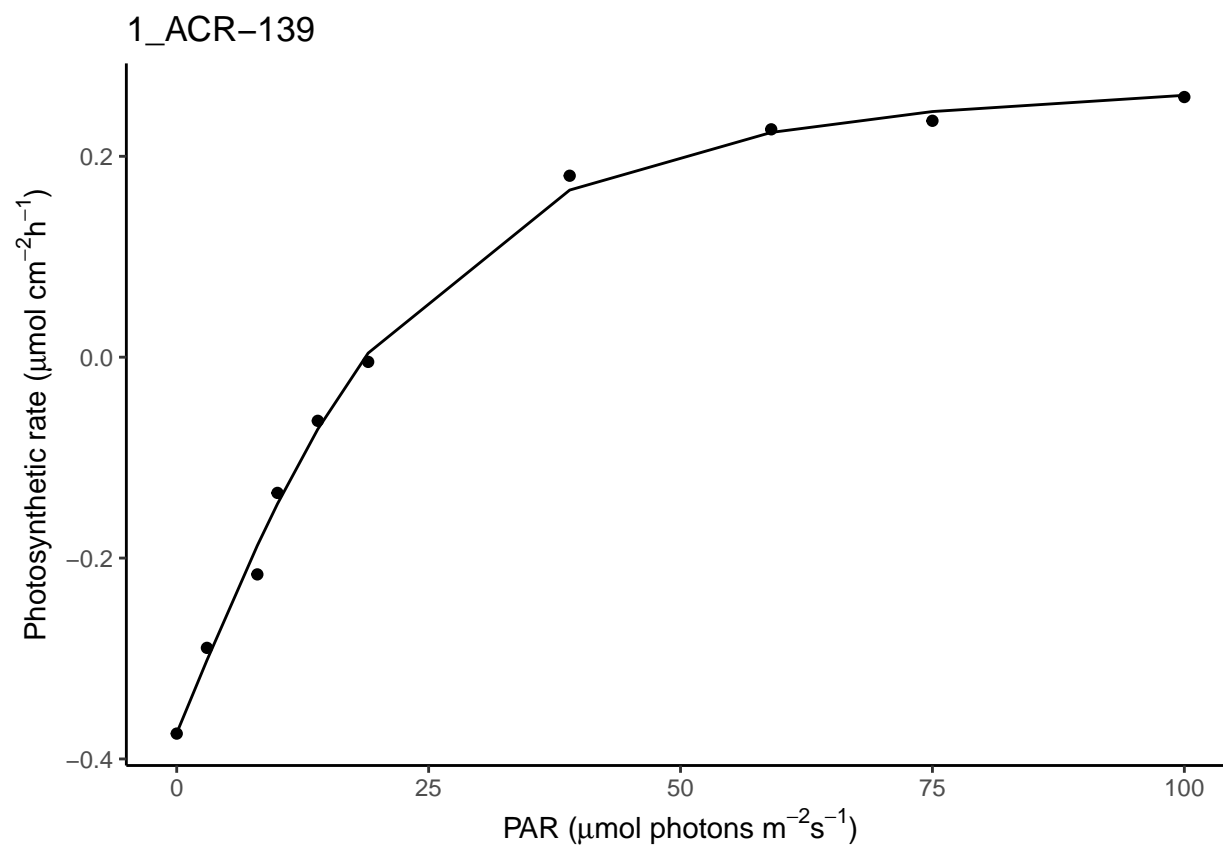
```
## -----  
## augmented$colony_id: POC-373
```



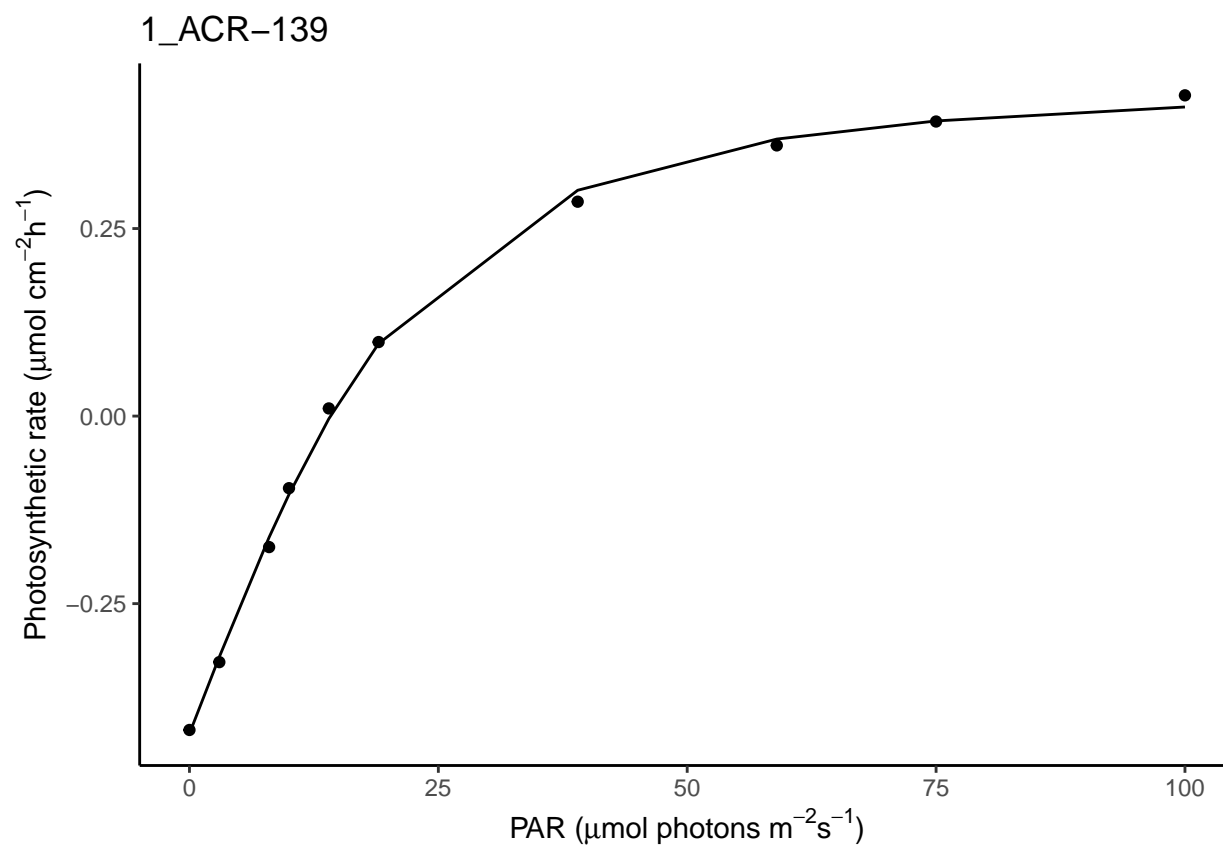
augmented\$colony_id: POC-375



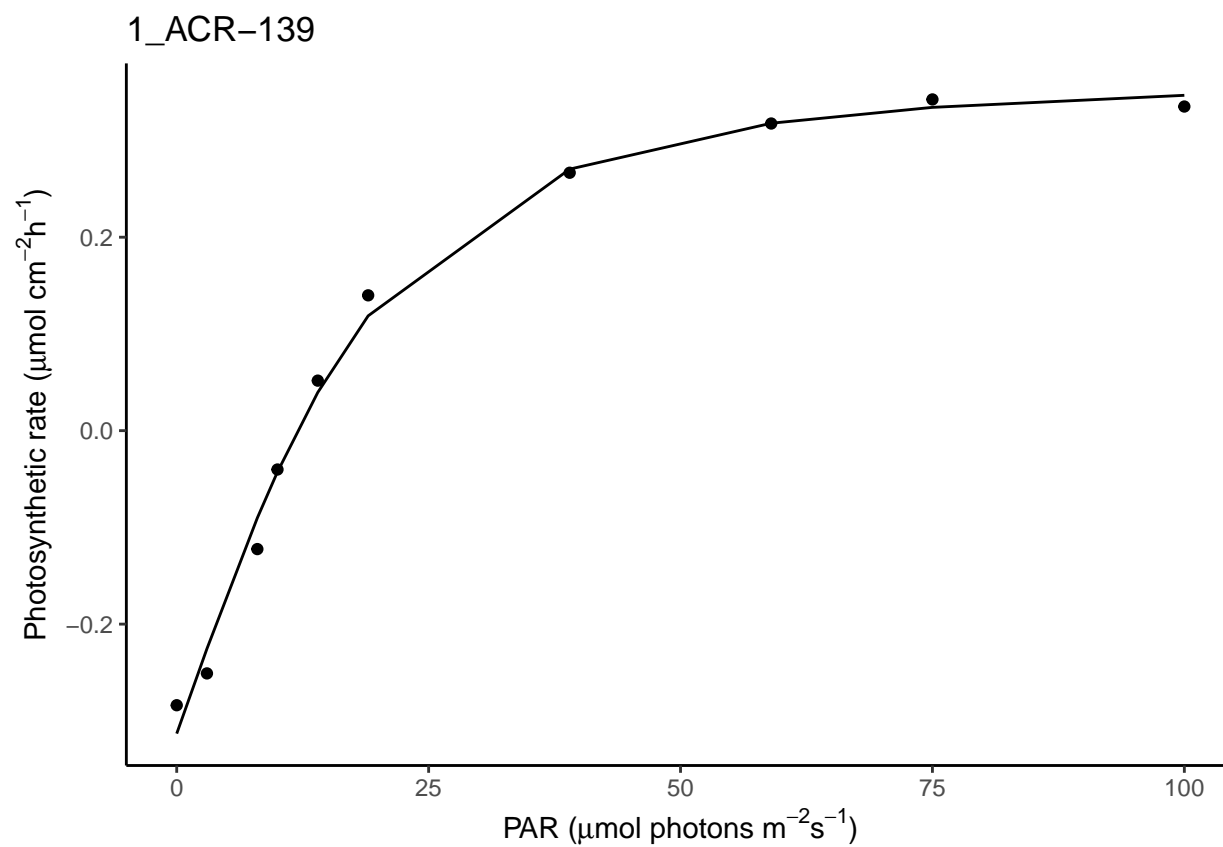
```
## -----  
## augmented$colony_id: POC-377
```



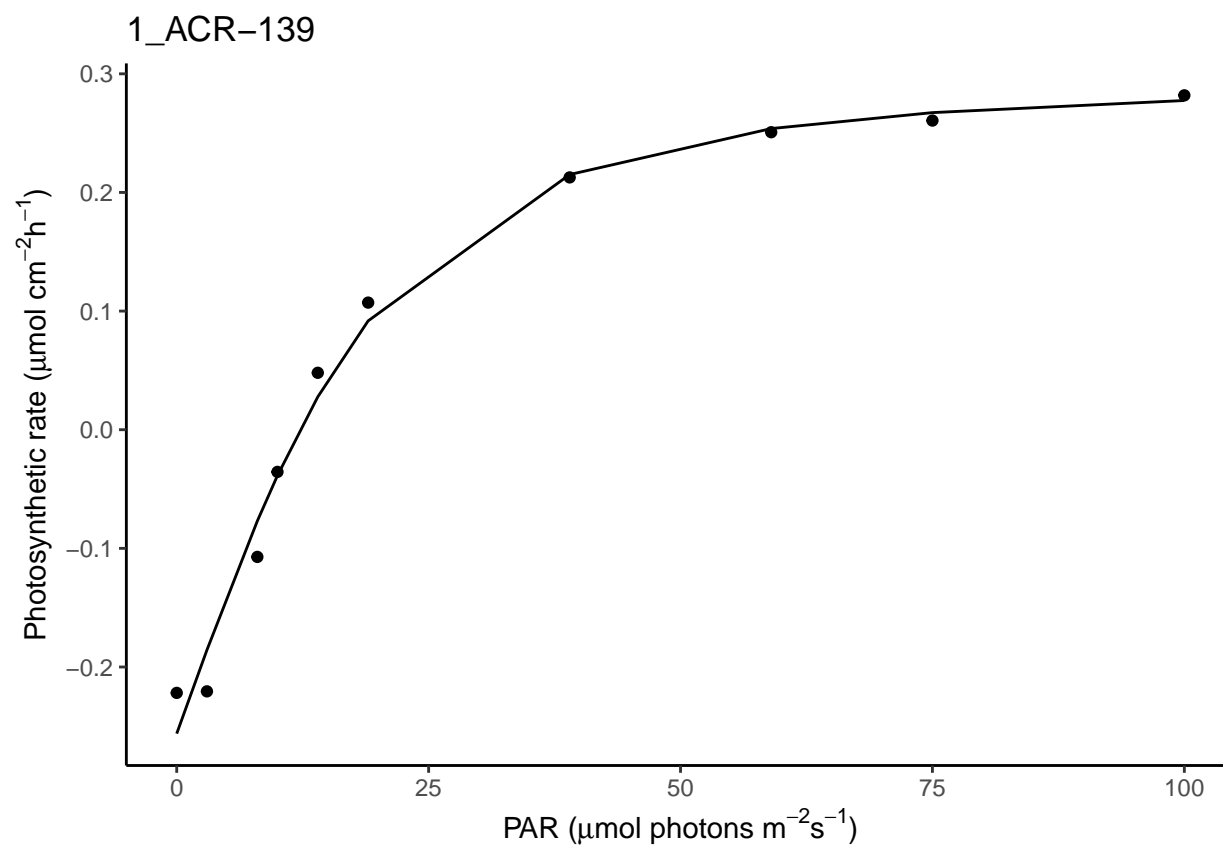
```
## -----  
## augmented$colony_id: POC-378  
## NULL  
## -----  
## augmented$colony_id: POC-386
```



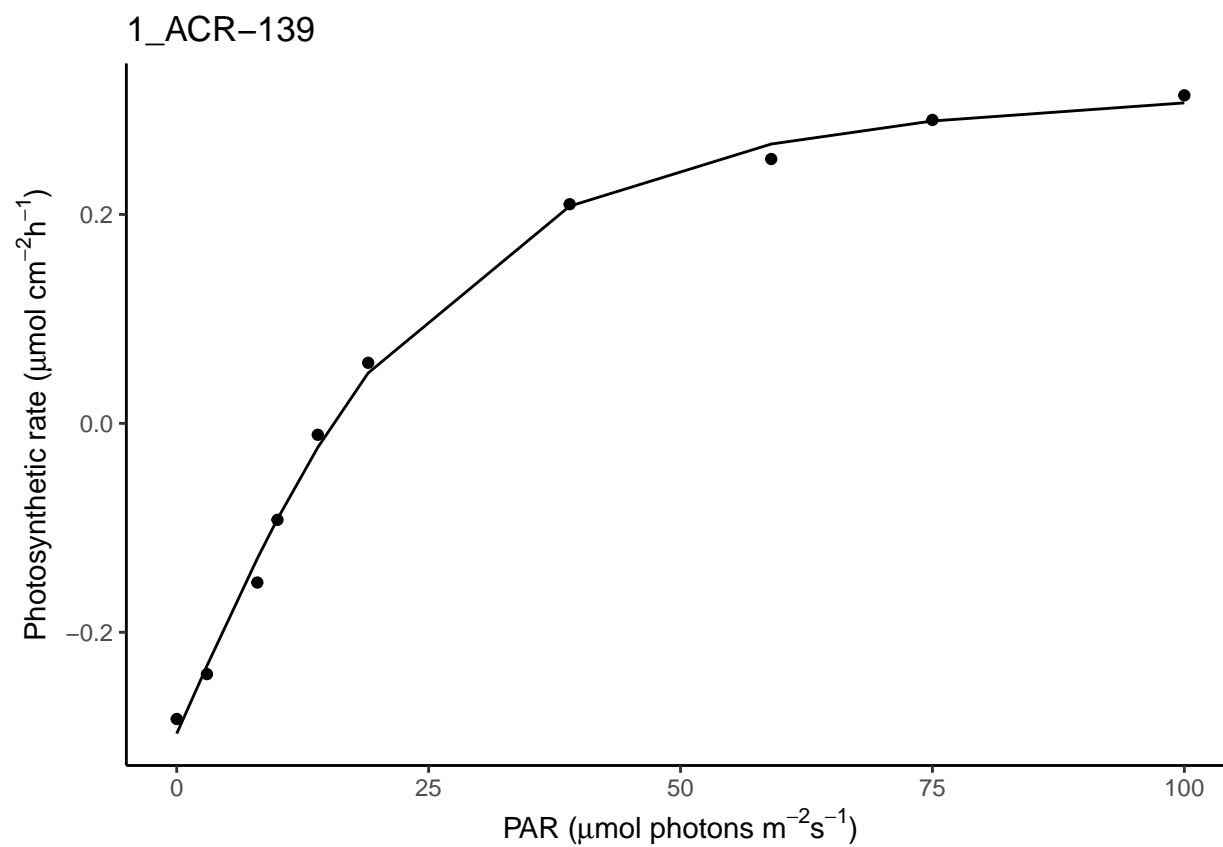
```
## -----  
## augmented$colony_id: POC-391
```



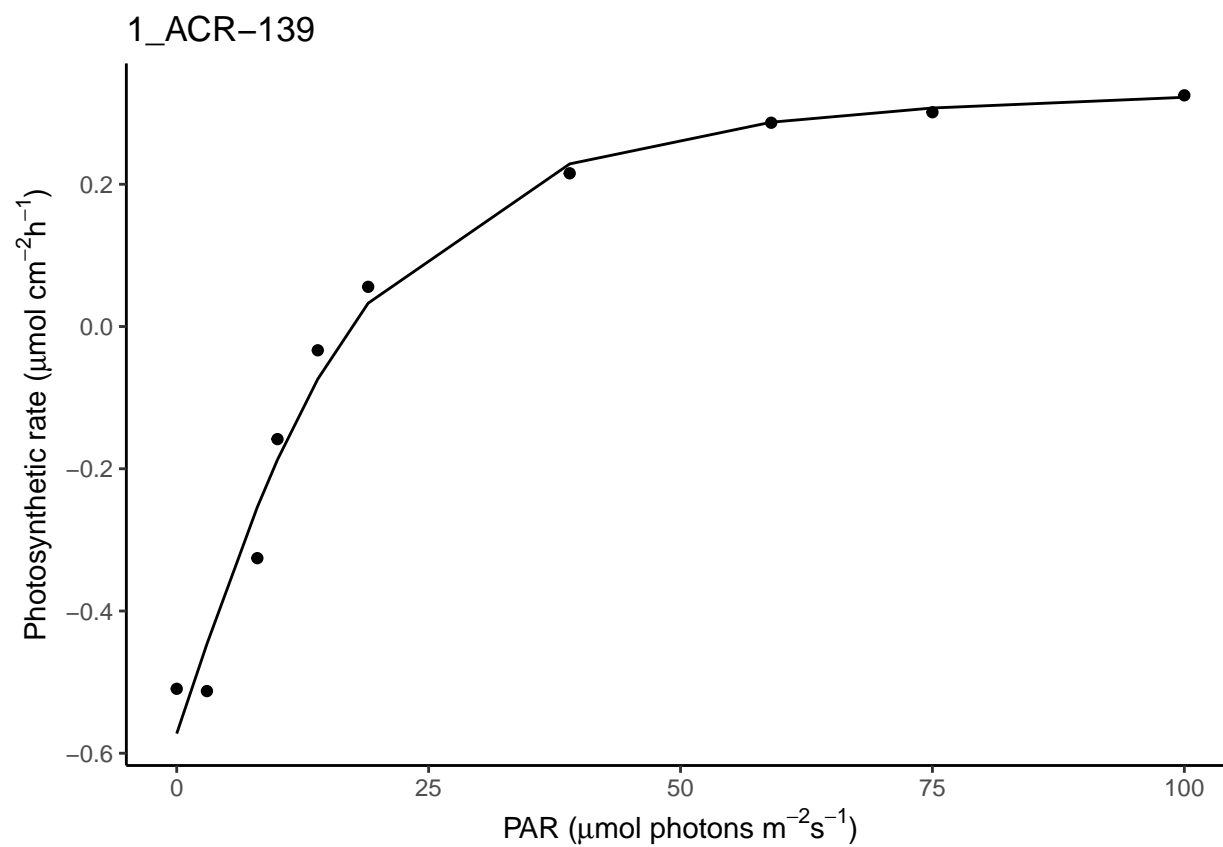
```
## -----  
## augmented$colony_id: POC-394
```



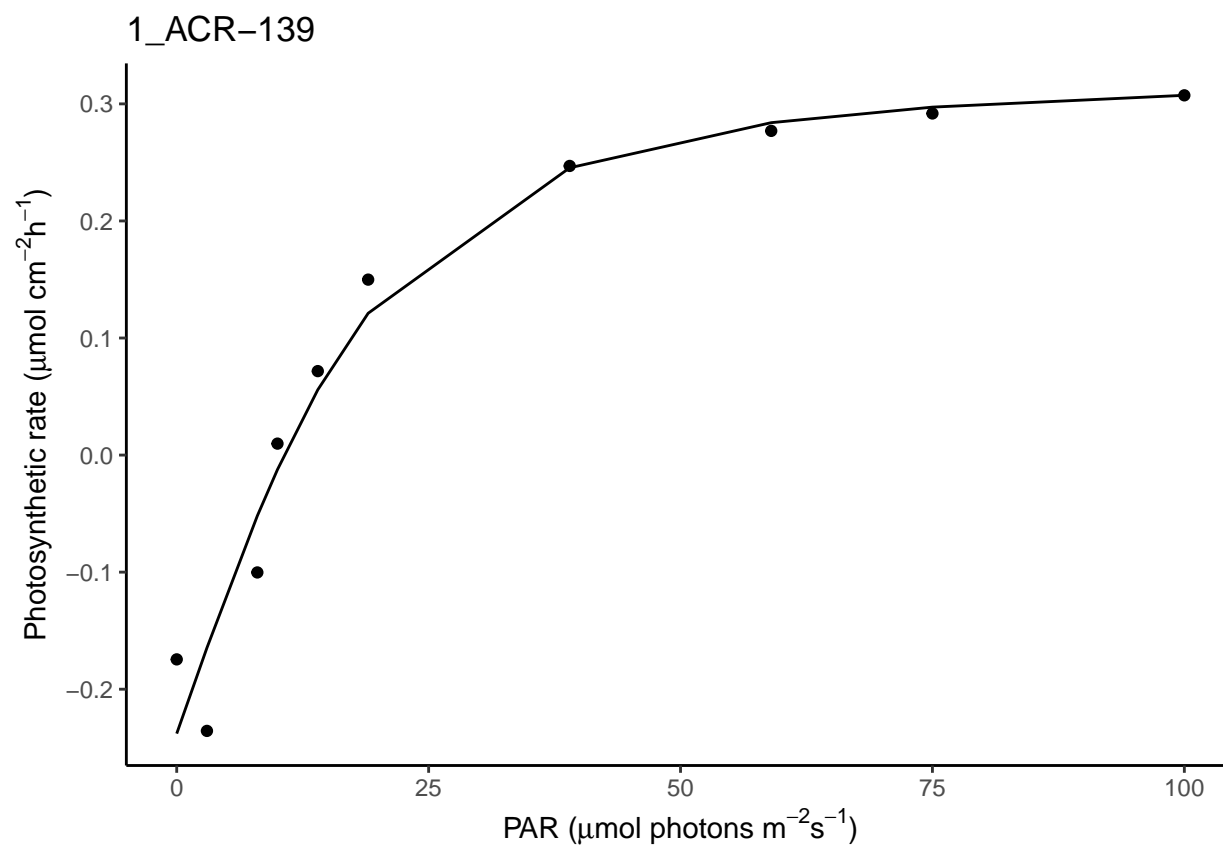
```
## -----  
## augmented$colony_id: POC-395
```



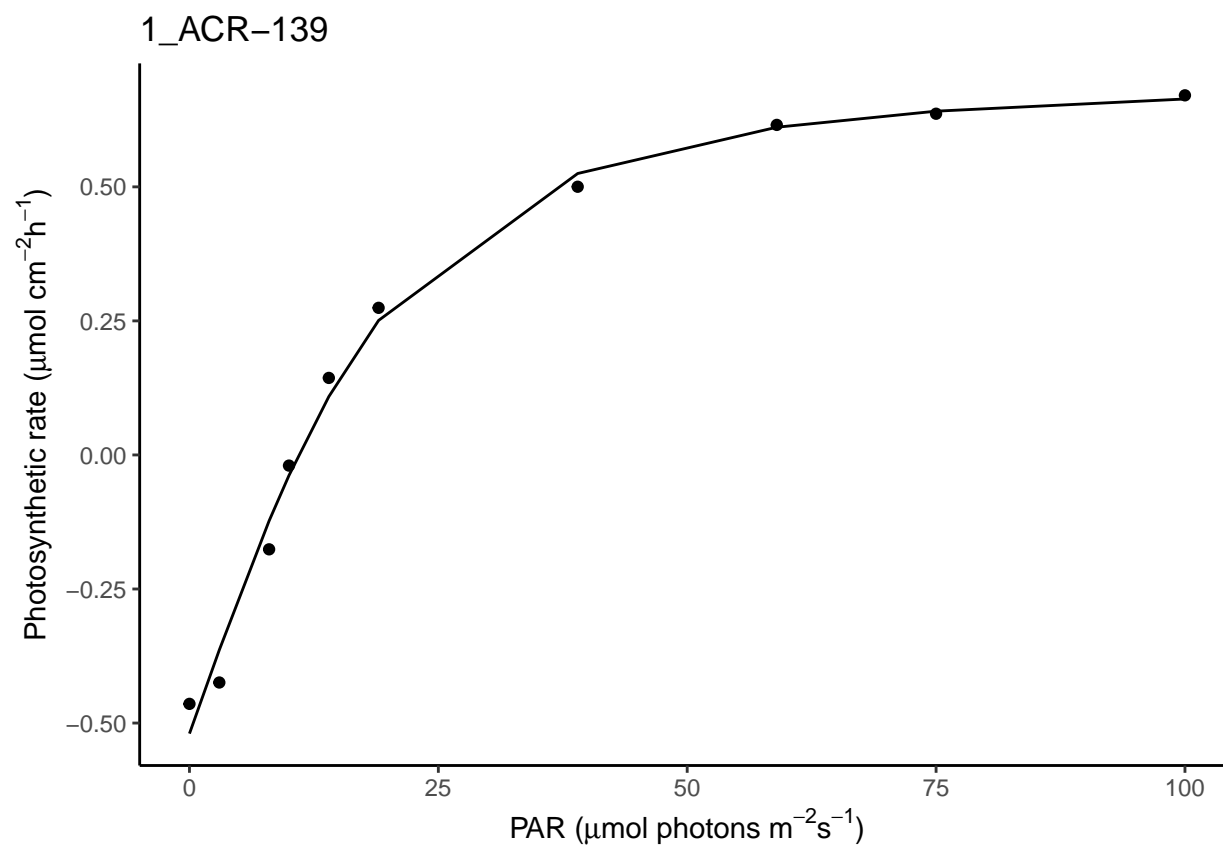
```
## -----  
## augmented$colony_id: POC-40
```

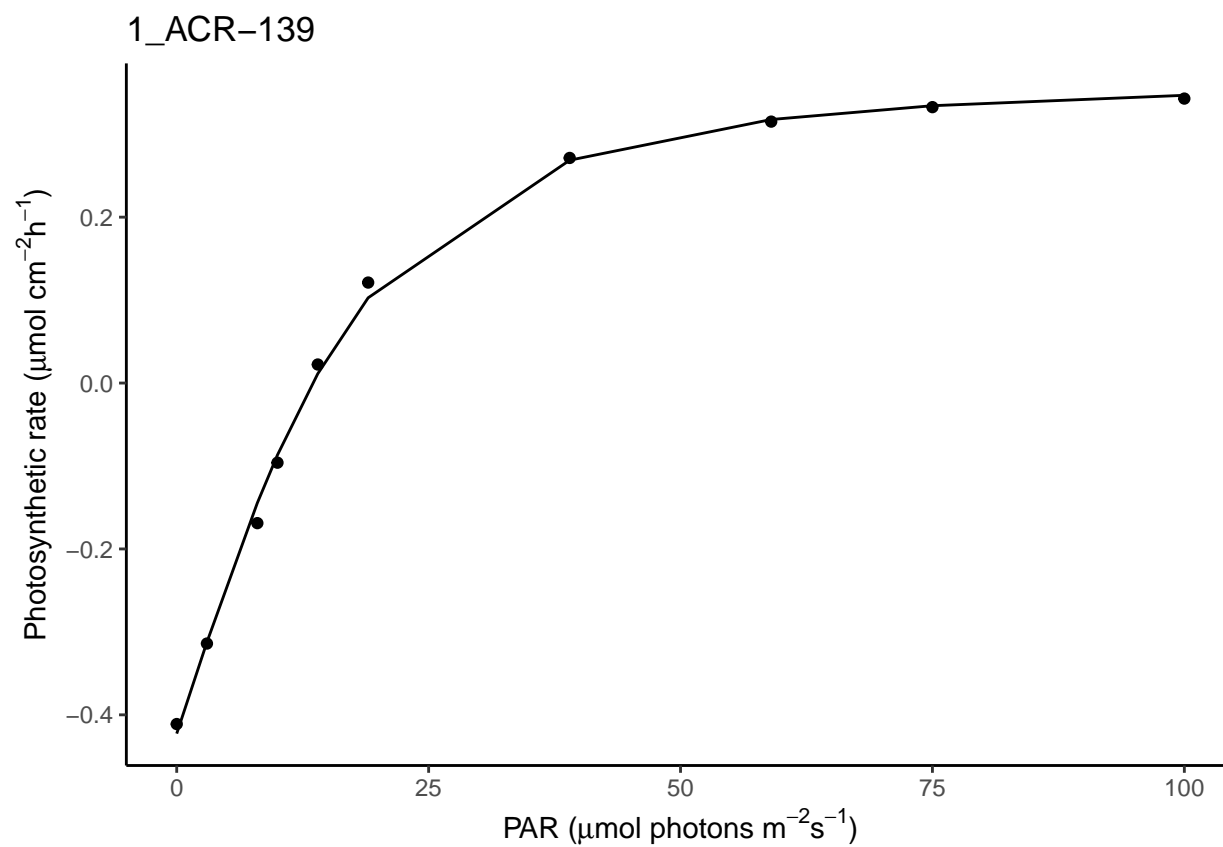
```
## -----  
## augmented$colony_id: POC-42
```



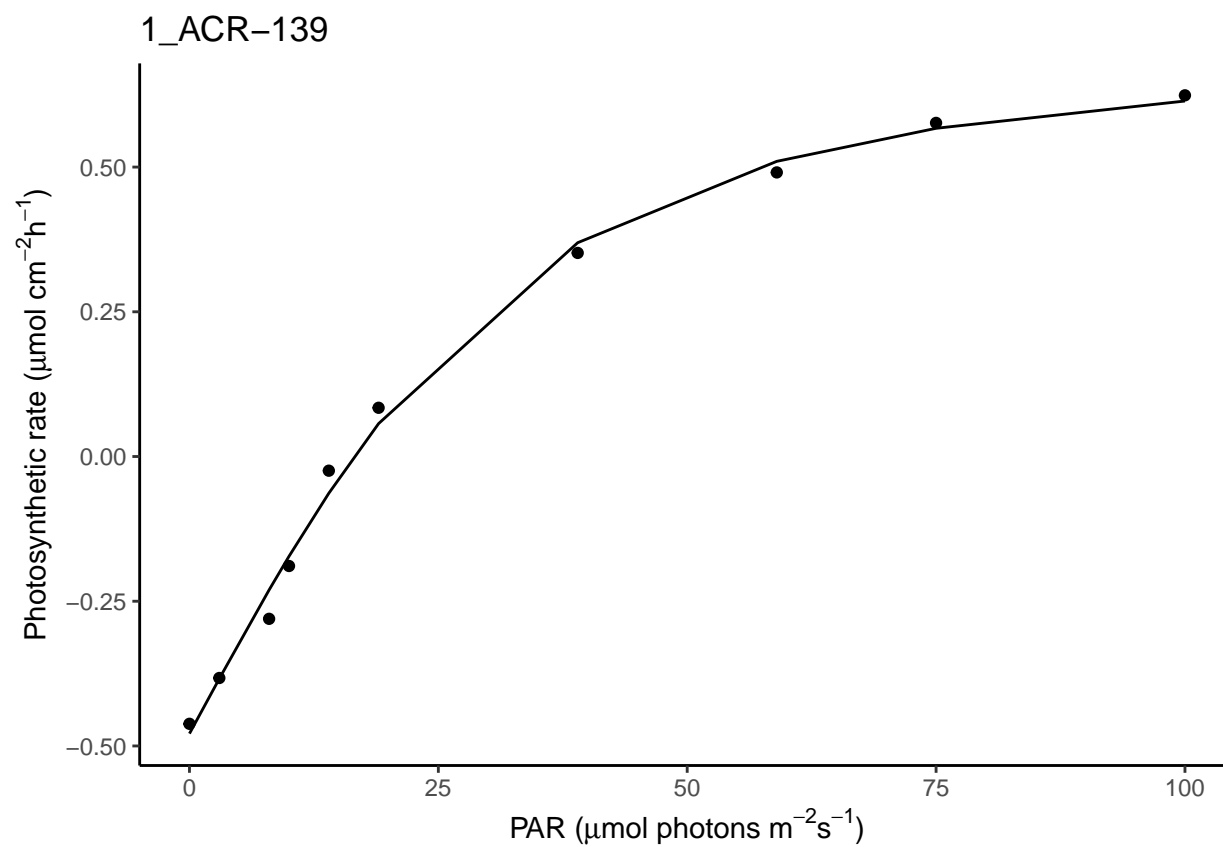
augmented\$colony_id: POC-43



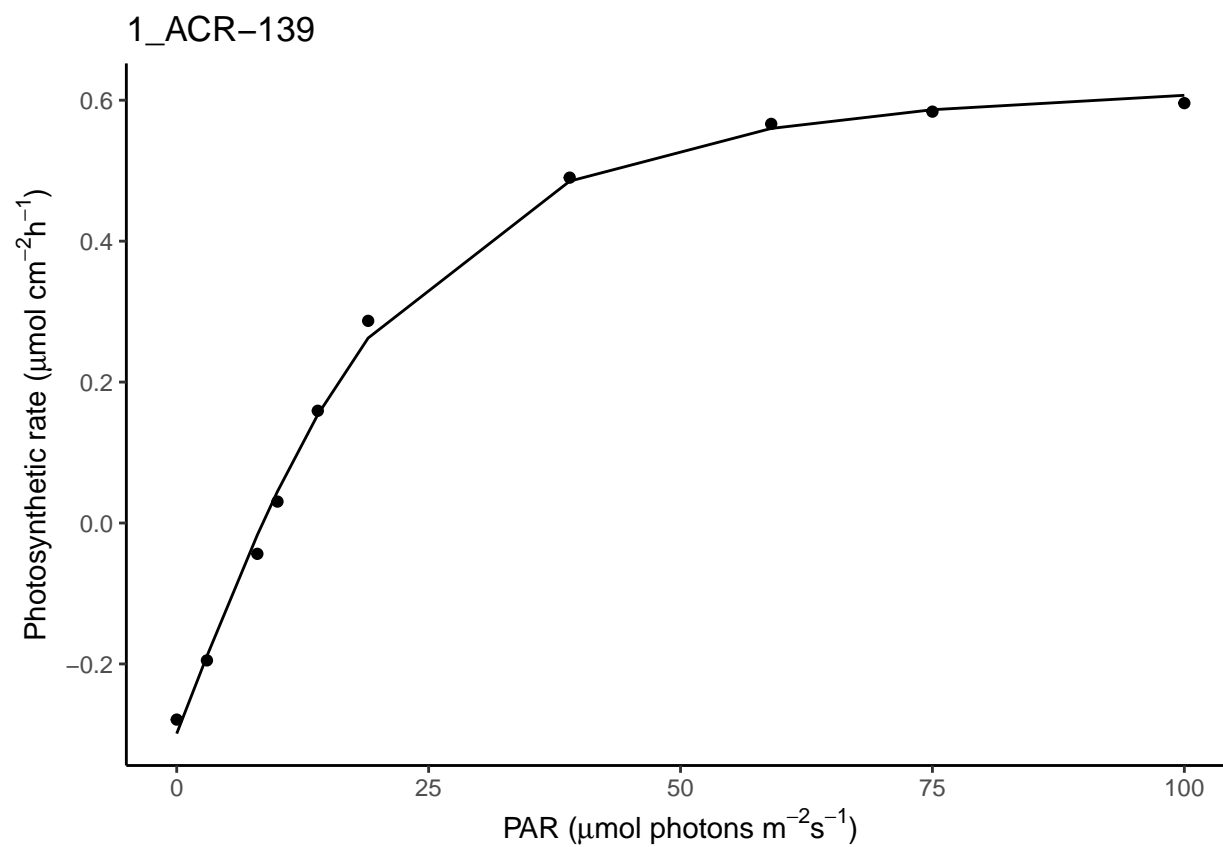
augmented\$colony_id: POC-44



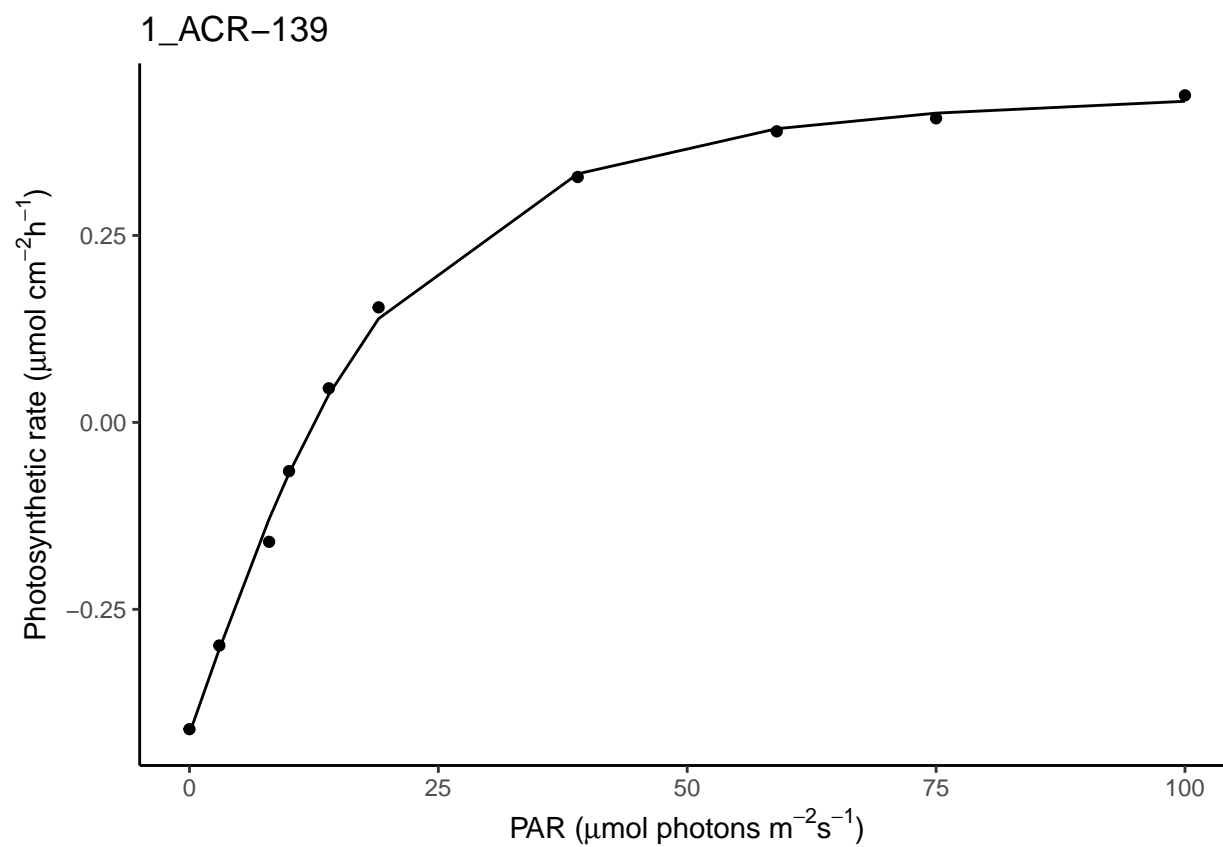
```
## -----  
## augmented$colony_id: POC-45
```



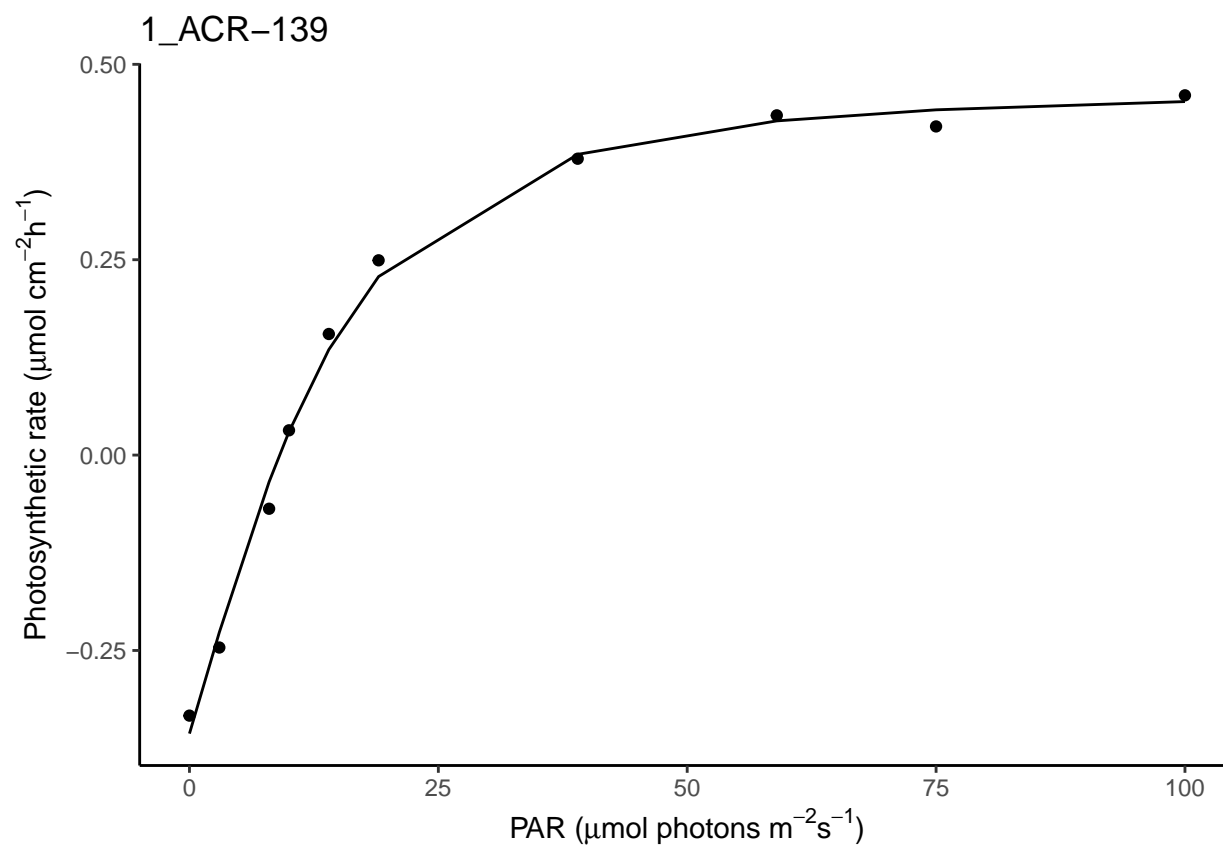
augmented\$colony_id: POC-47



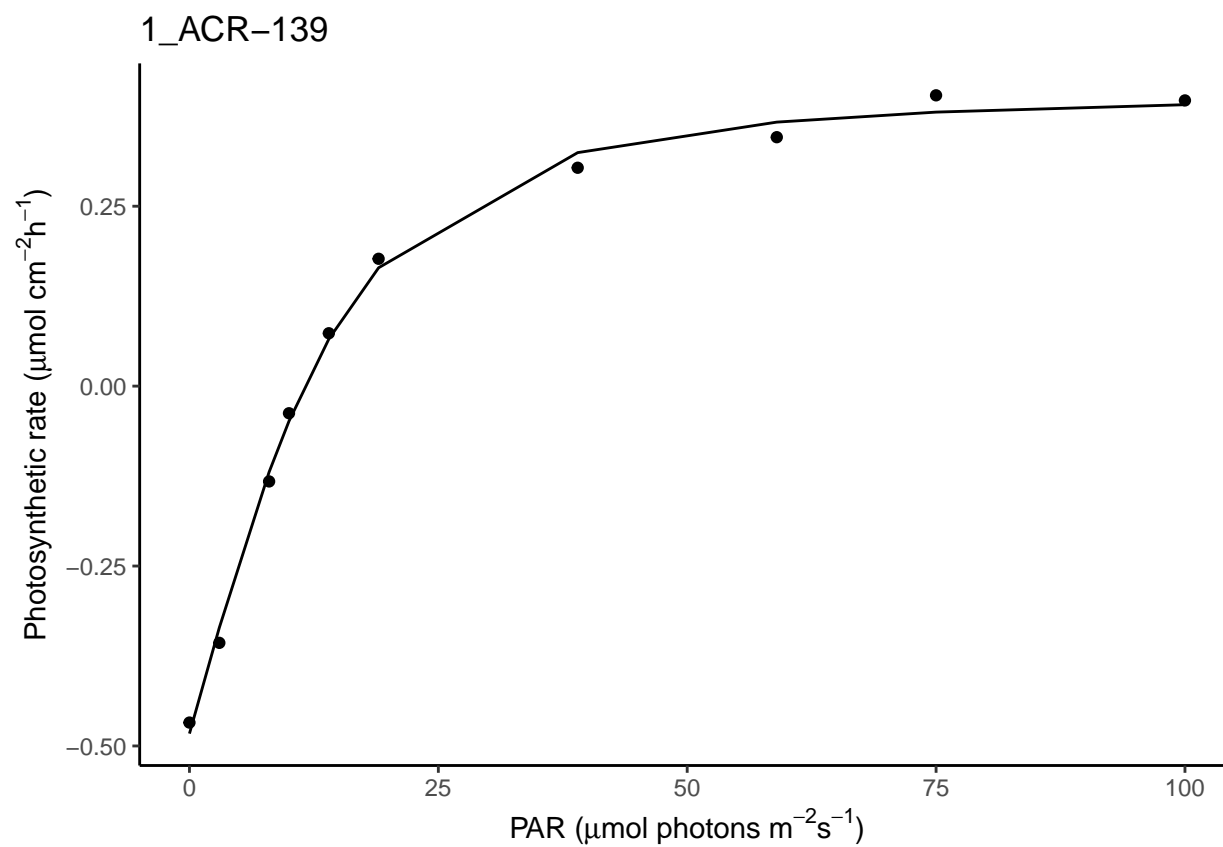
```
## -----  
## augmented$colony_id: POC-48
```



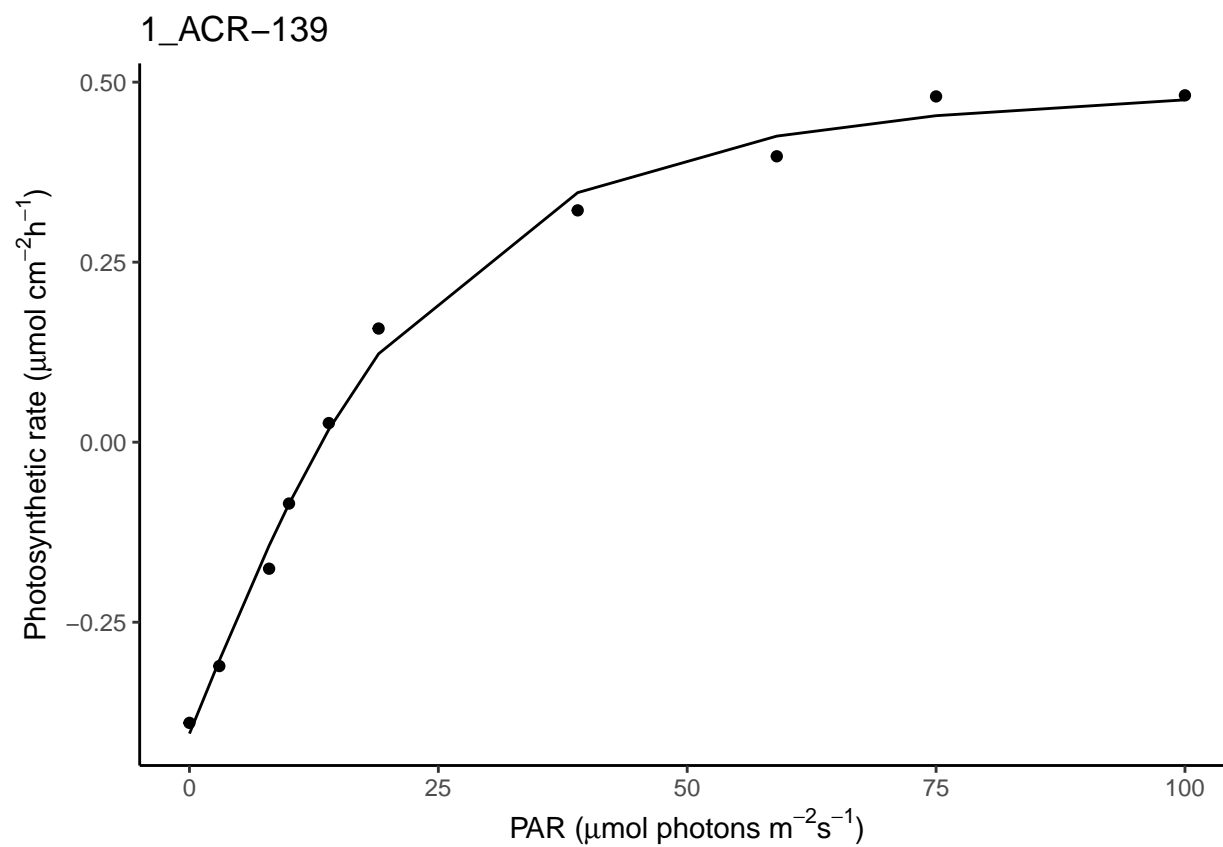
```
## -----  
## augmented$colony_id: POC-50
```



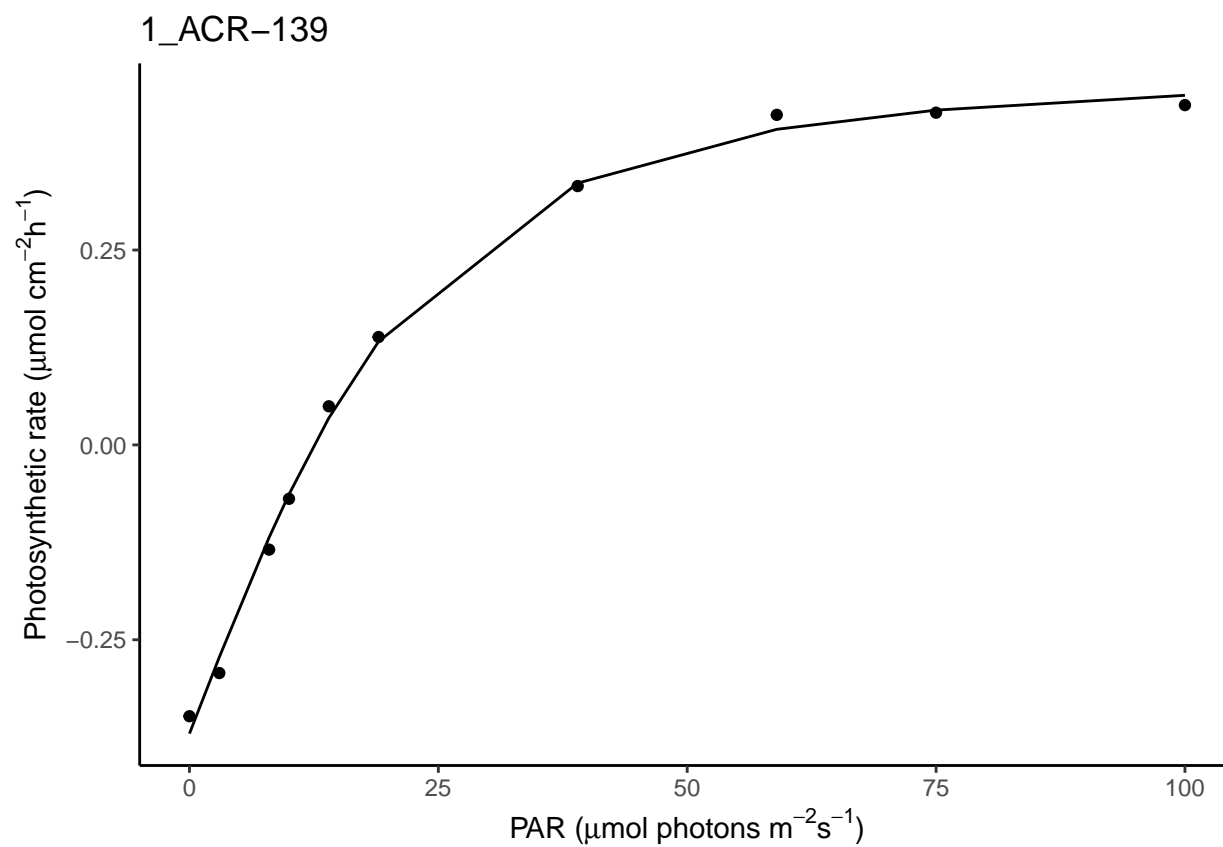
augmented\$colony_id: POC-52



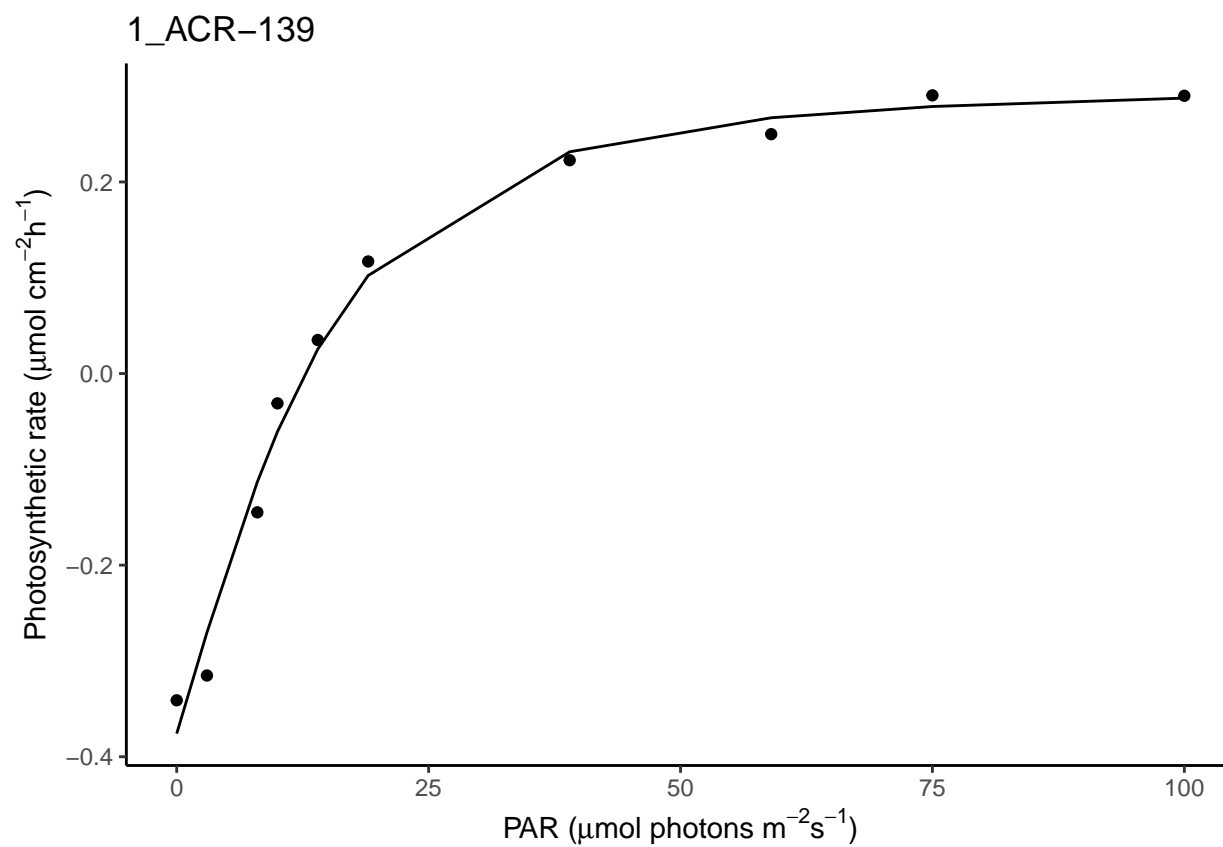
```
## -----  
## augmented$colony_id: POC-53
```



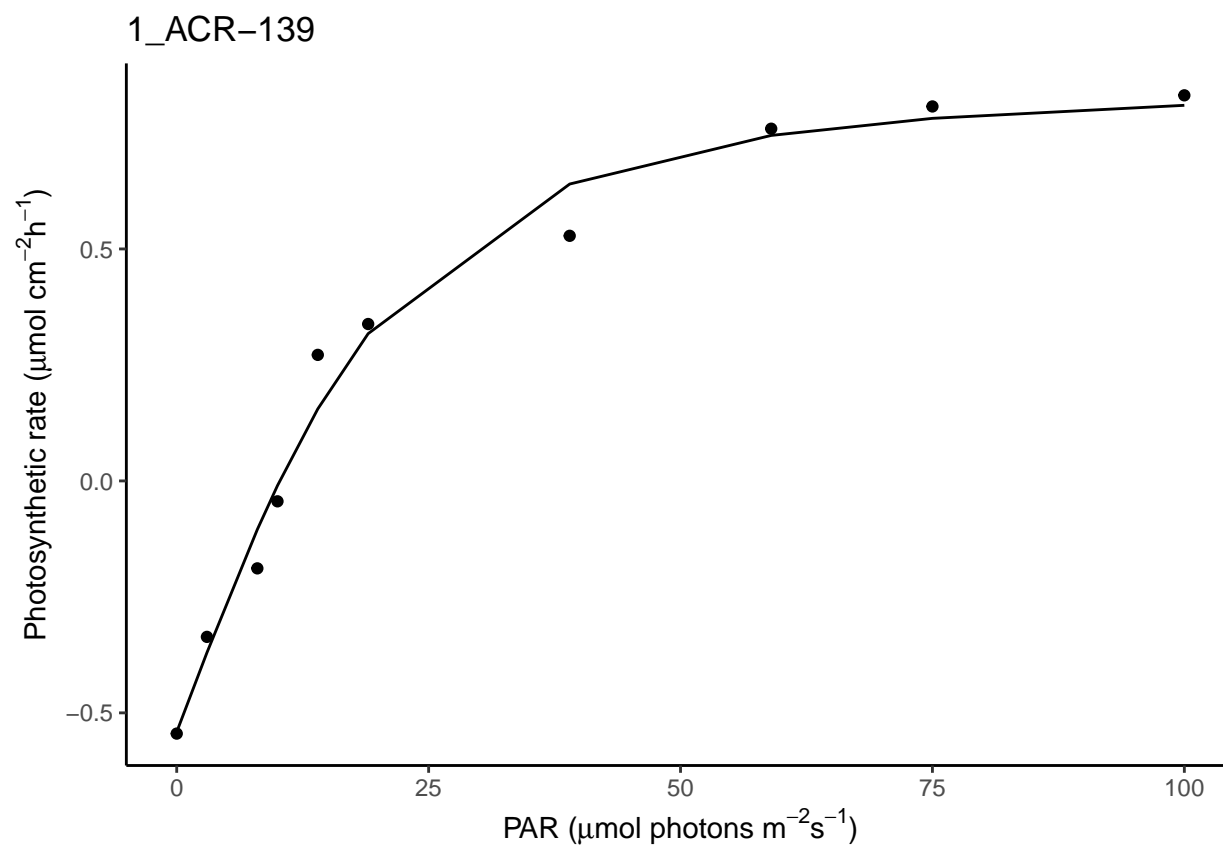
```
## -----  
## augmented$colony_id: POC-55  
## NULL  
## -----  
## augmented$colony_id: POC-57
```



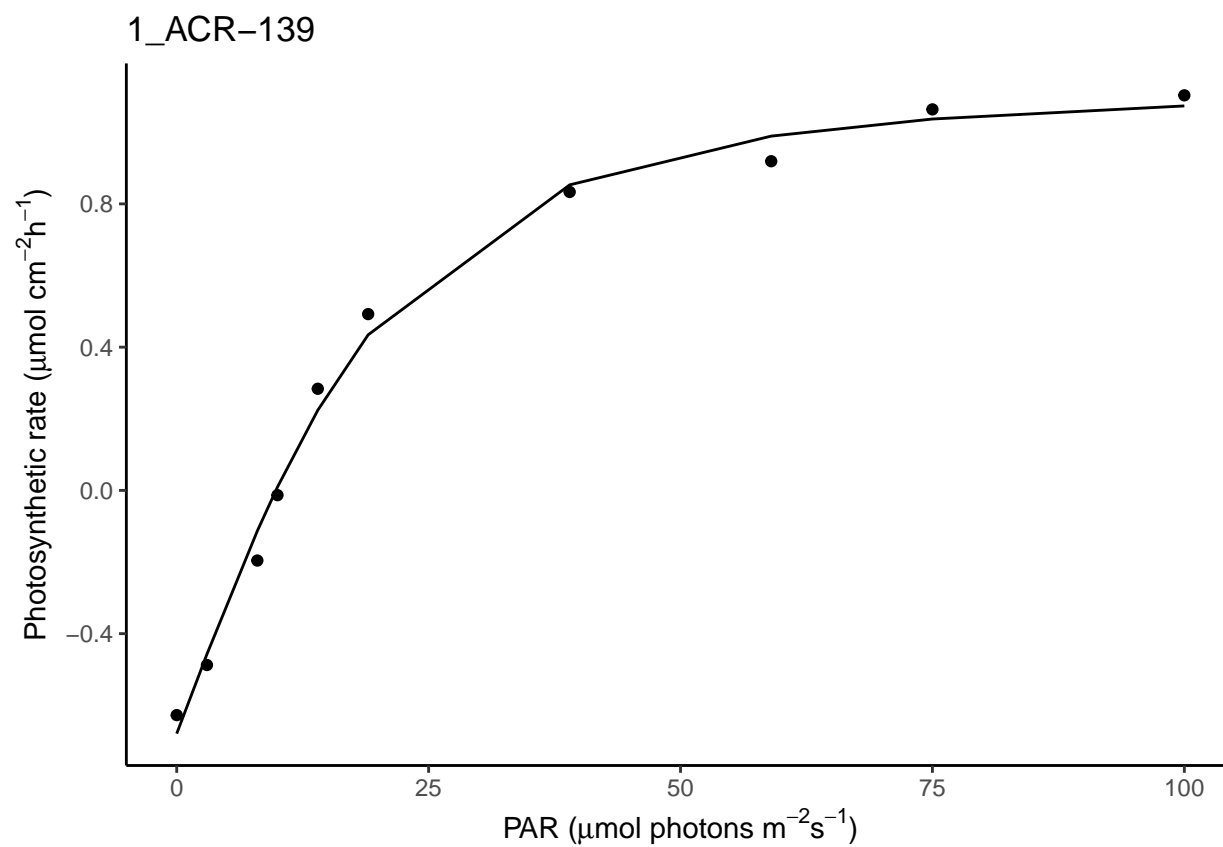
```
## -----  
## augmented$colony_id: POC-68
```



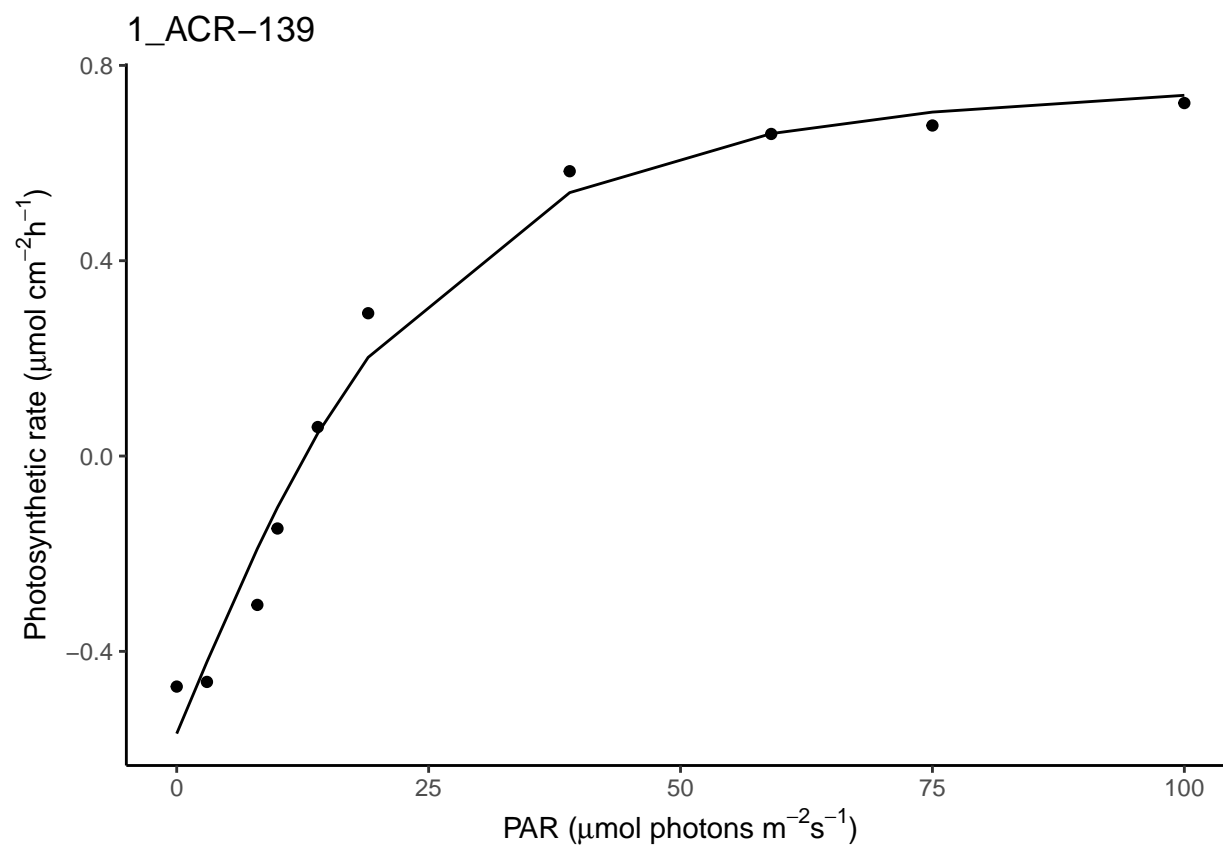
augmented\$colony_id: POR-209



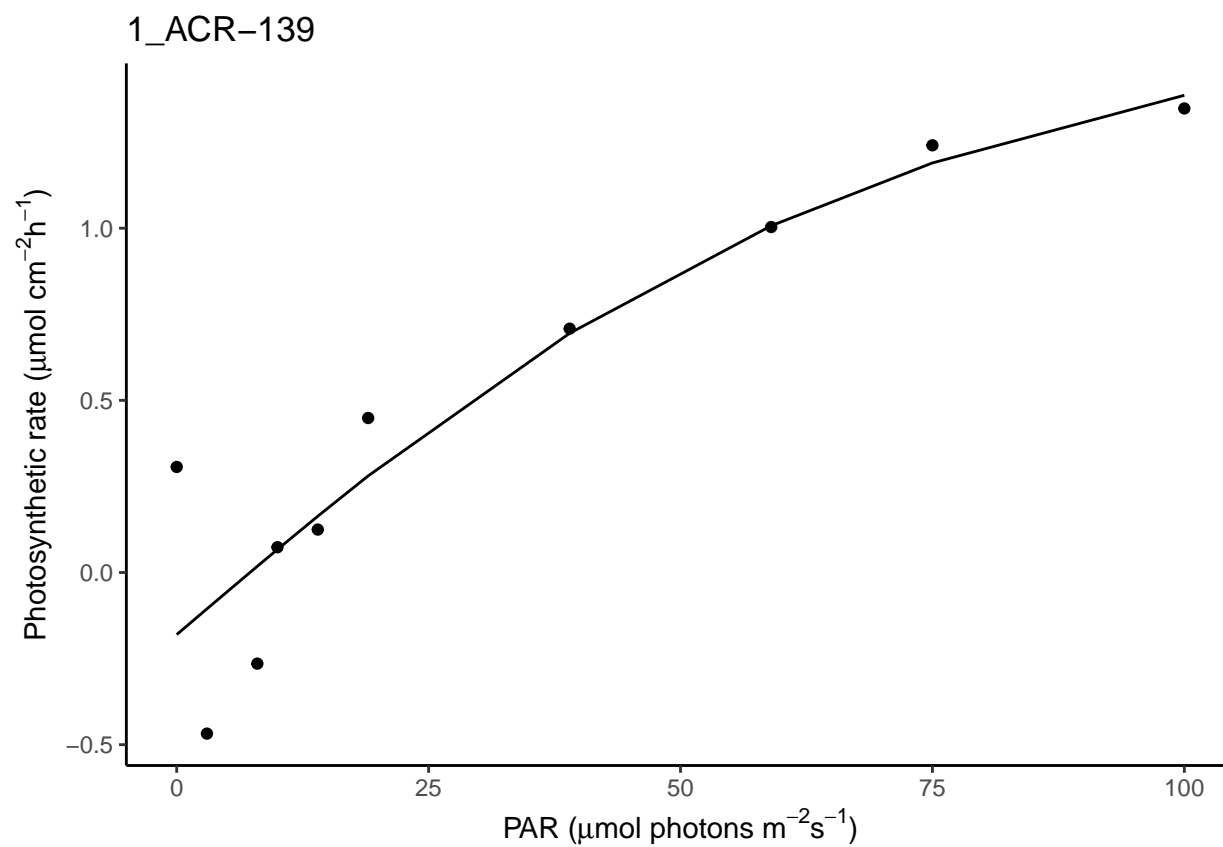
augmented\$colony_id: POR-214



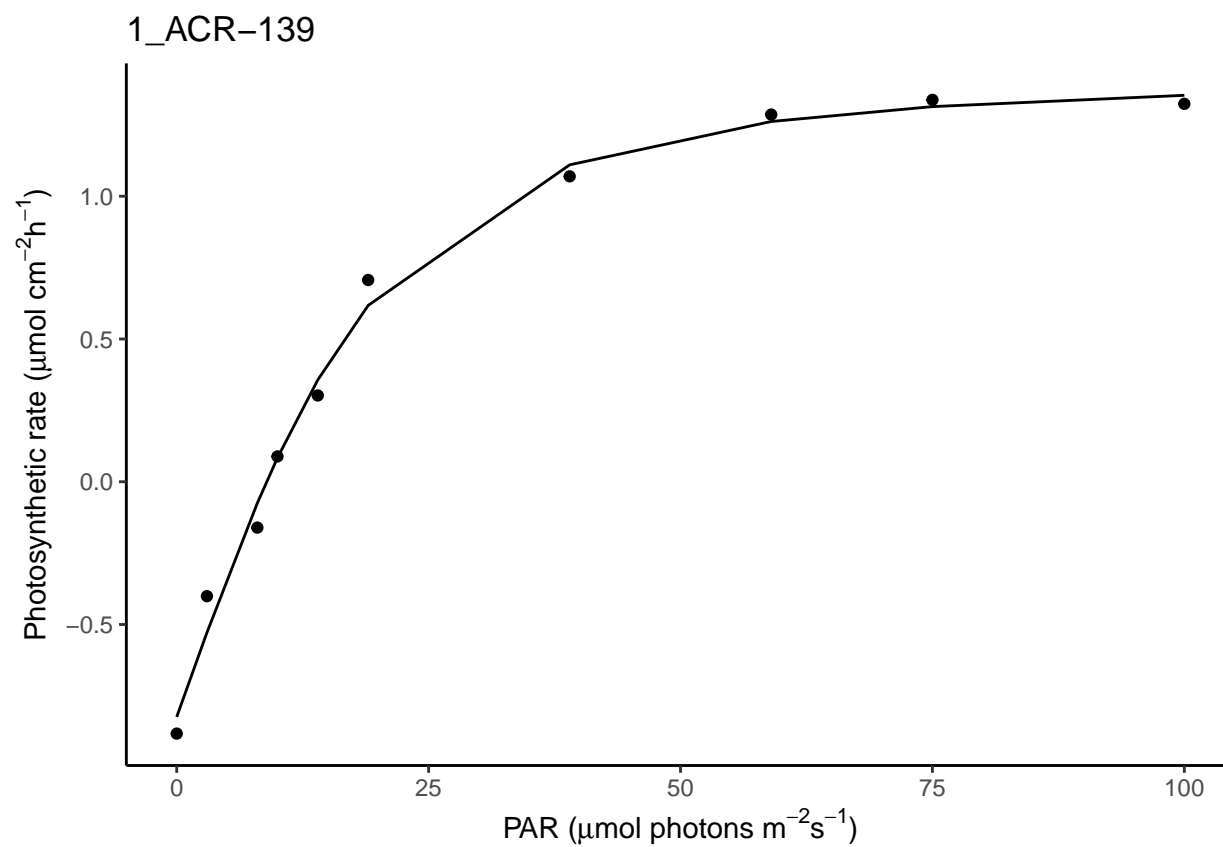
```
## -----  
## augmented$colony_id: POR-216
```



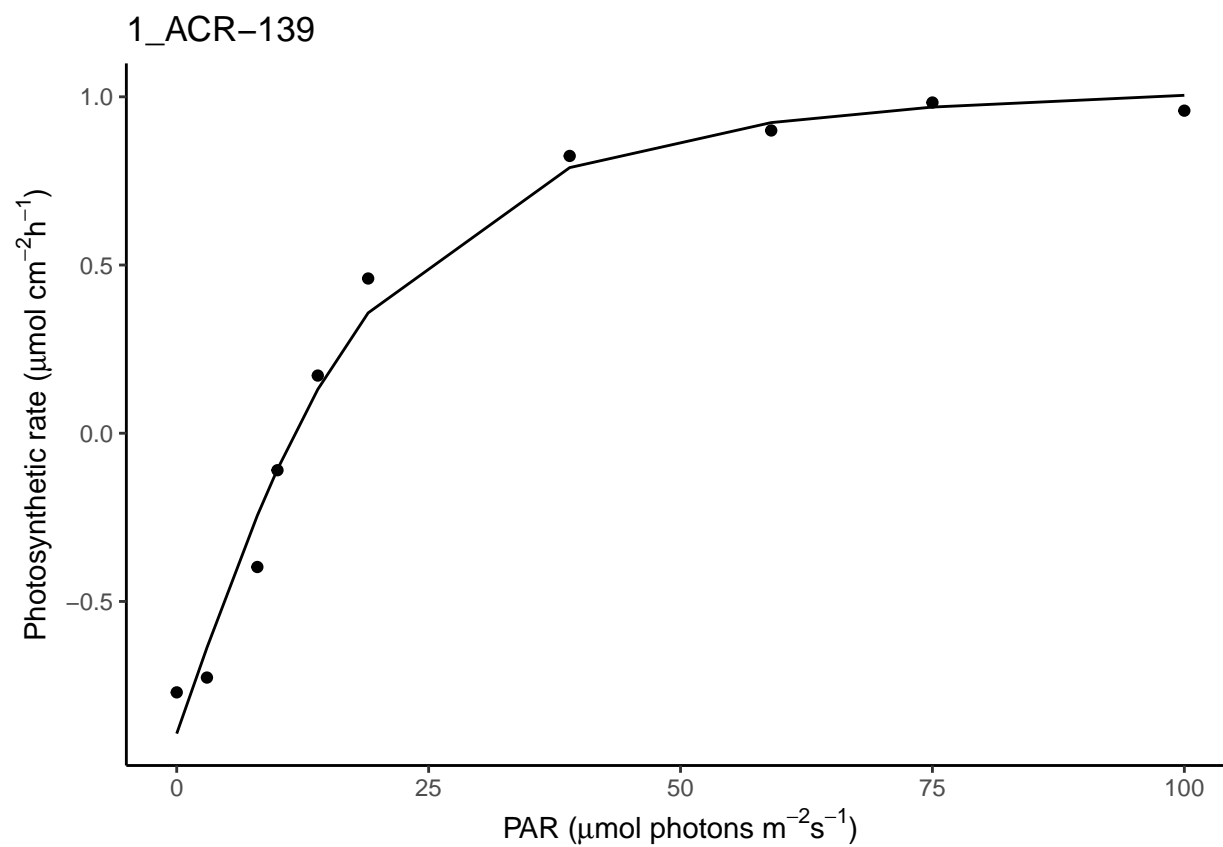
```
## -----  
## augmented$colony_id: POR-221
```



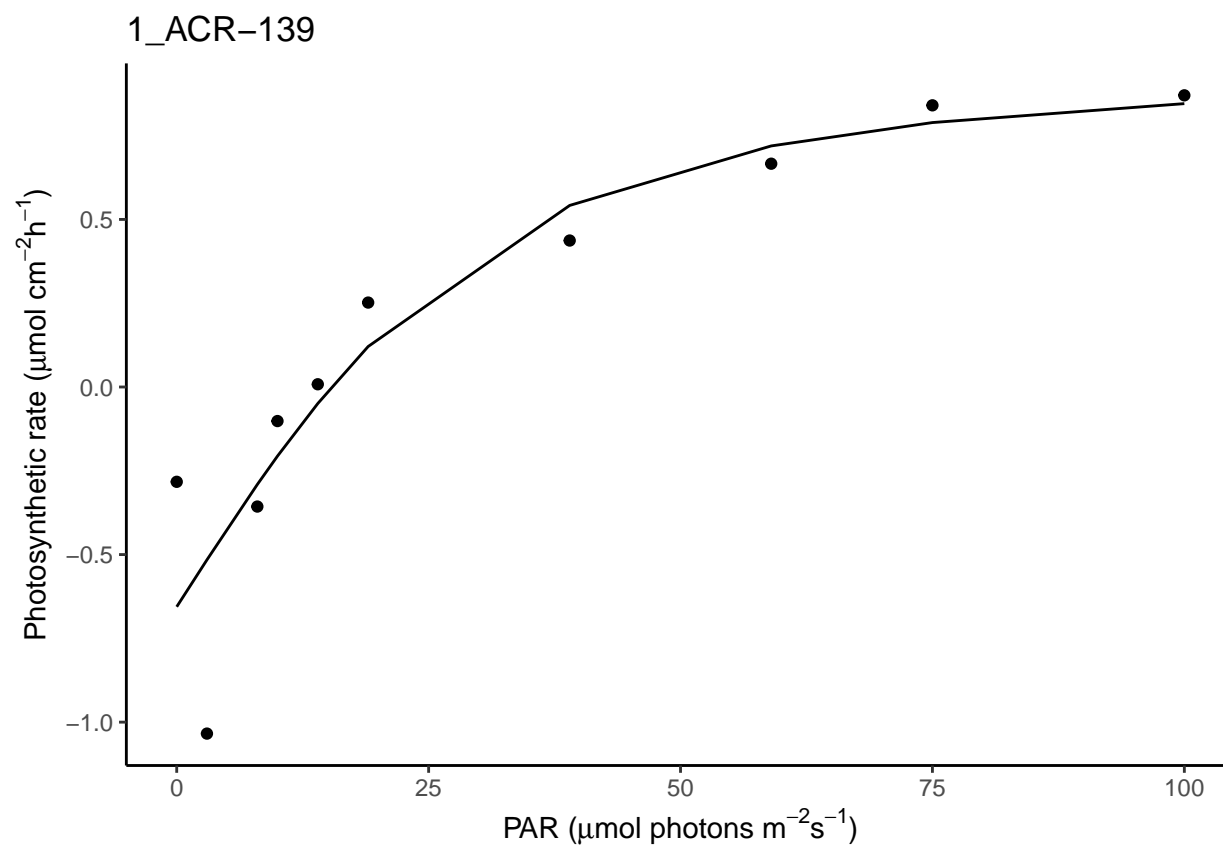
```
## -----  
## augmented$colony_id: POR-224
```

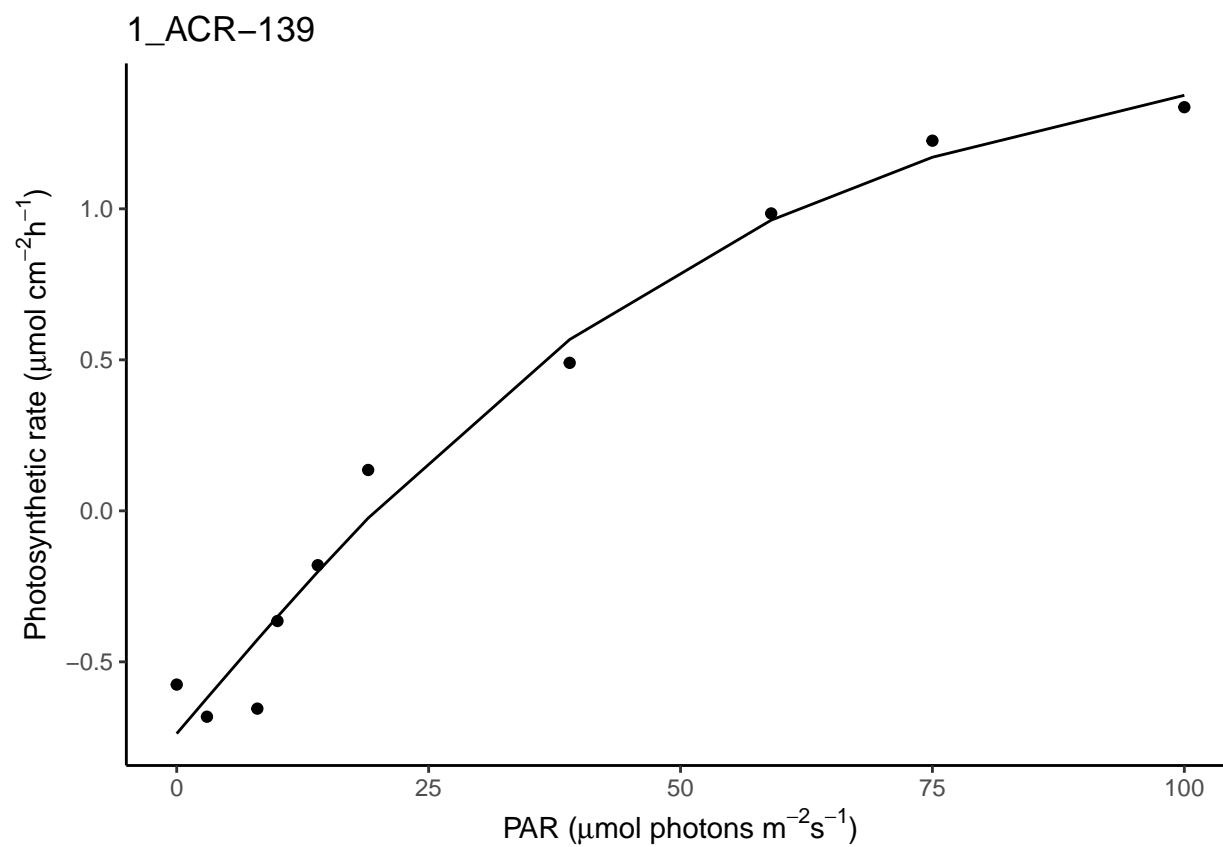
augmented\$colony_id: POR-240



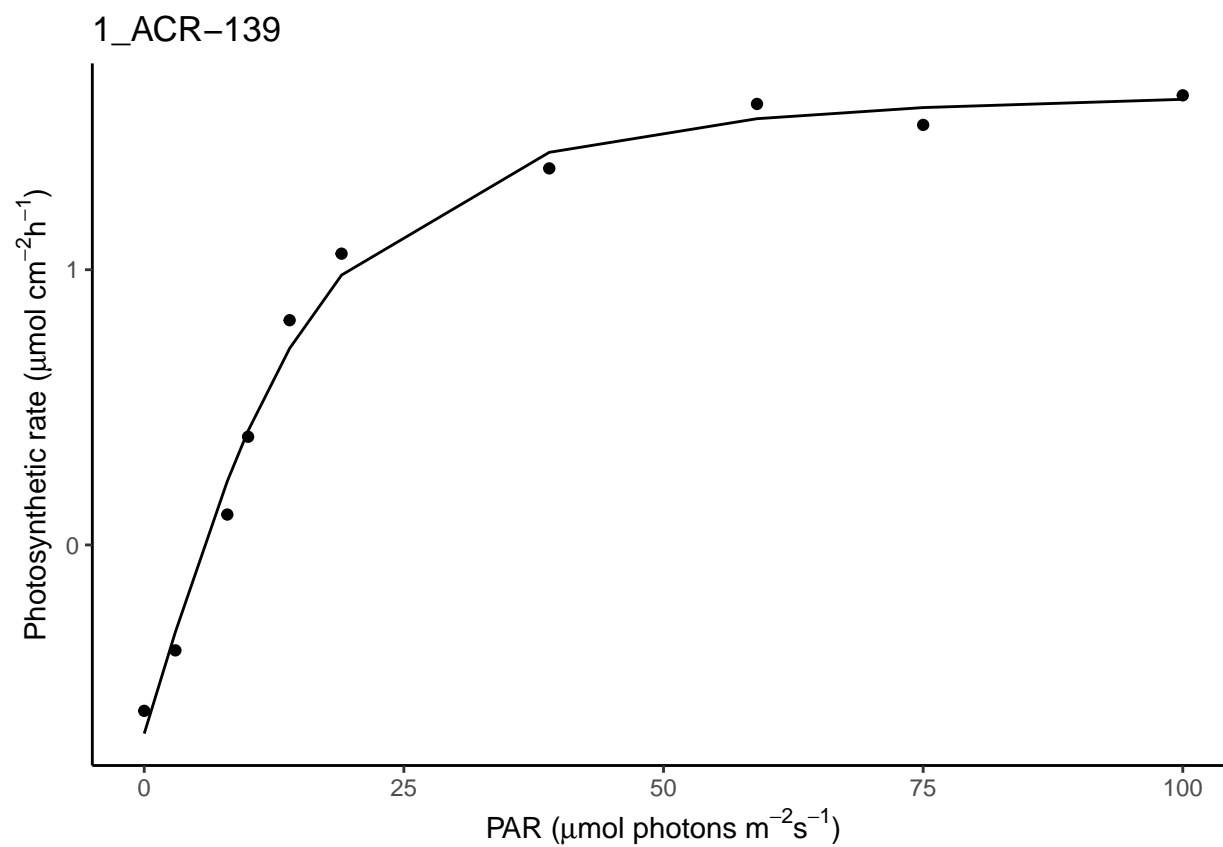
augmented\$colony_id: POR-242



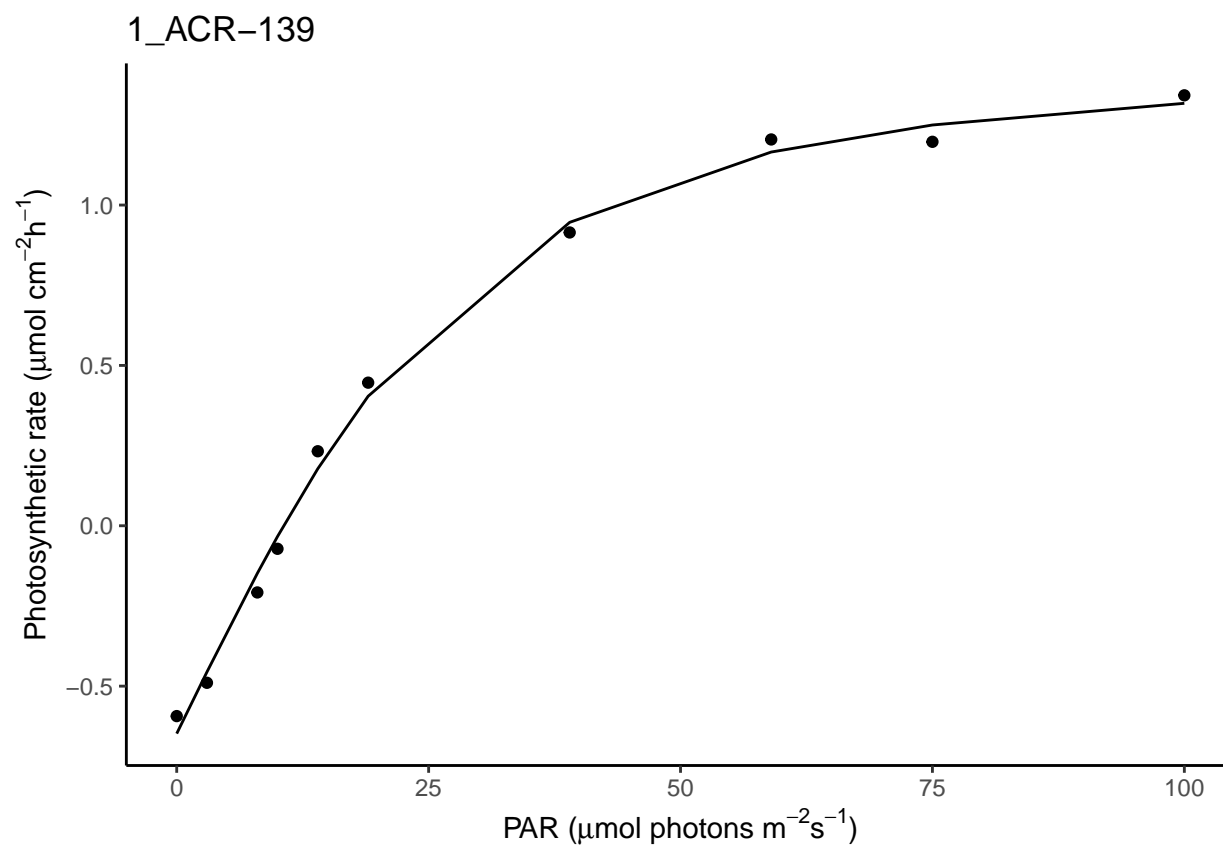
```
## -----  
## augmented$colony_id: POR-245
```



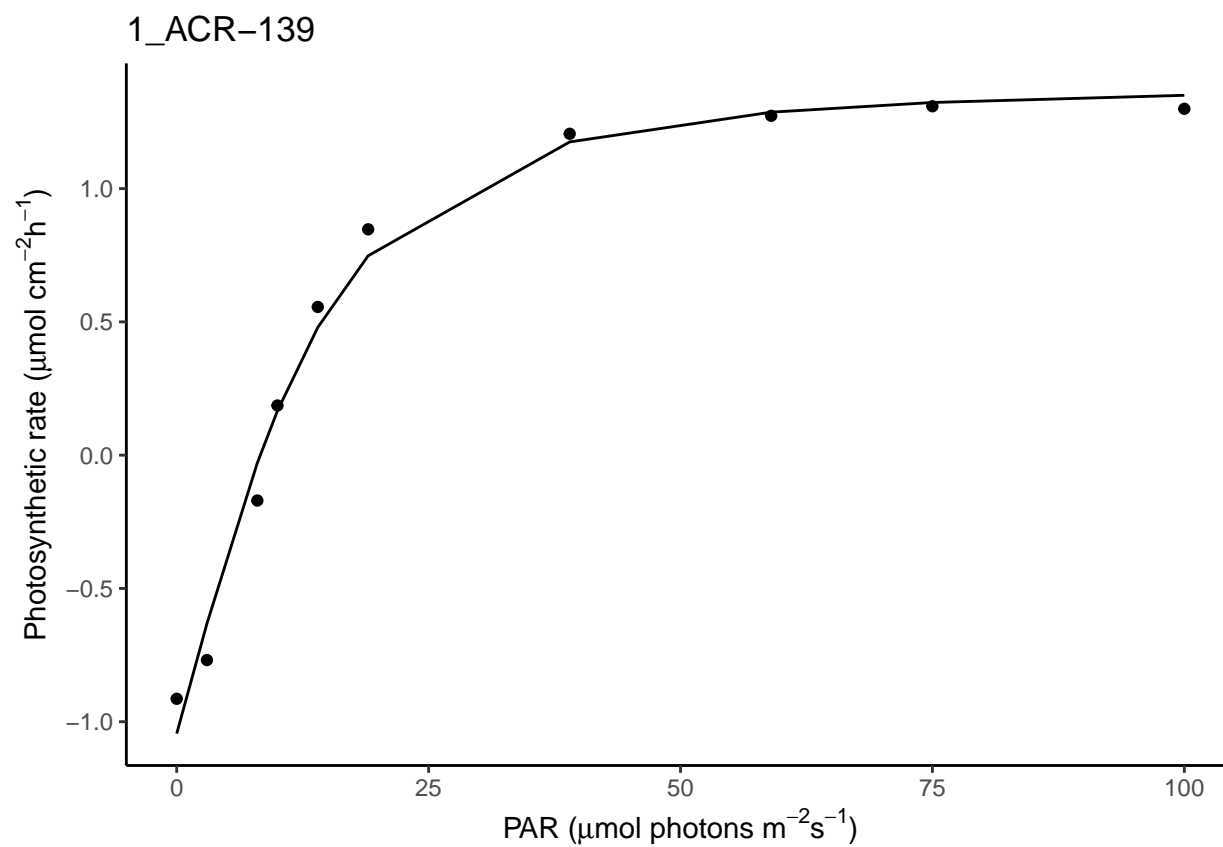
```
## -----  
## augmented$colony_id: POR-251
```



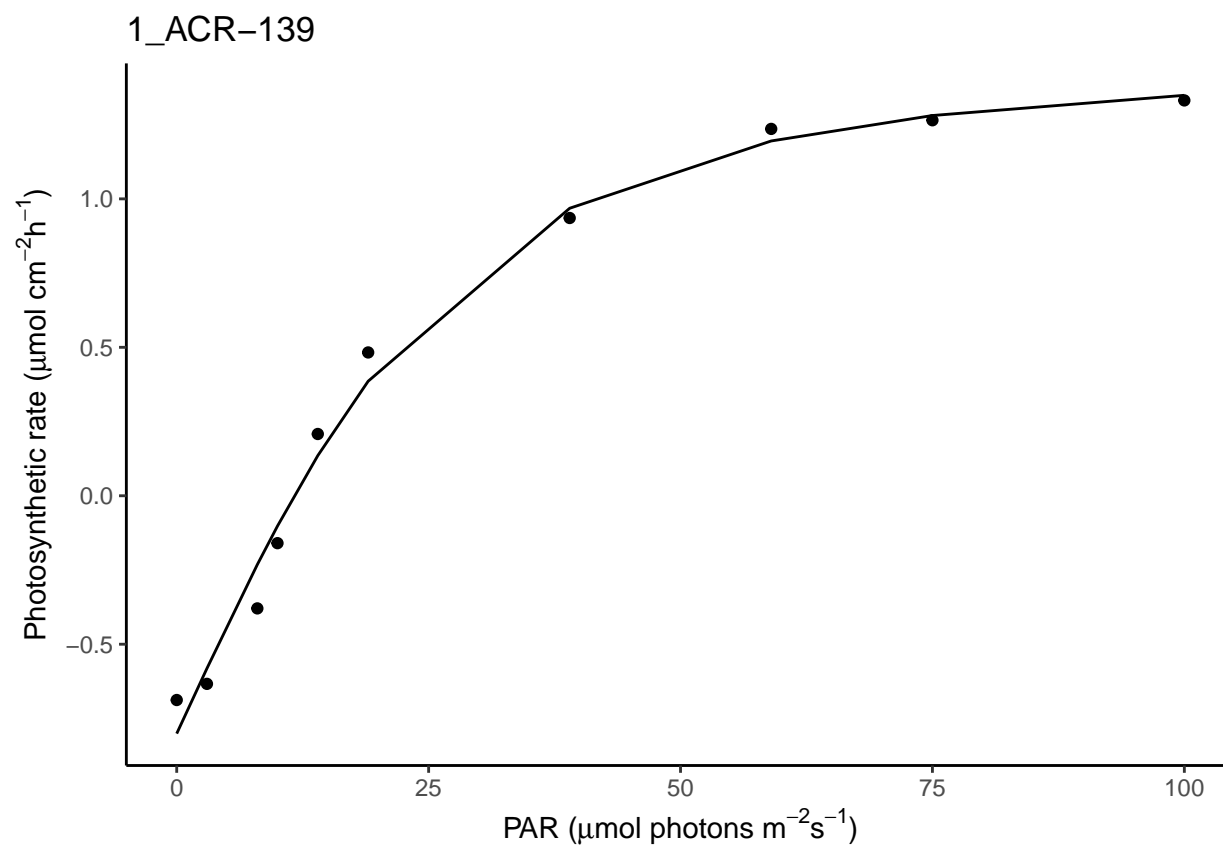
```
## -----  
## augmented$colony_id: POR-253
```



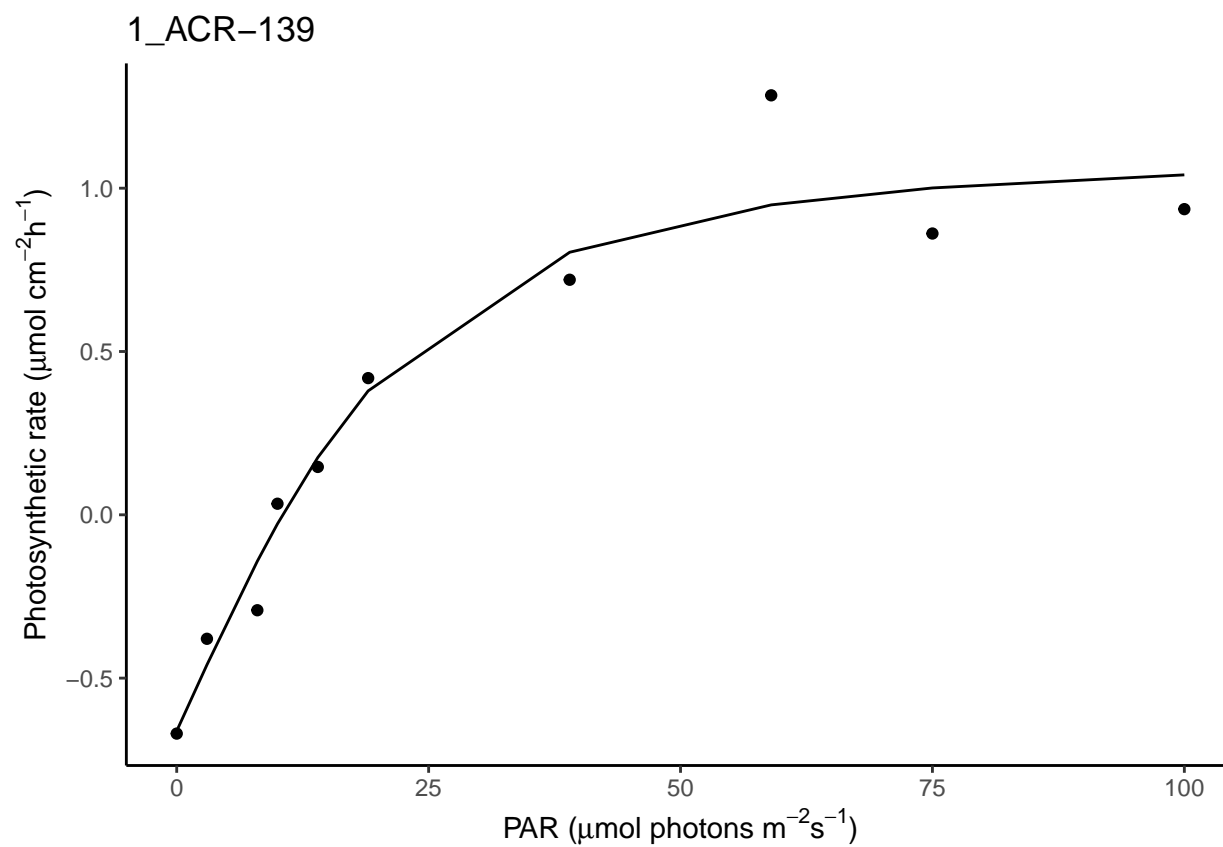
augmented\$colony_id: POR-260



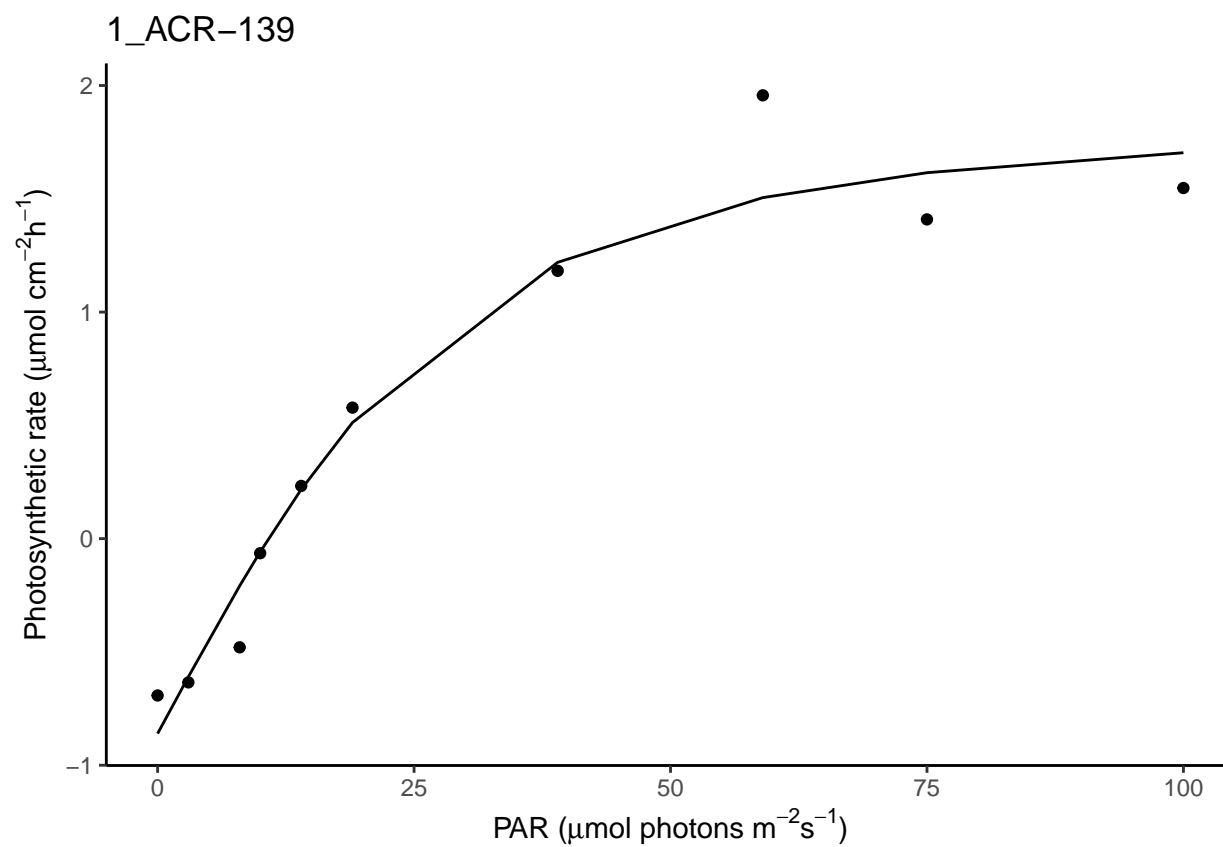
augmented\$colony_id: POR-262



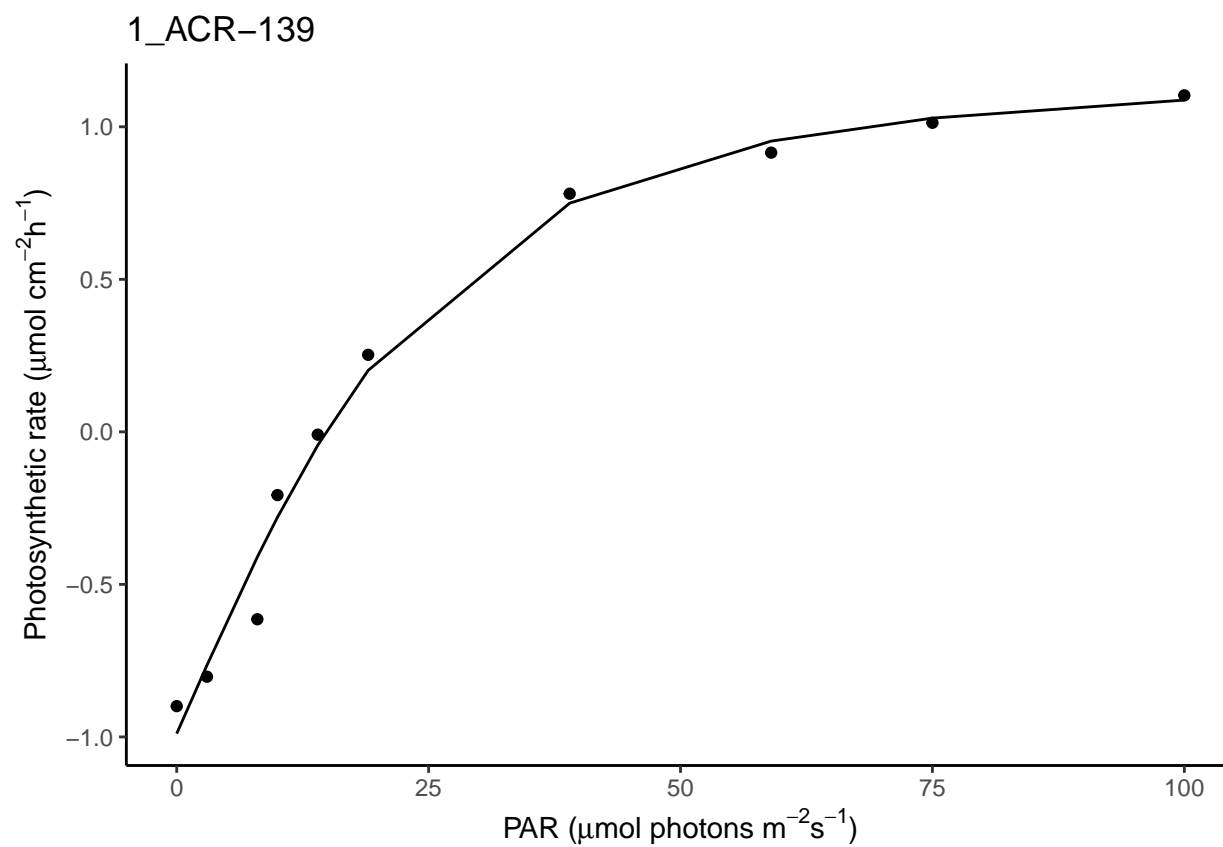
```
## -----  
## augmented$colony_id: POR-338
```

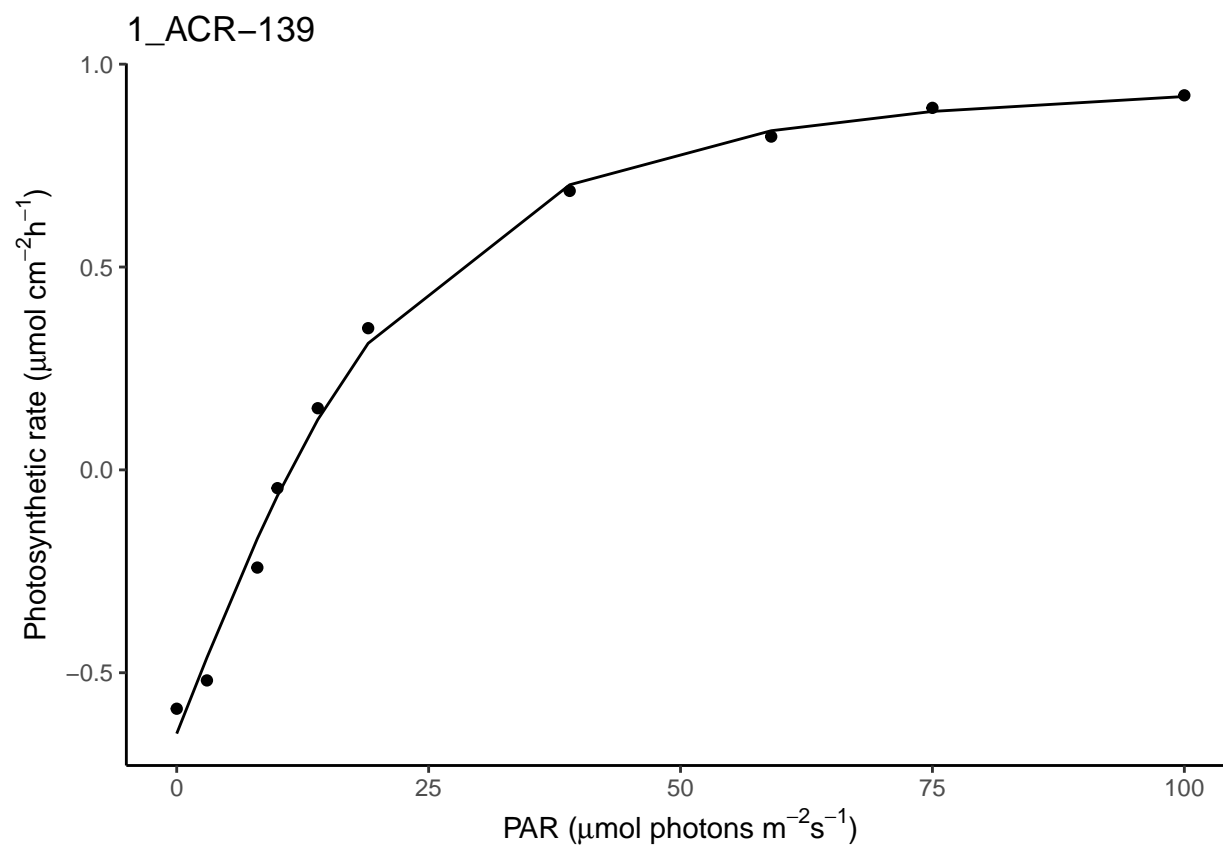
```
## -----  
## augmented$colony_id: POR-340
```



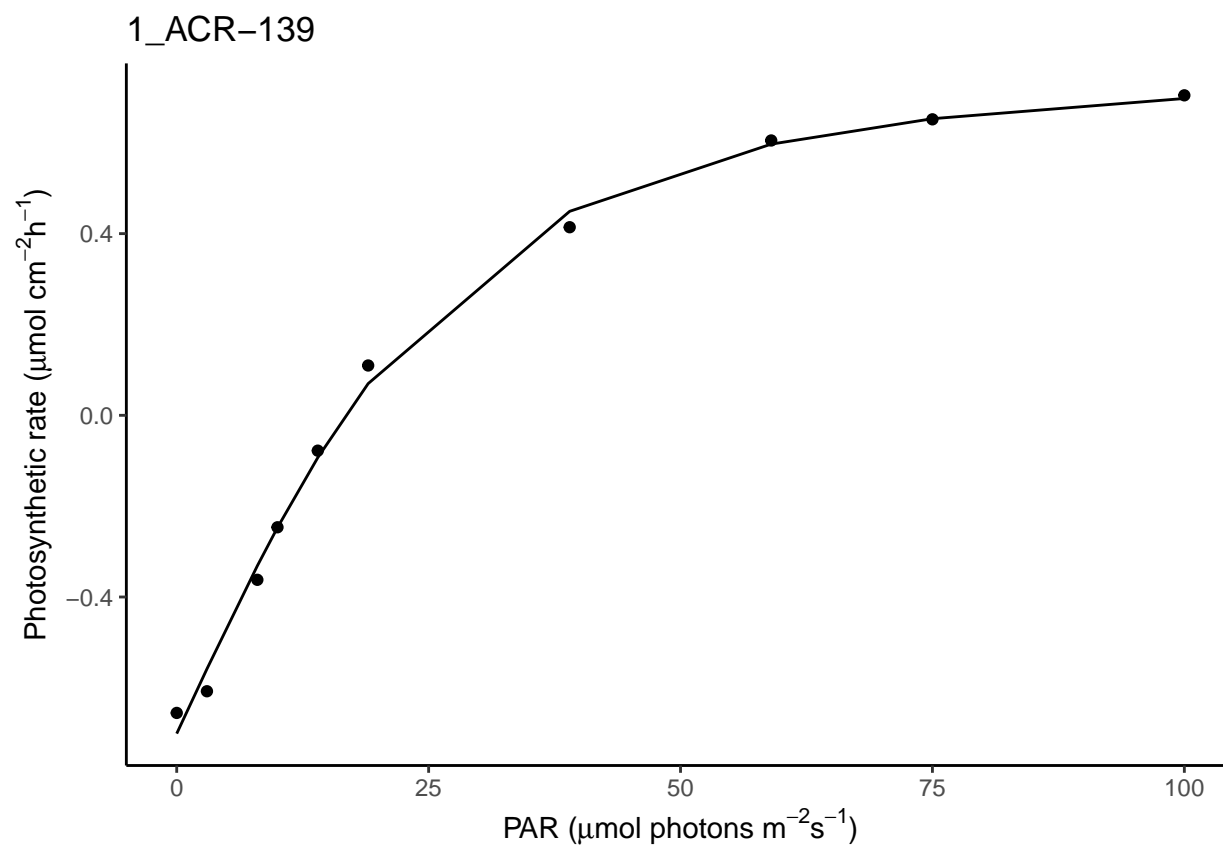
```
## -----  
## augmented$colony_id: POR-341
```



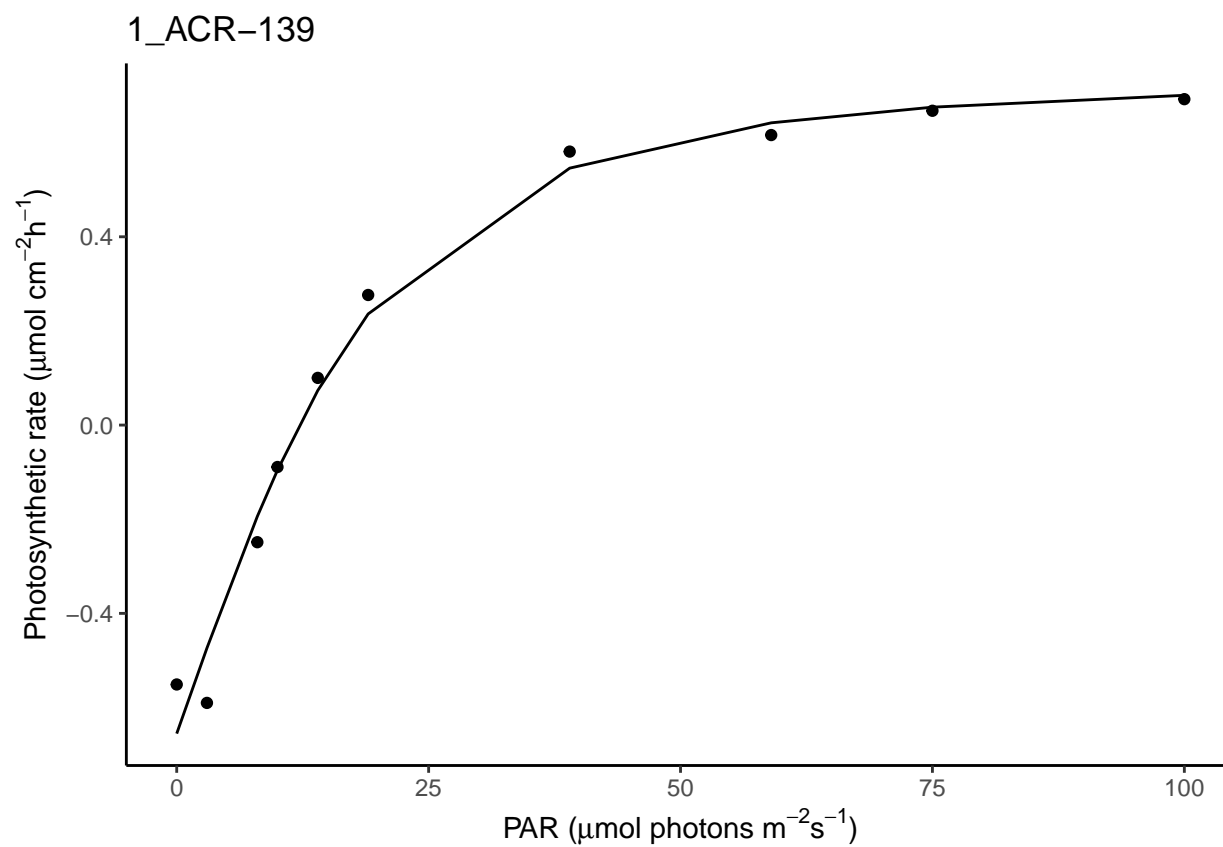
```
## -----  
## augmented$colony_id: POR-349
```



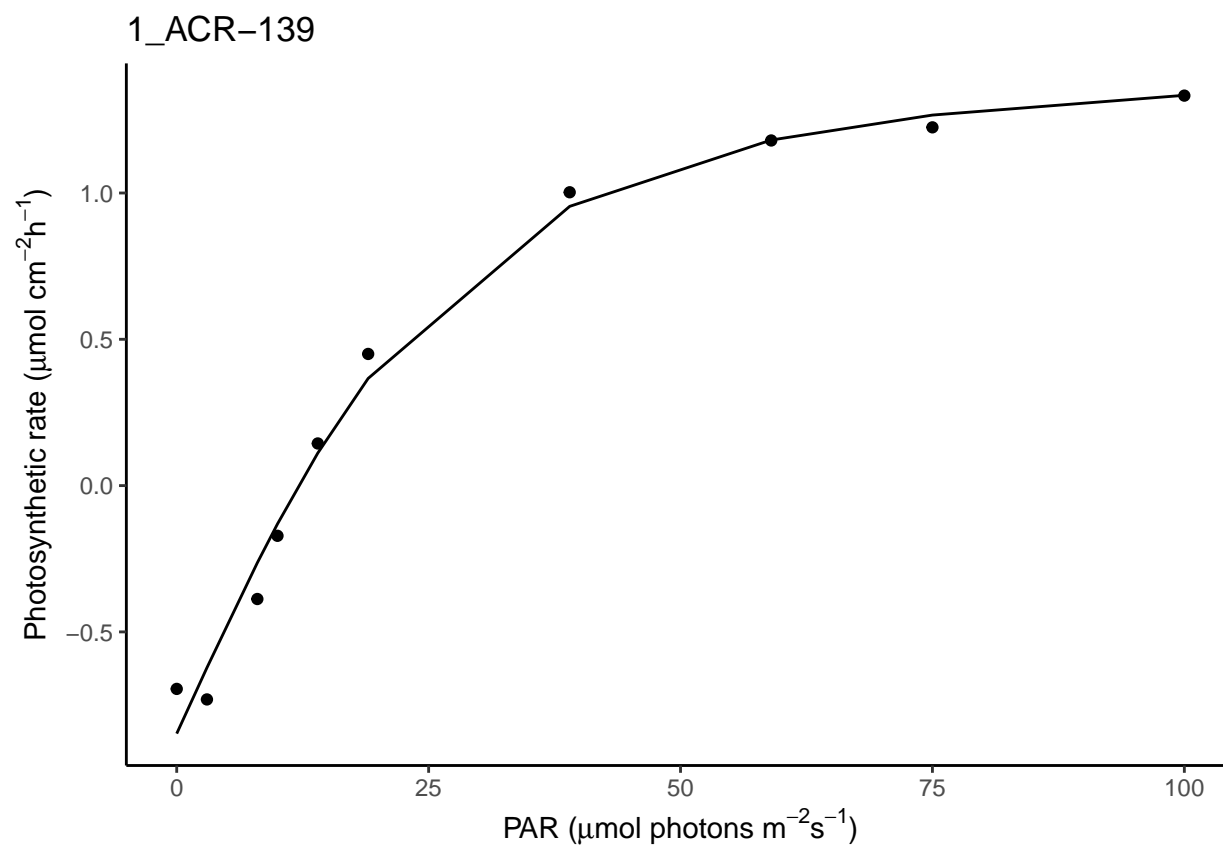
```
## -----  
## augmented$colony_id: POR-353  
## NULL  
## -----  
## augmented$colony_id: POR-354
```



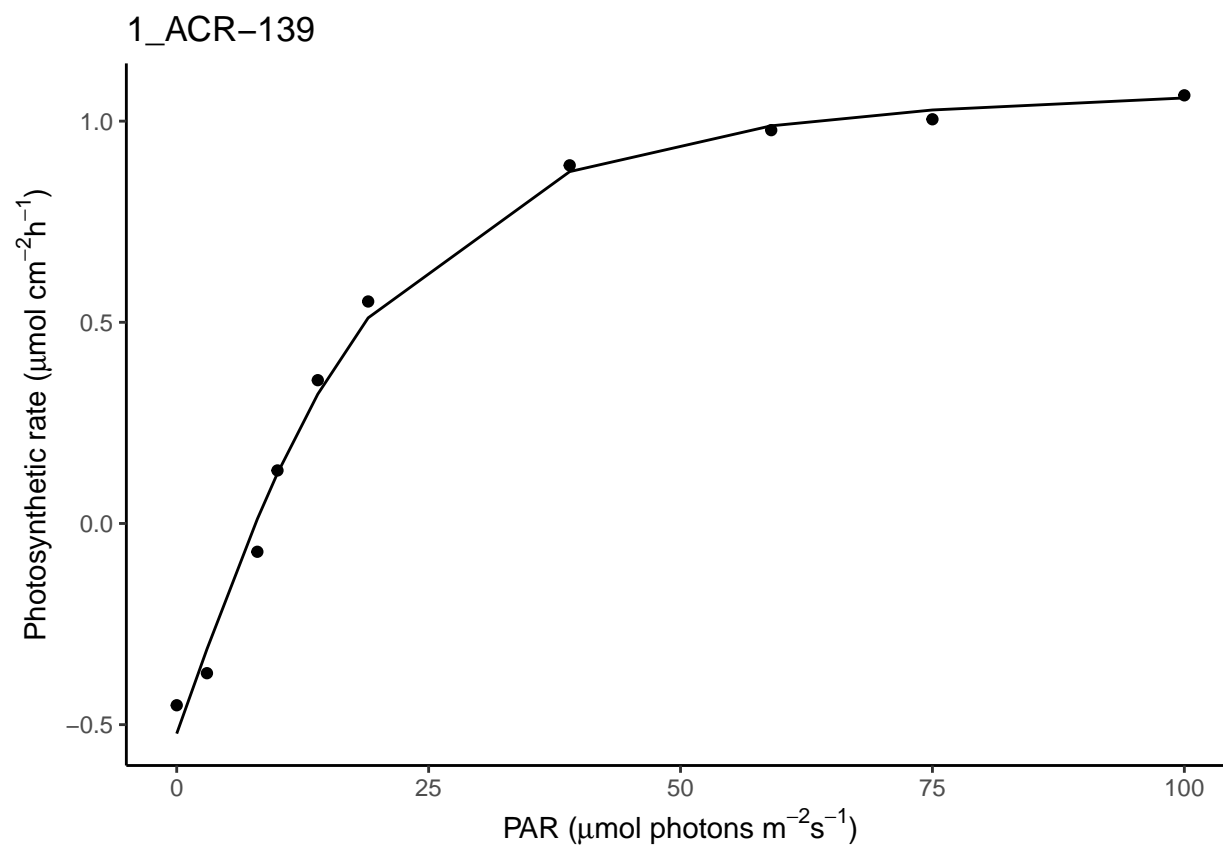
augmented\$colony_id: POR-357



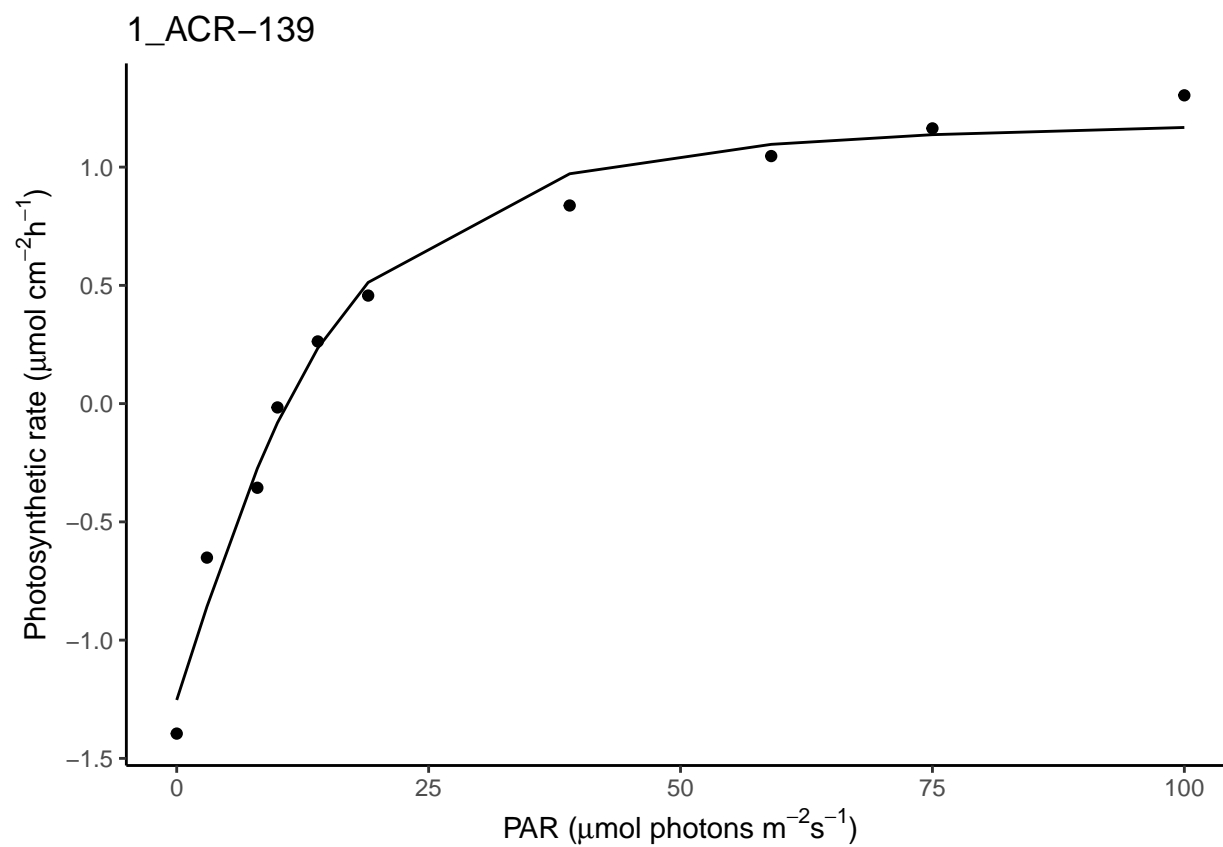
```
## -----  
## augmented$colony_id: POR-362
```



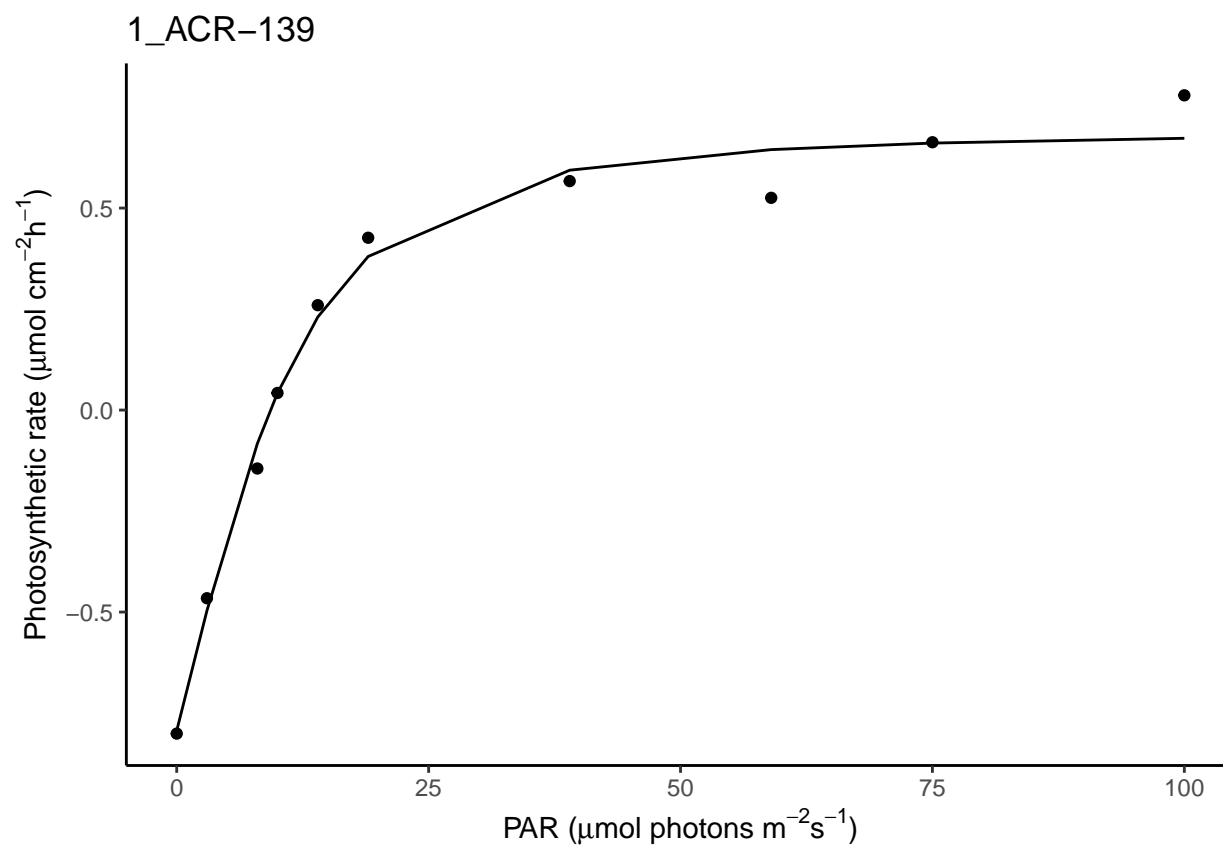
```
## -----
## augmented$colony_id: POR-365
## NULL
## -----
## augmented$colony_id: POR-367
```



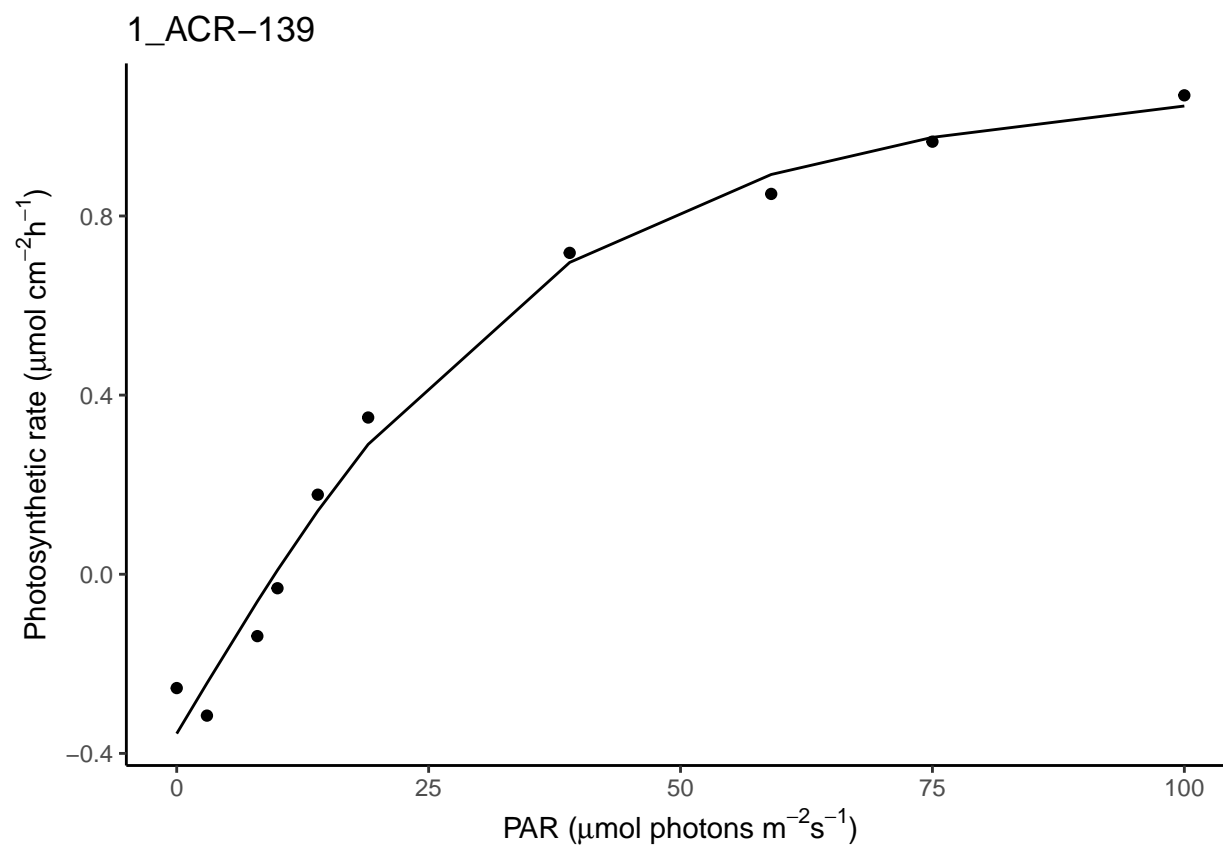
```
## -----  
## augmented$colony_id: POR-381
```

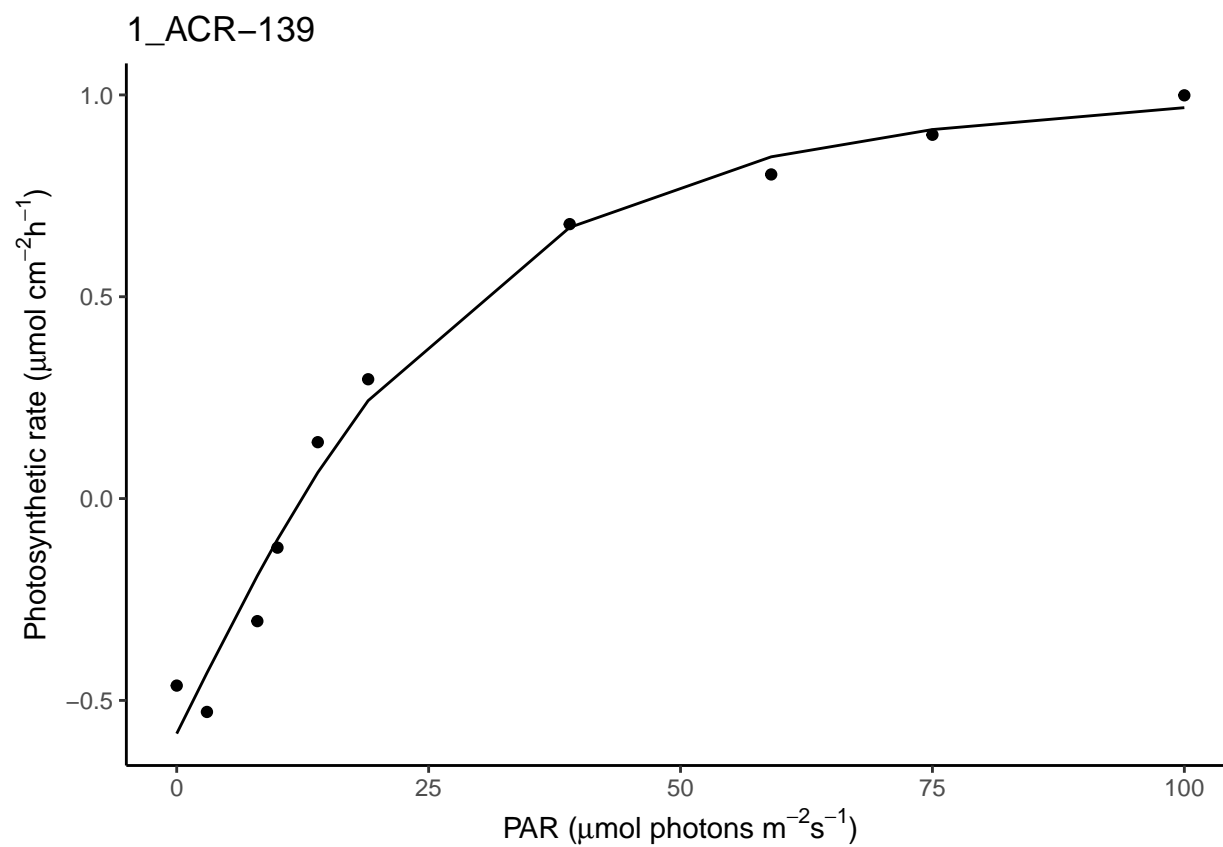
augmented\$colony_id: POR-383



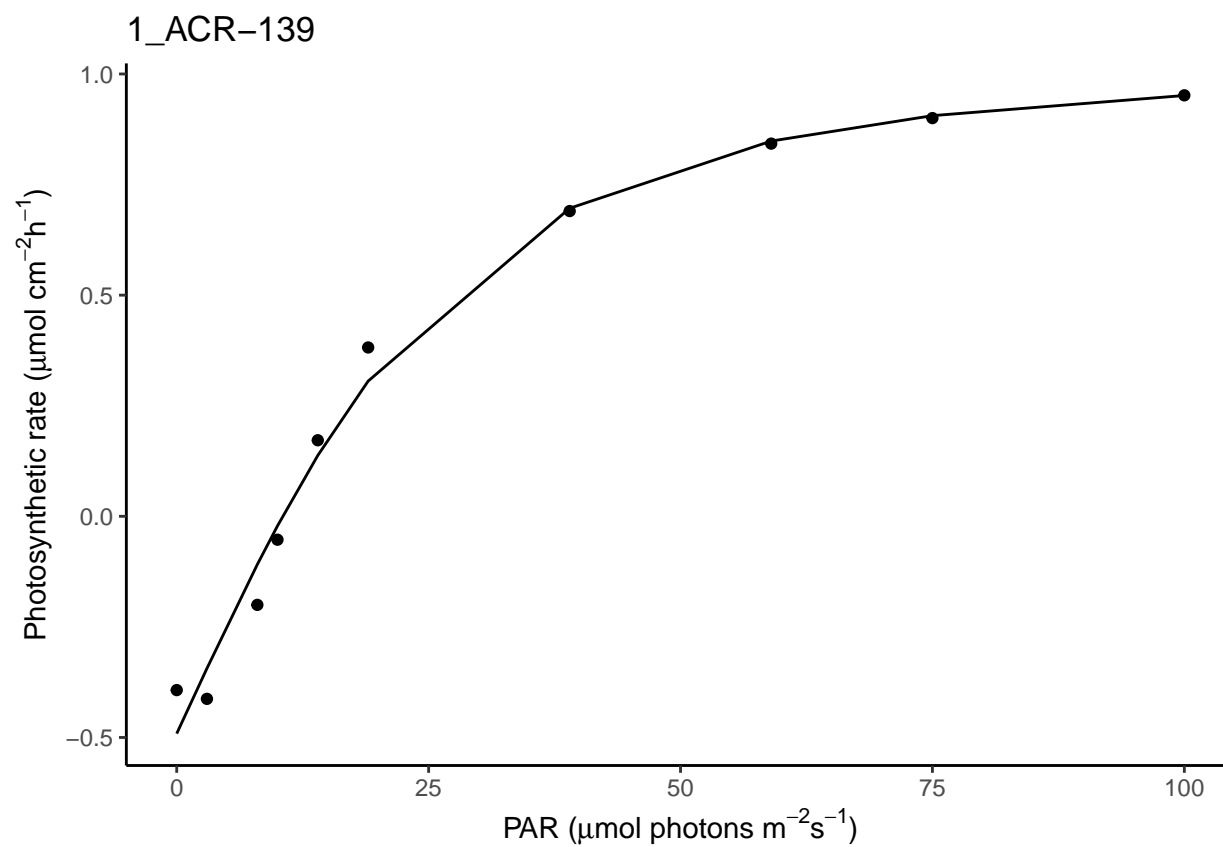
```
## -----  
## augmented$colony_id: POR-384
```



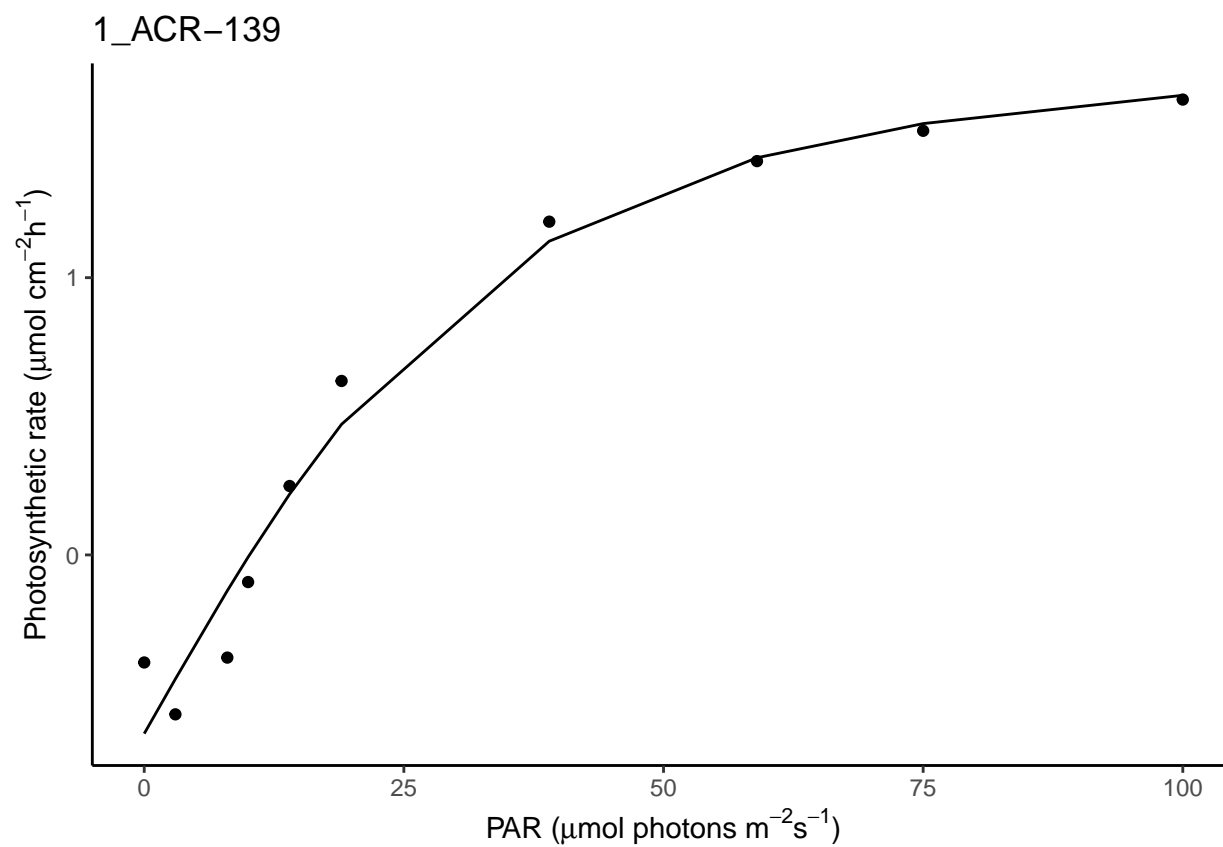
augmented\$colony_id: POR-385



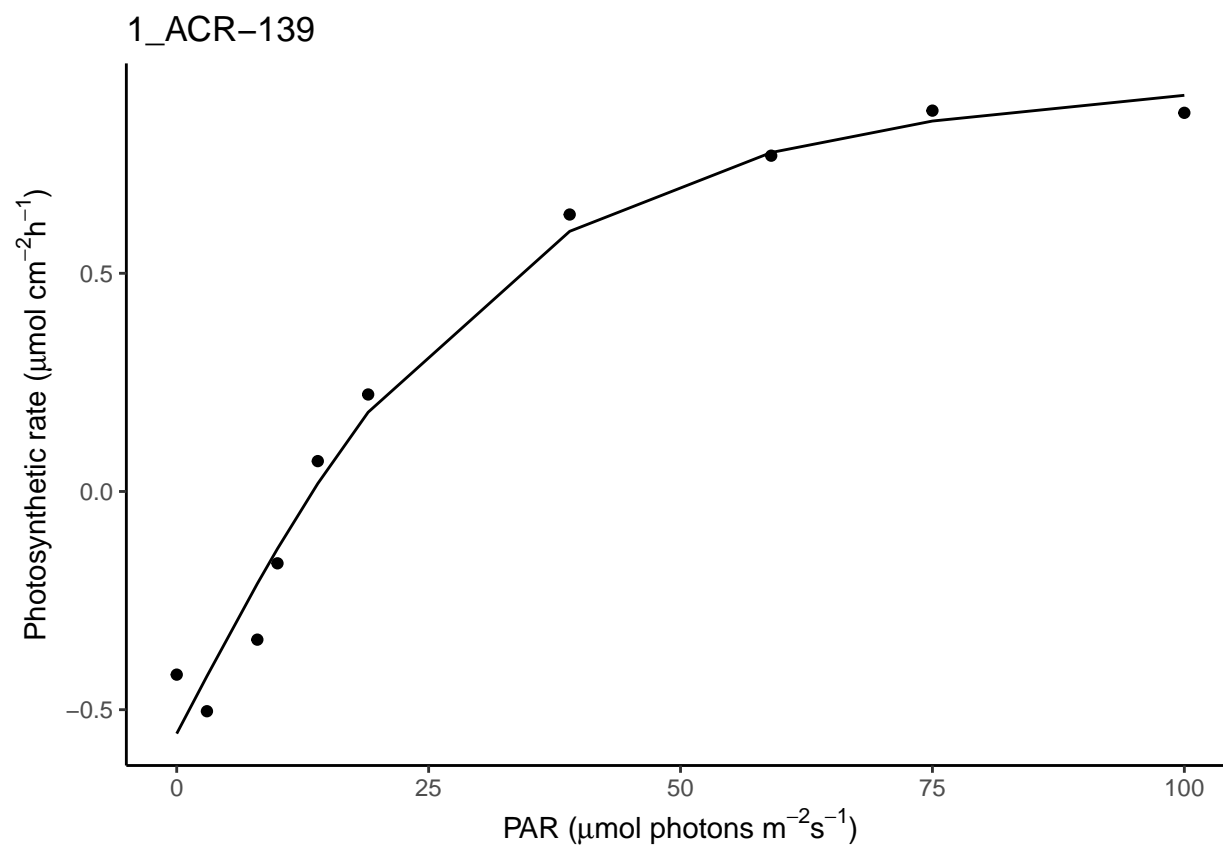
```
## -----  
## augmented$colony_id: POR-69
```



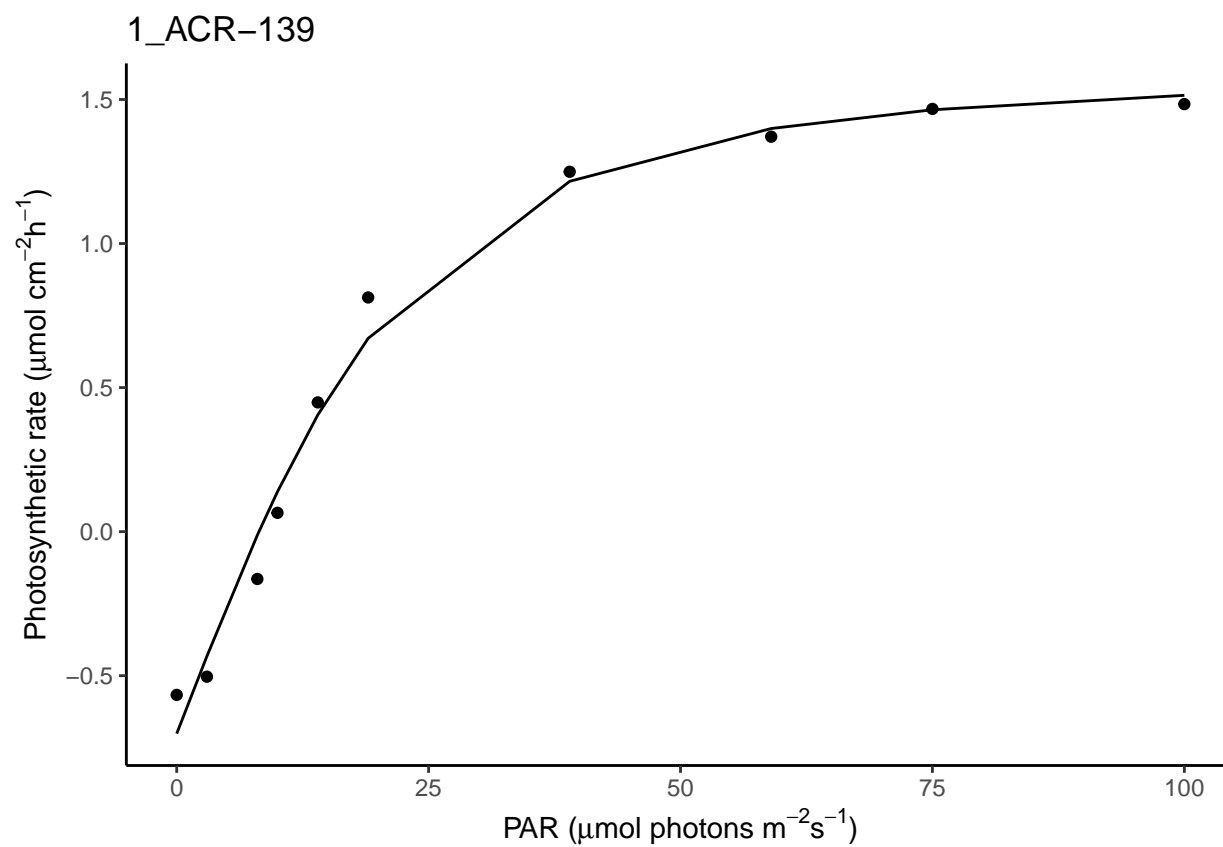
```
## -----  
## augmented$colony_id: POR-70
```



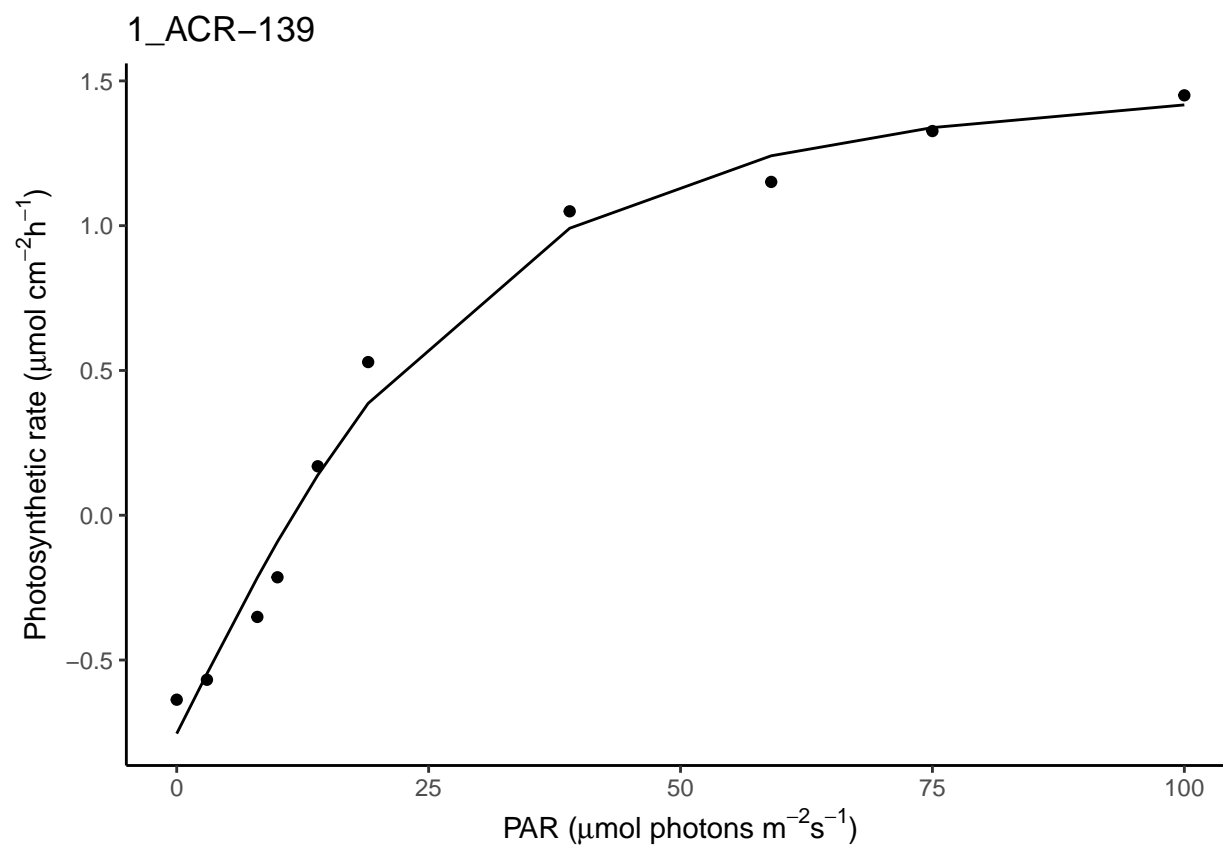
```
## -----  
## augmented$colony_id: POR-71
```



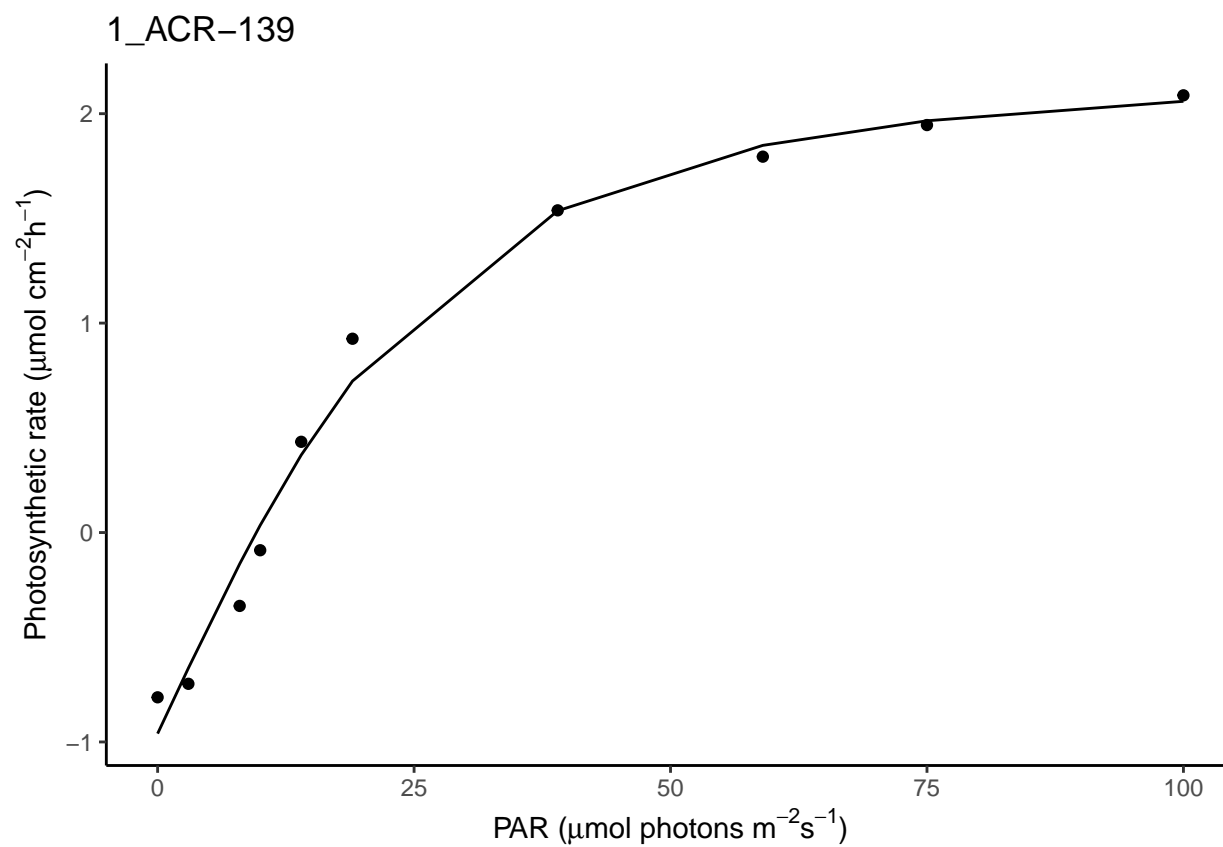
augmented\$colony_id: POR-72



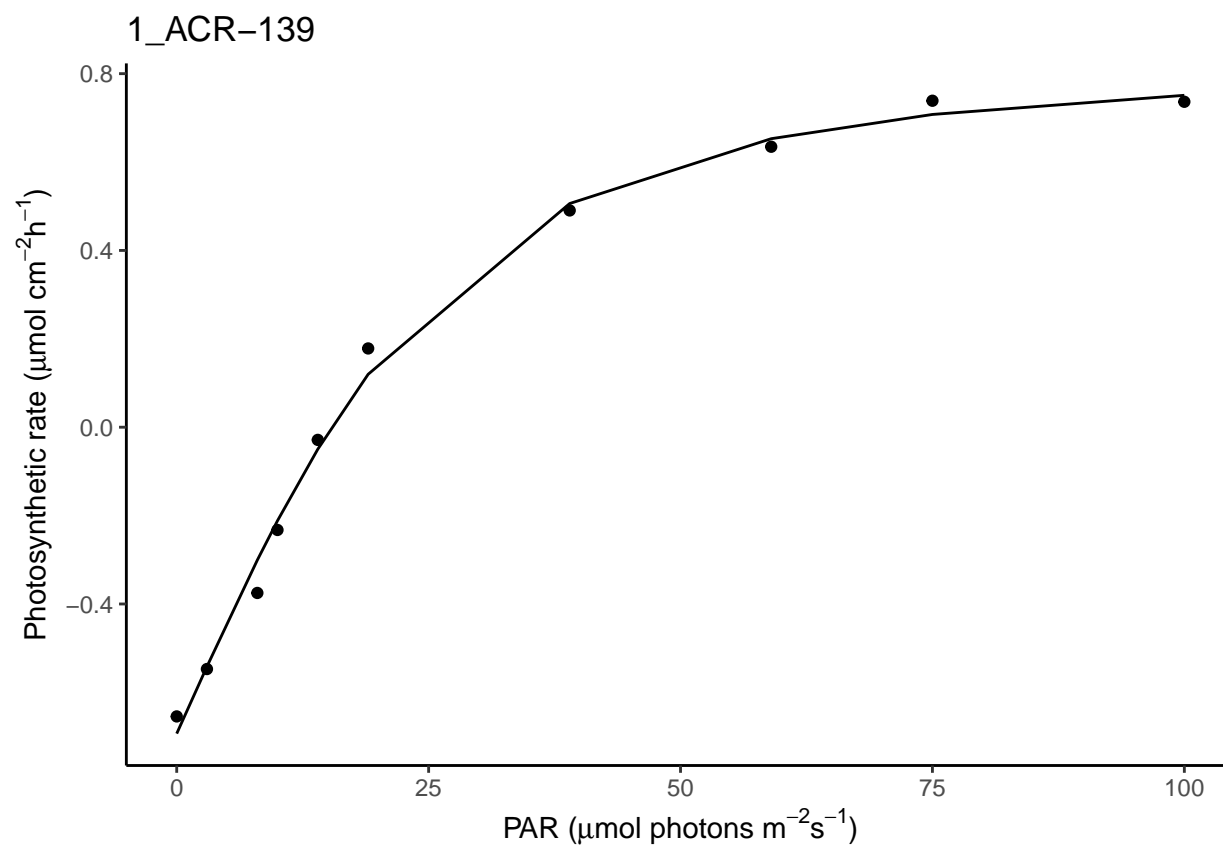
```
## -----  
## augmented$colony_id: POR-73
```

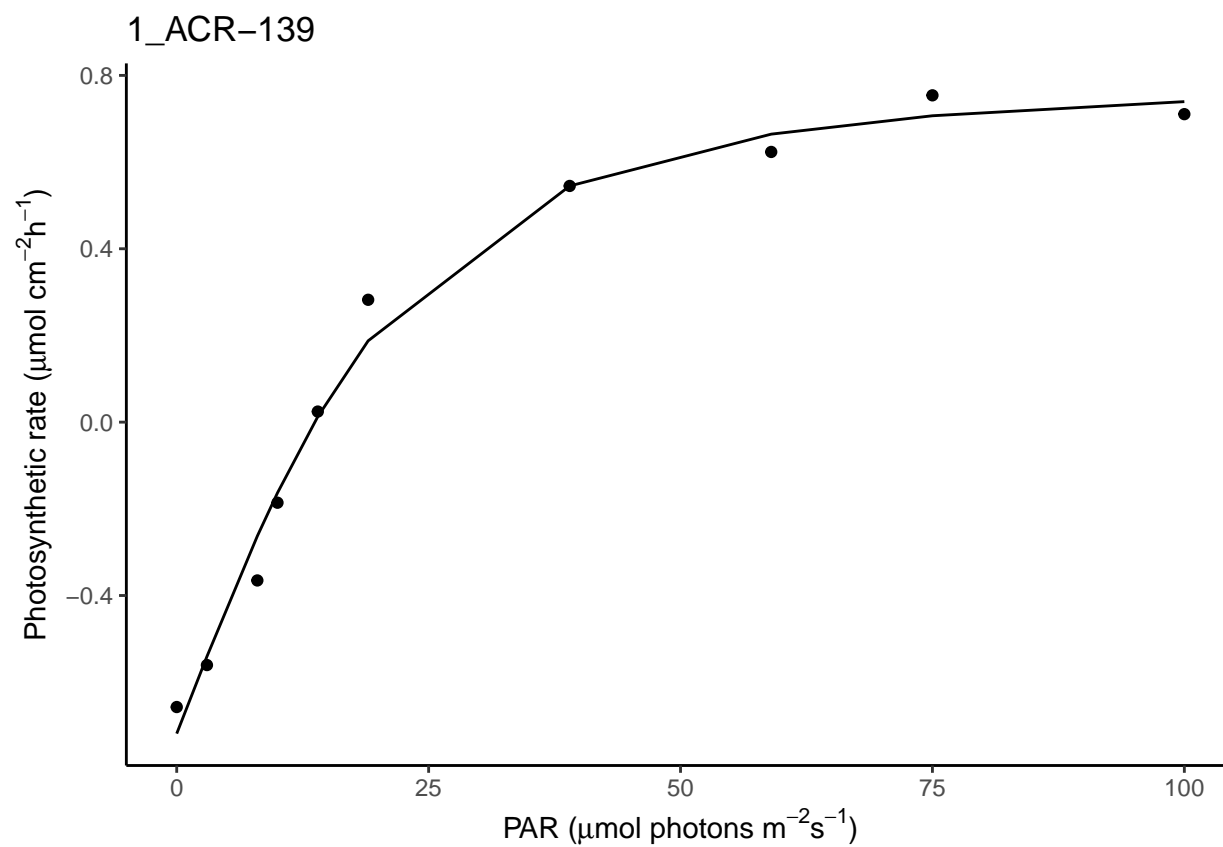
augmented\$colony_id: POR-74



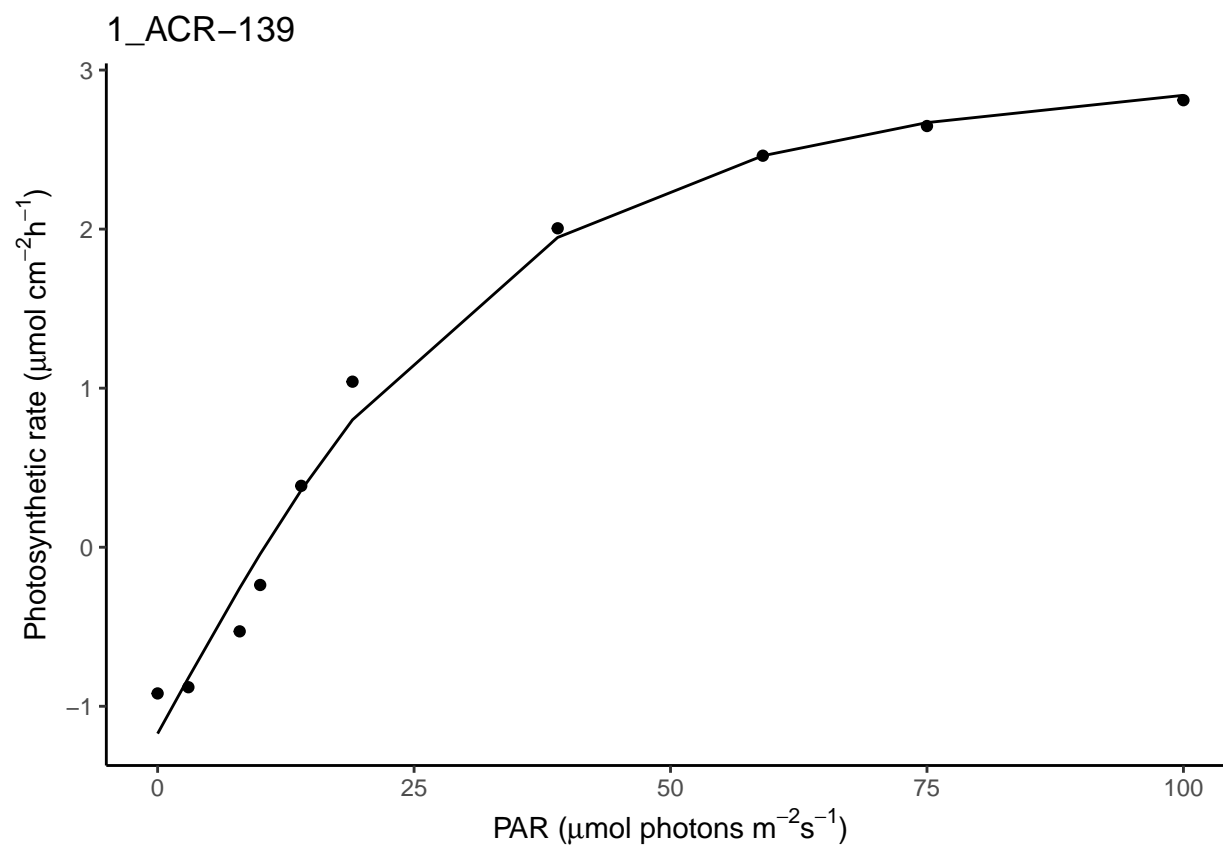
```
## -----  
## augmented$colony_id: POR-75  
## NULL  
## -----  
## augmented$colony_id: POR-76
```



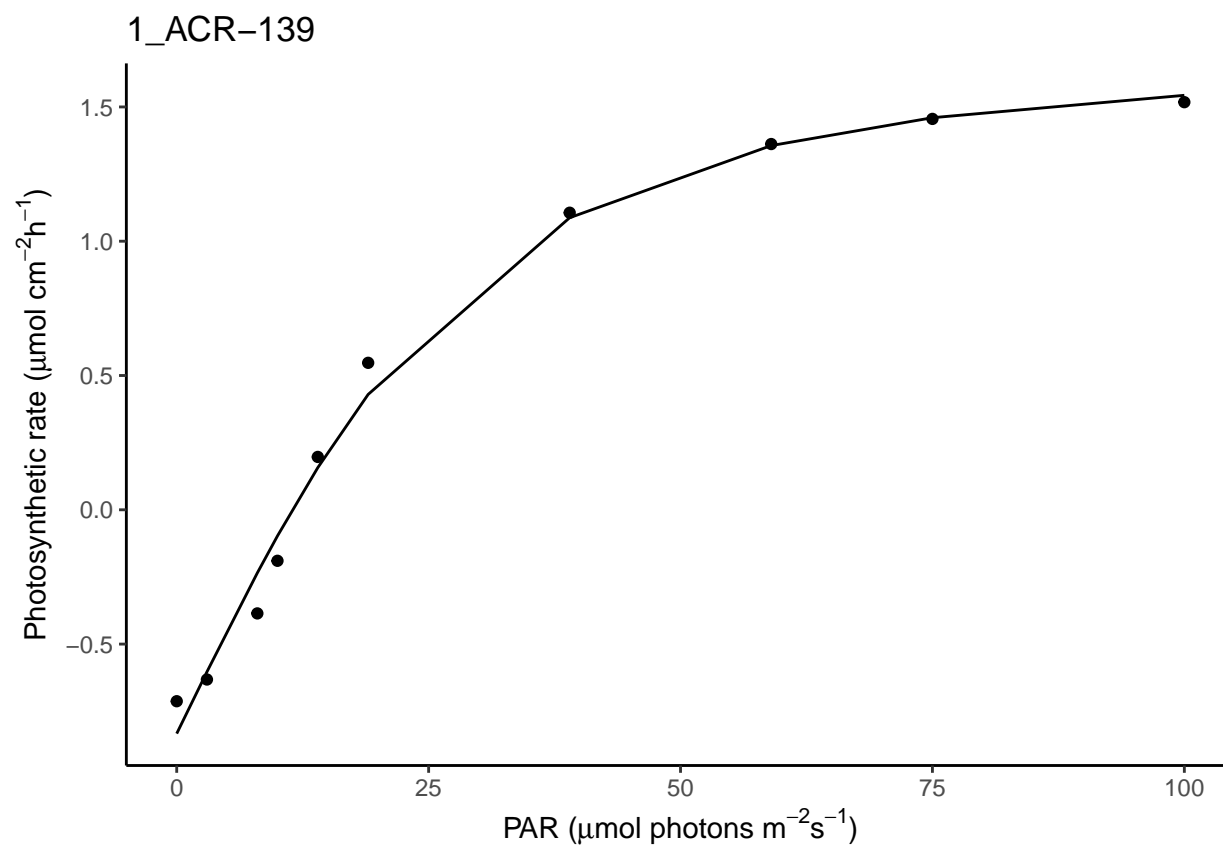
```
## -----  
## augmented$colony_id: POR-79
```



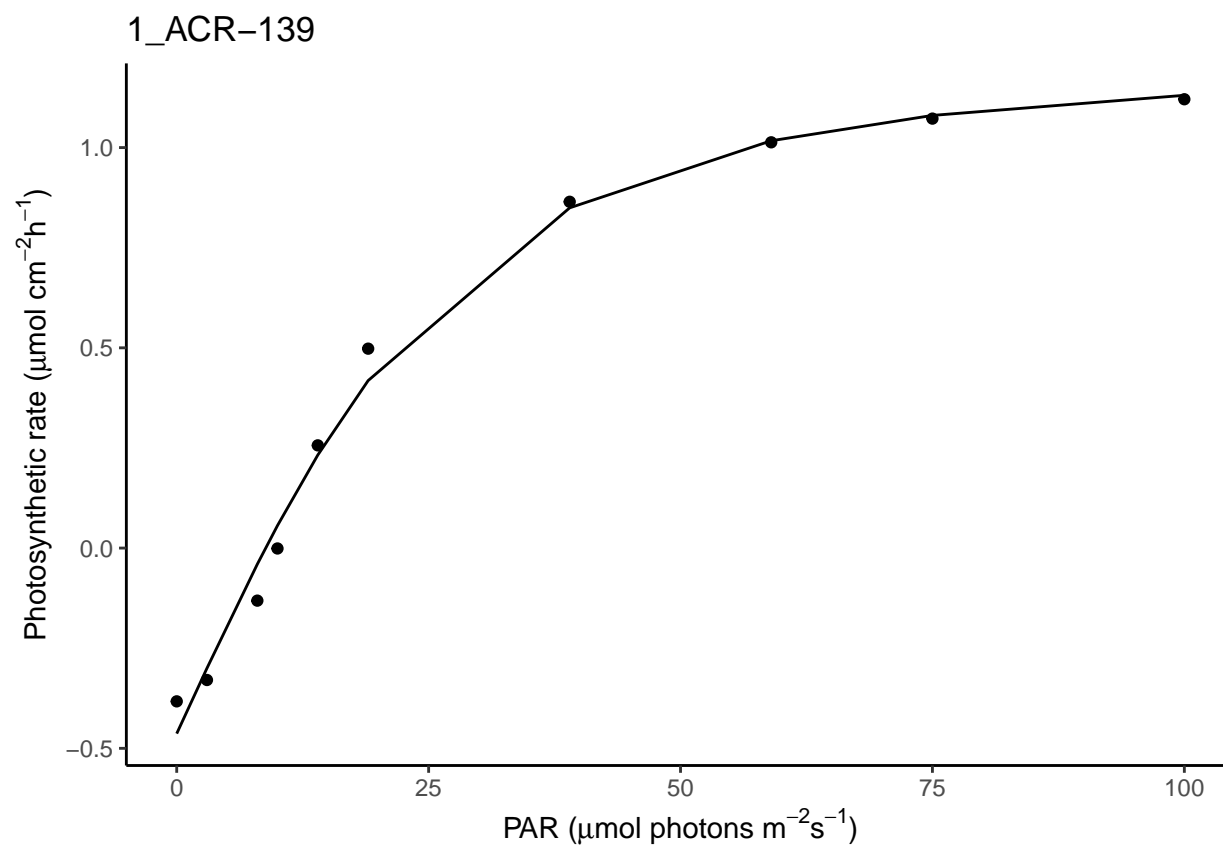
```
## -----  
## augmented$colony_id: POR-81
```



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



augmented\$colony_id: POR-83



#NEED TO FIND A WAY TO SAVE INDIVIDUALS