

pi_curves_nls

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3/18/2021

```
## 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 %>%
  filter(!colony_id=="POC-239")%>%
  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")
```

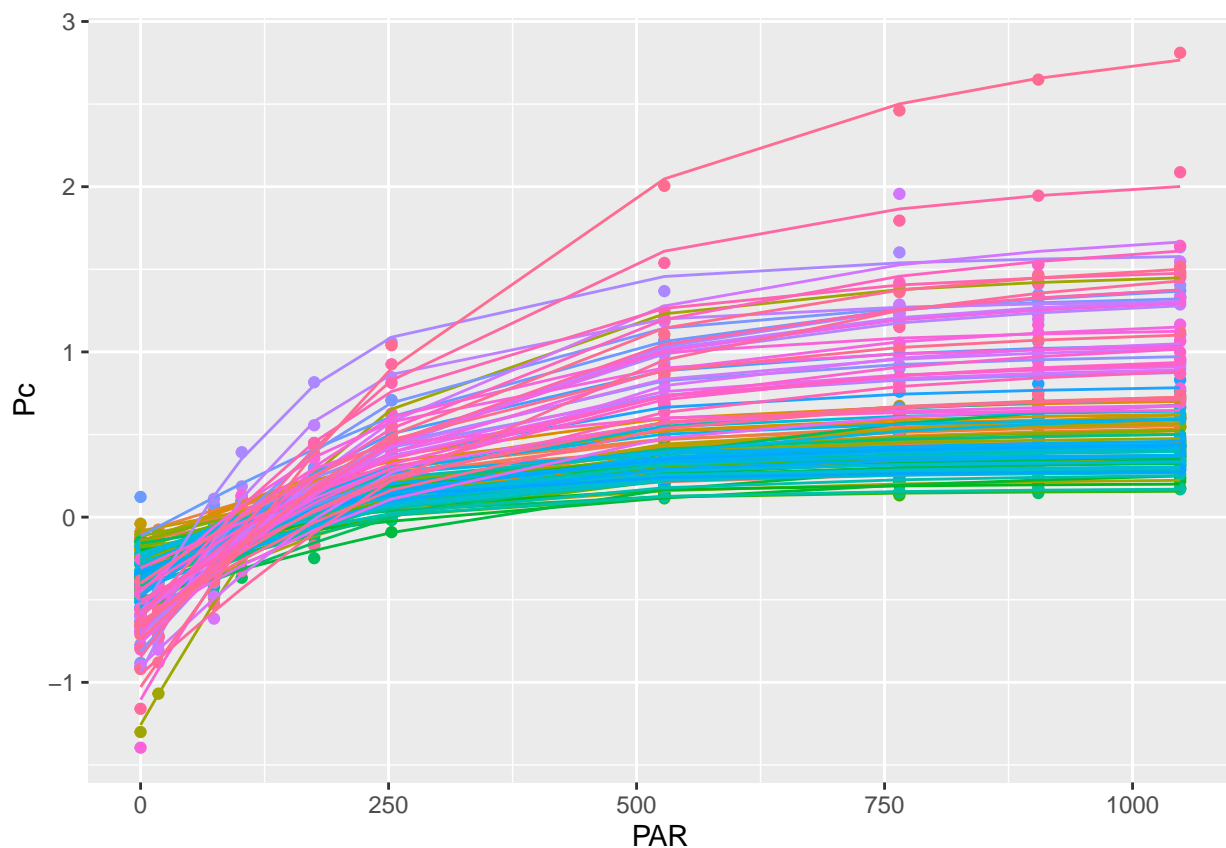
ERROR HERE - not plotting

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=(m
    augmented = map(fit, augment),
  ) %>%
  unnest(augmented)
```

#all colonies together

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



#view individual plots

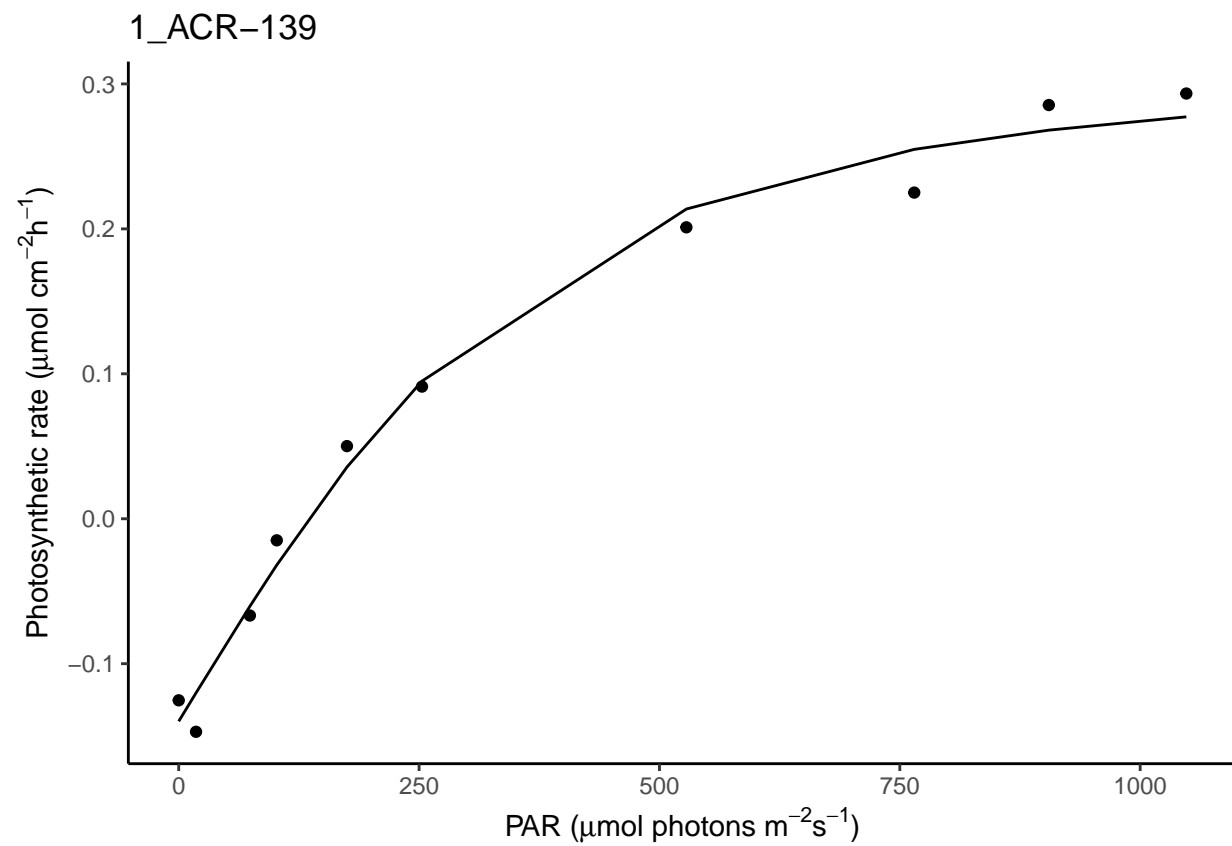
```
by(augmented, augmented$colony_id, function(i) {
  ggplot(i) +
    geom_point(aes(PAR, Pc, group=colony_id)) +
    geom_line(aes(y=.fitted, x=PAR)) +
    theme_classic()
})
```

```

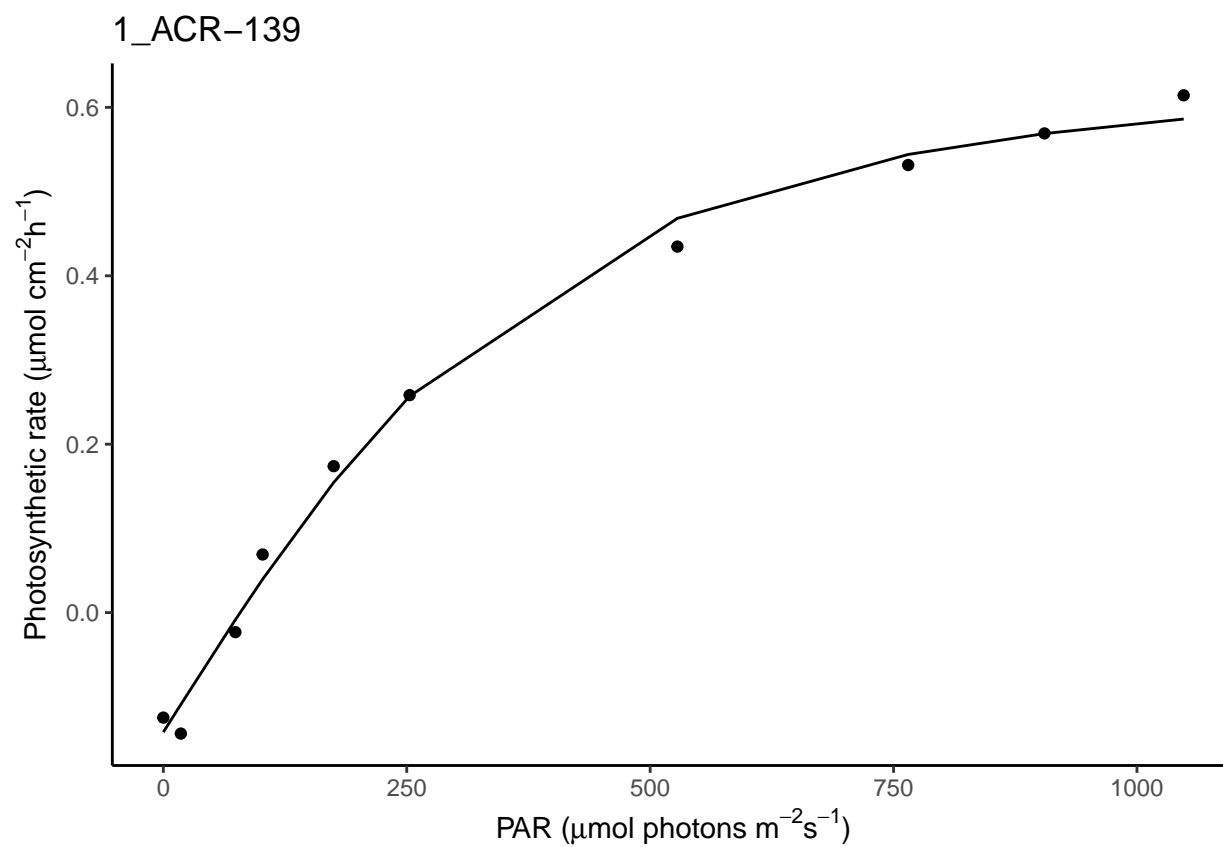
labs(x = expression(paste('PAR (', mu, "mol photons m"-2, 's'-1,")")),
     y = expression(paste('Photosynthetic rate (', mu, "mol cm"-2, 'h'-1,")")),
     title = paste0("1_", augmented$colony_id))
})

```

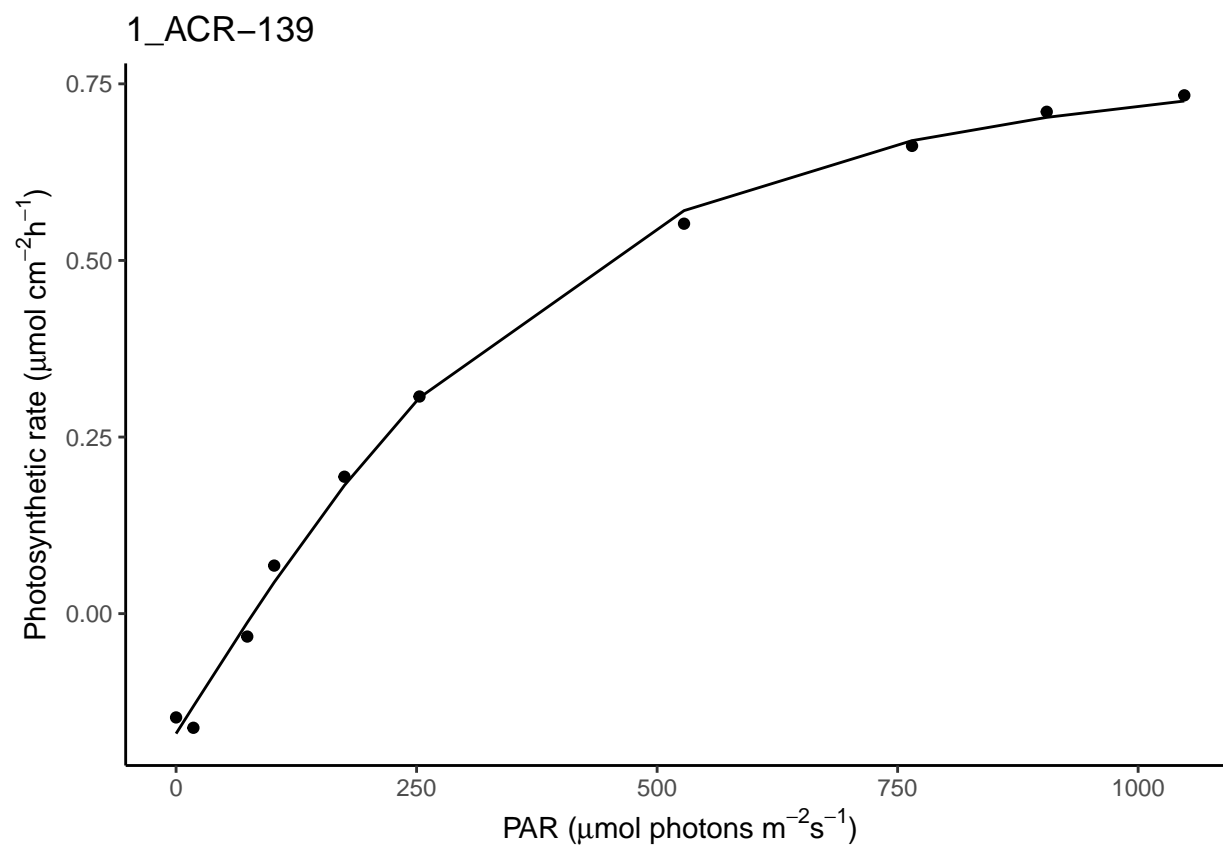
```
## augmented$colony_id: ACR-139
```



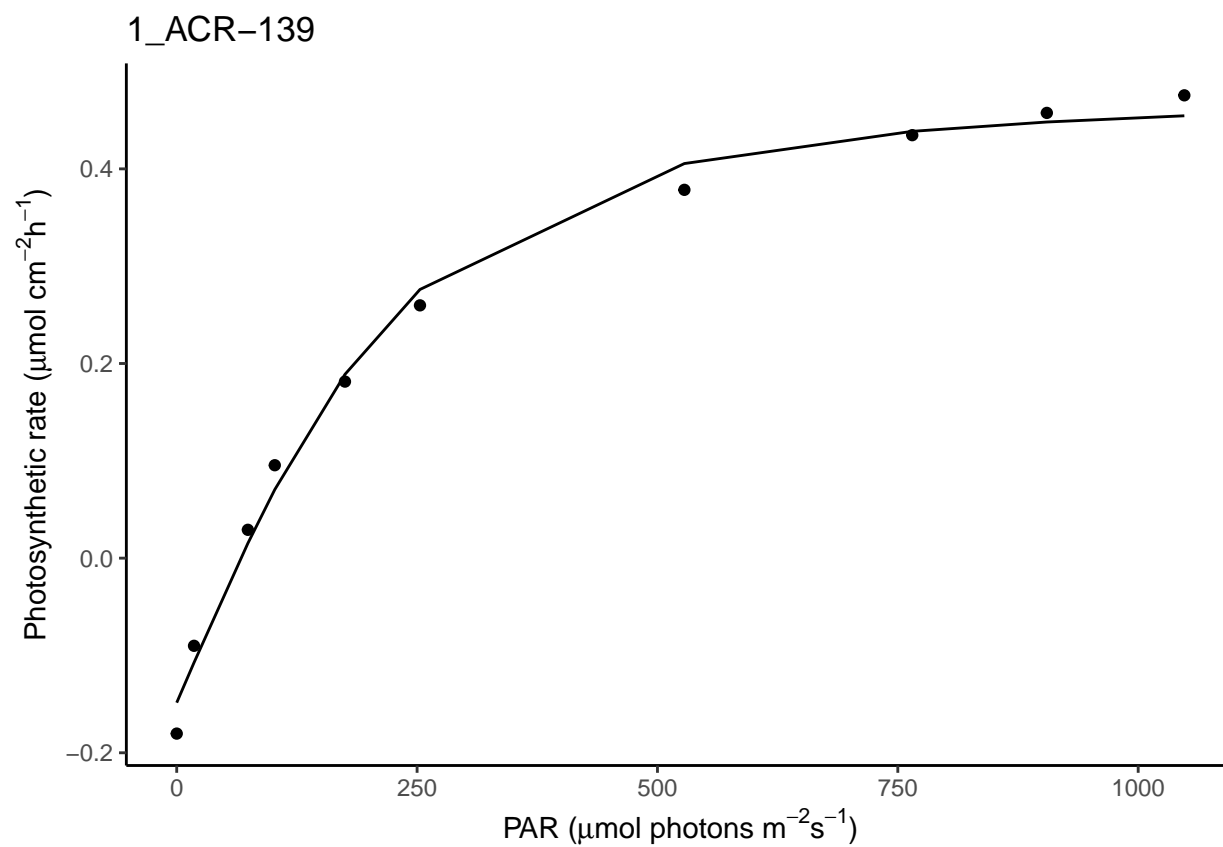
```
## -----
## augmented$colony_id: ACR-145
```



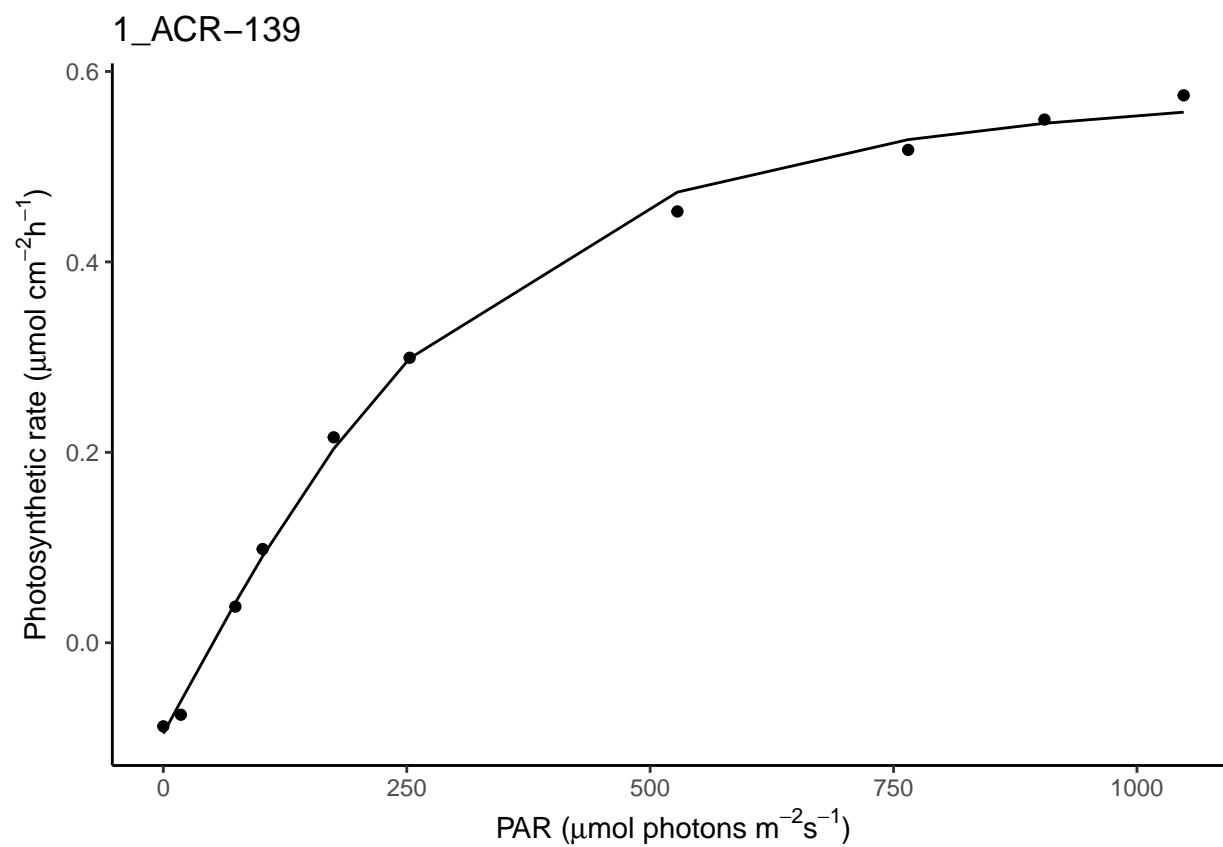
```
## -----  
## augmented$colony_id: ACR-150
```



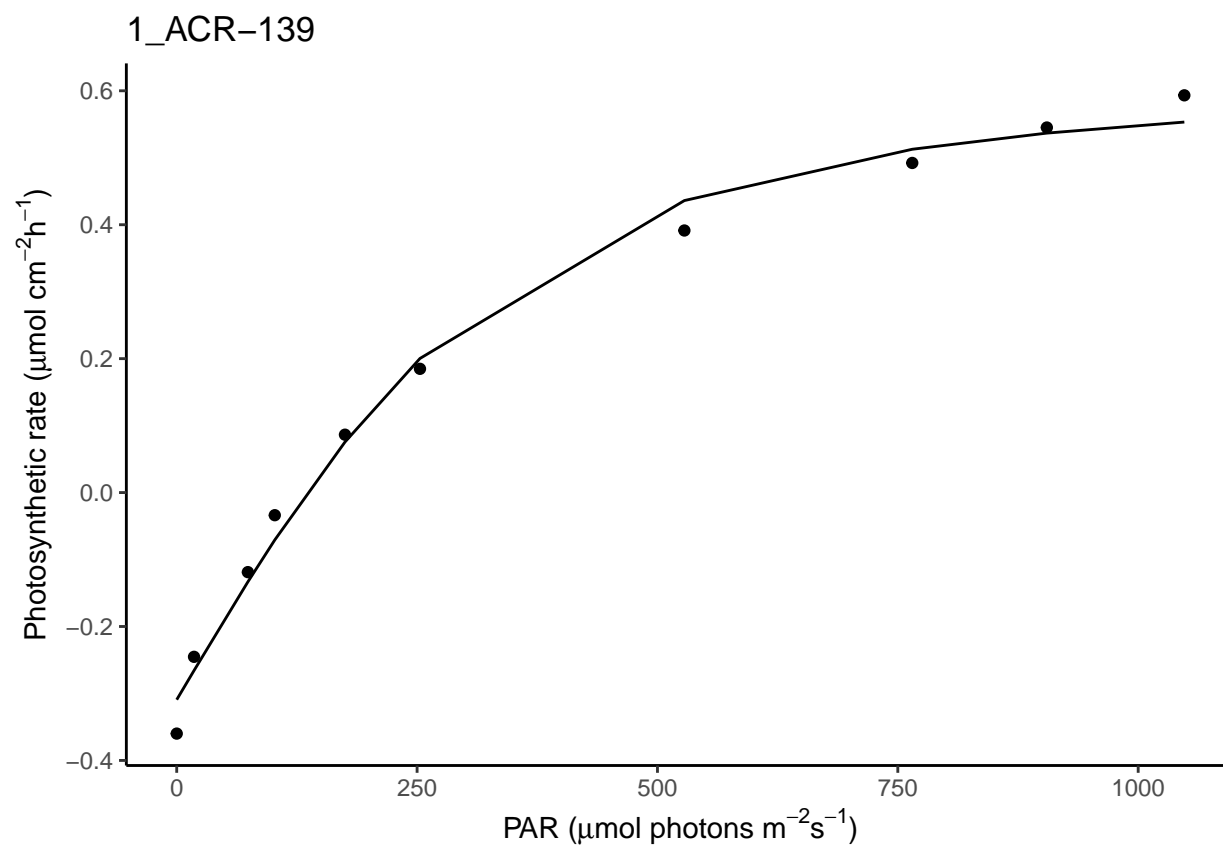
```
## -----  
## augmented$colony_id: ACR-173
```



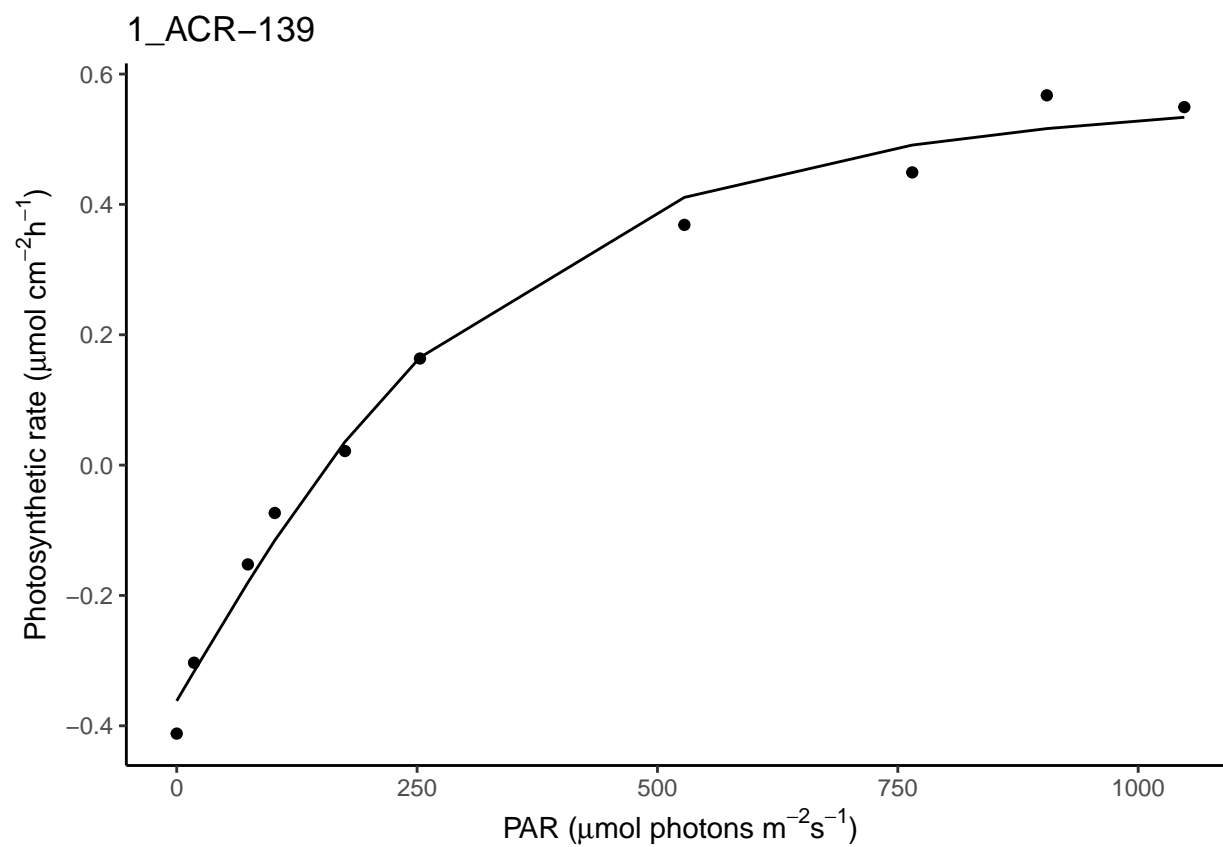
augmented\$colony_id: ACR-175



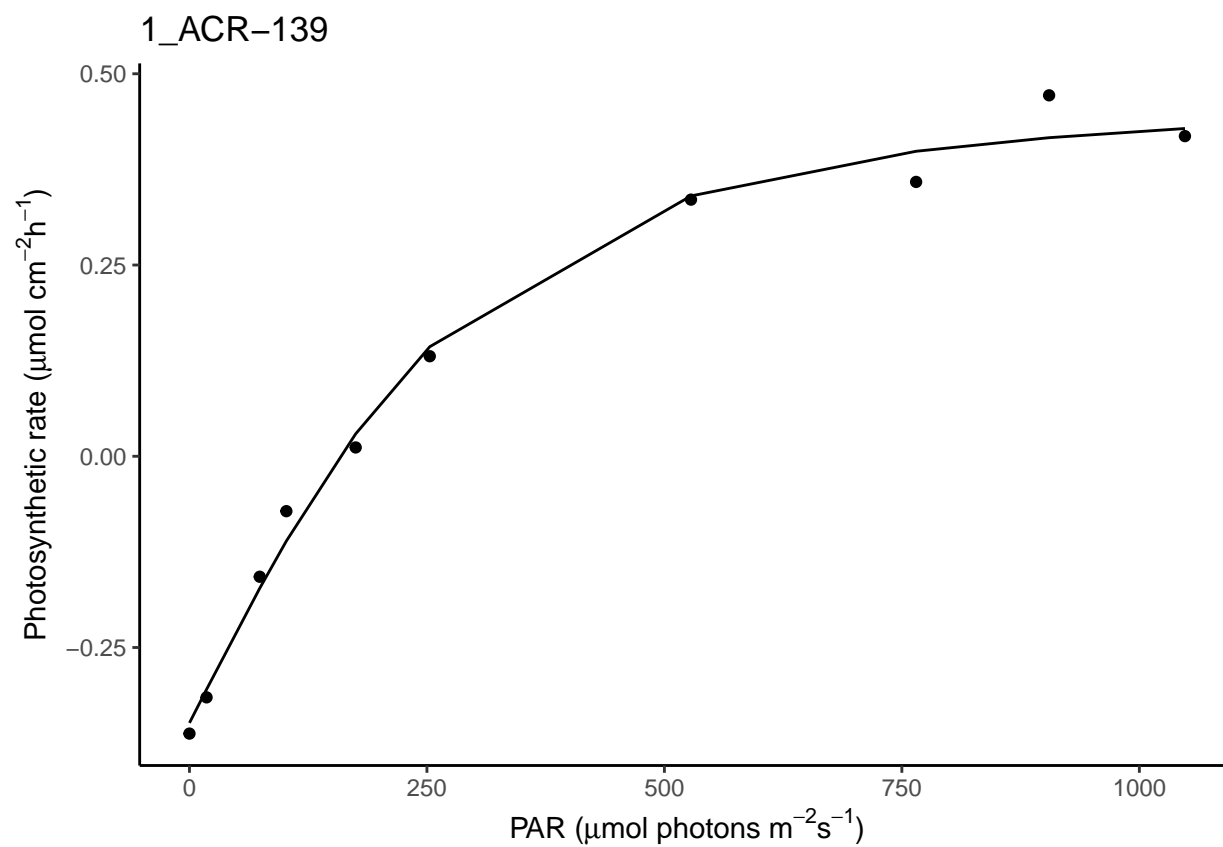
augmented\$colony_id: ACR-176



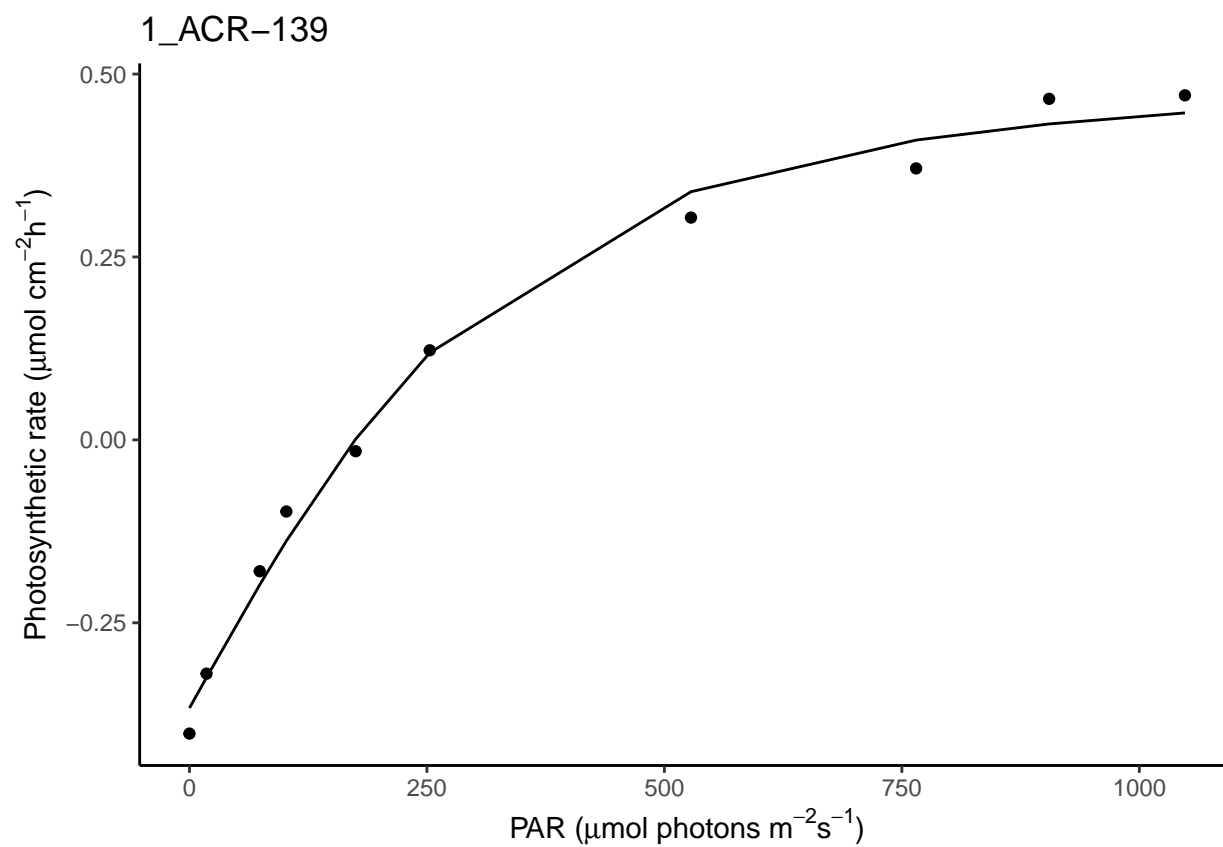
augmented\$colony_id: ACR-178



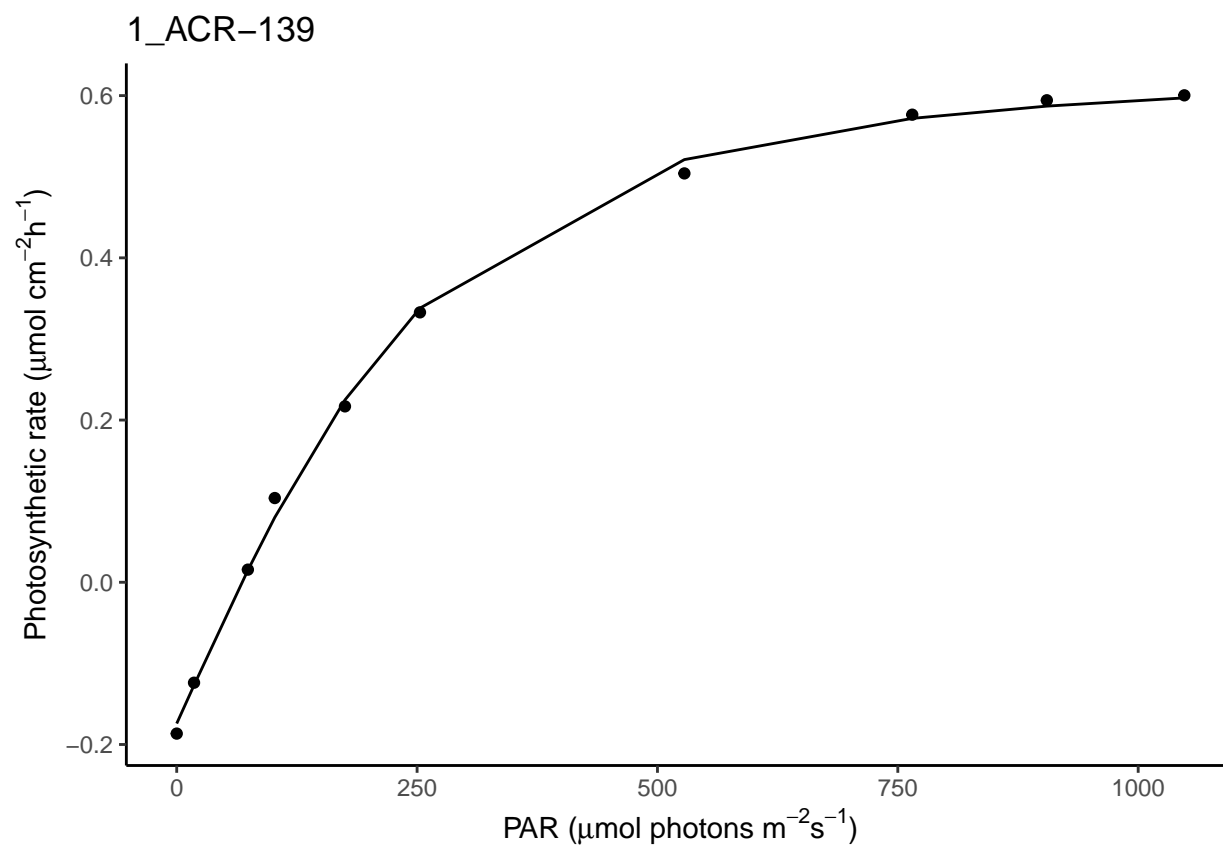
augmented\$colony_id: ACR-180



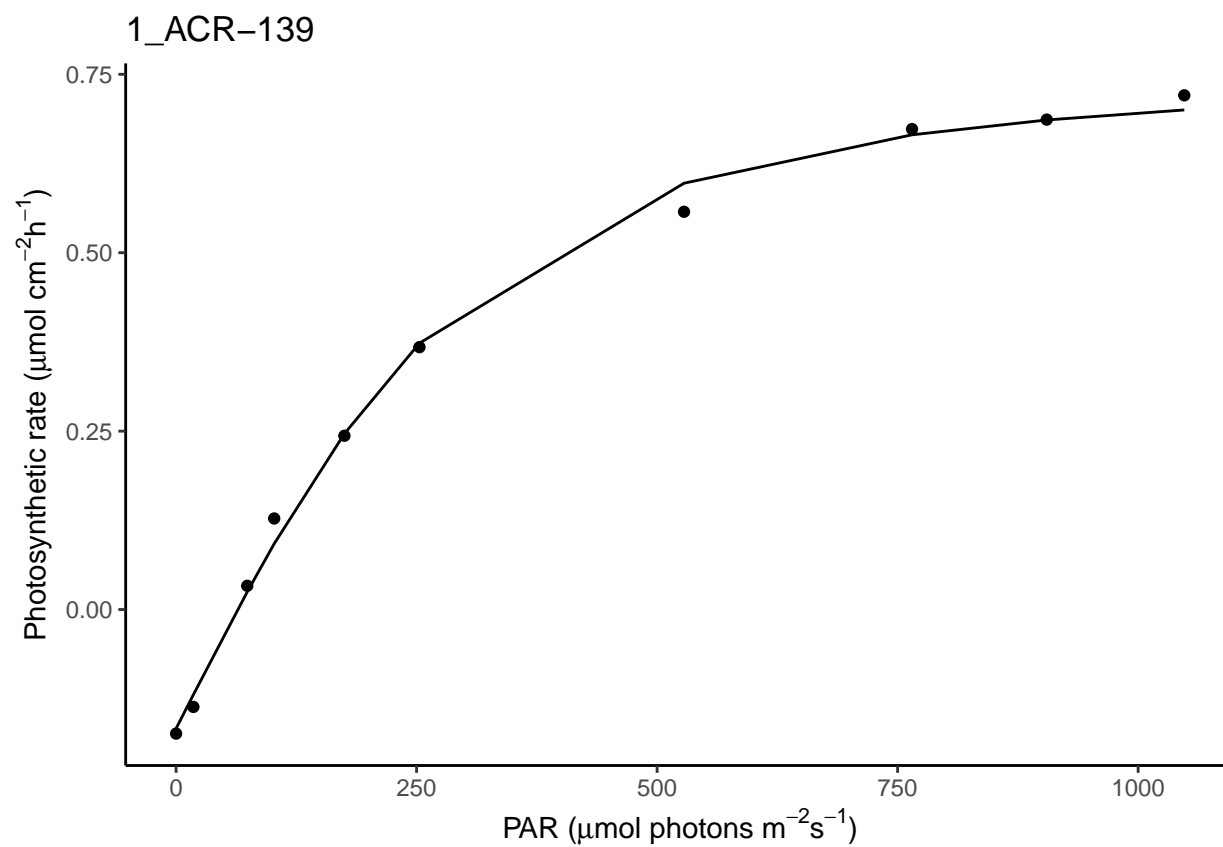
augmented\$colony_id: ACR-185



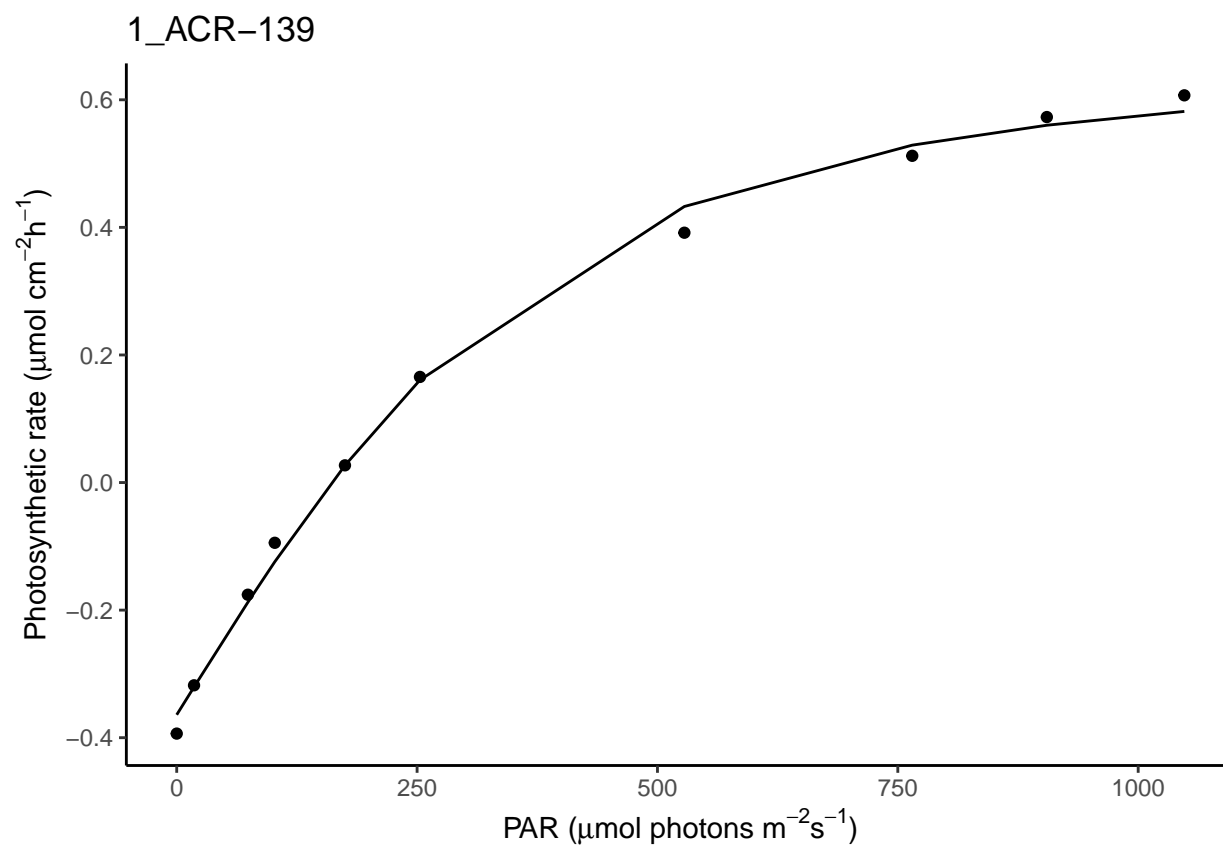
augmented\$colony_id: ACR-186



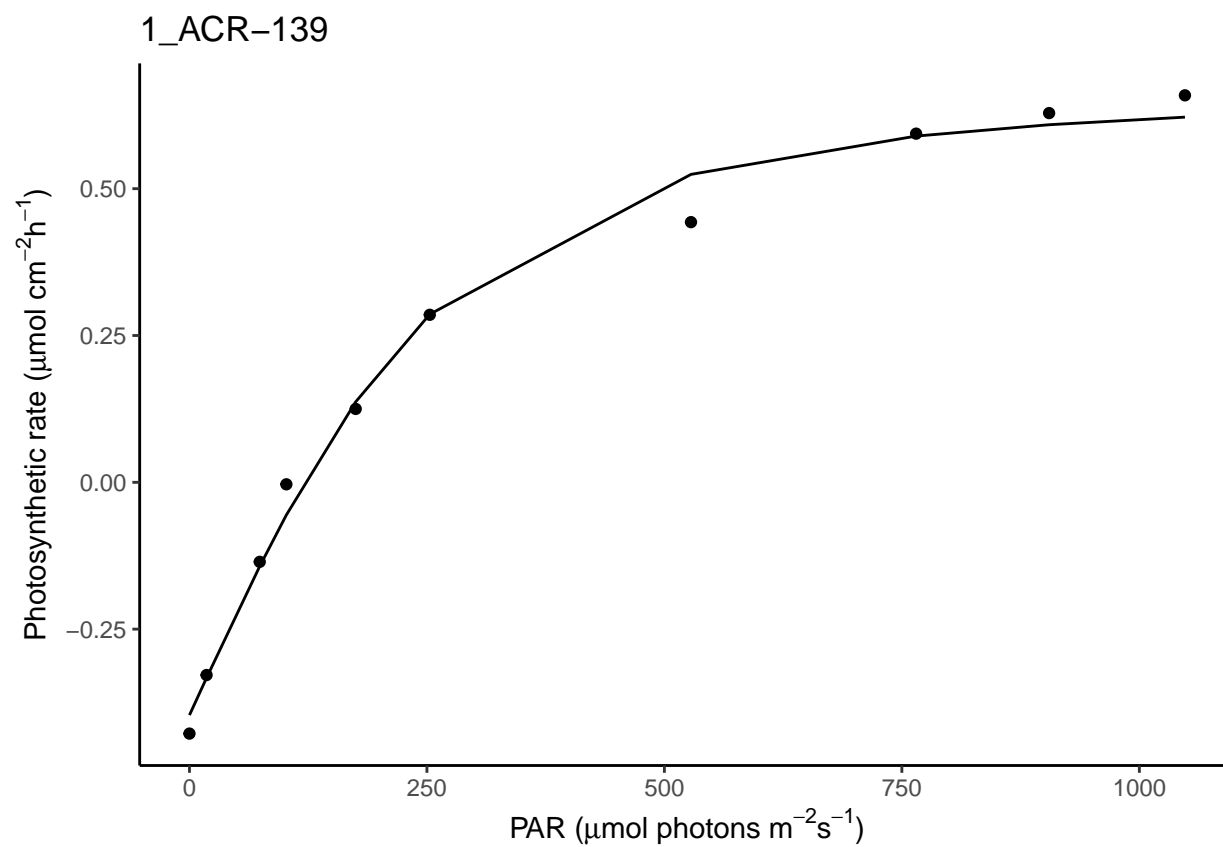
augmented\$colony_id: ACR-187



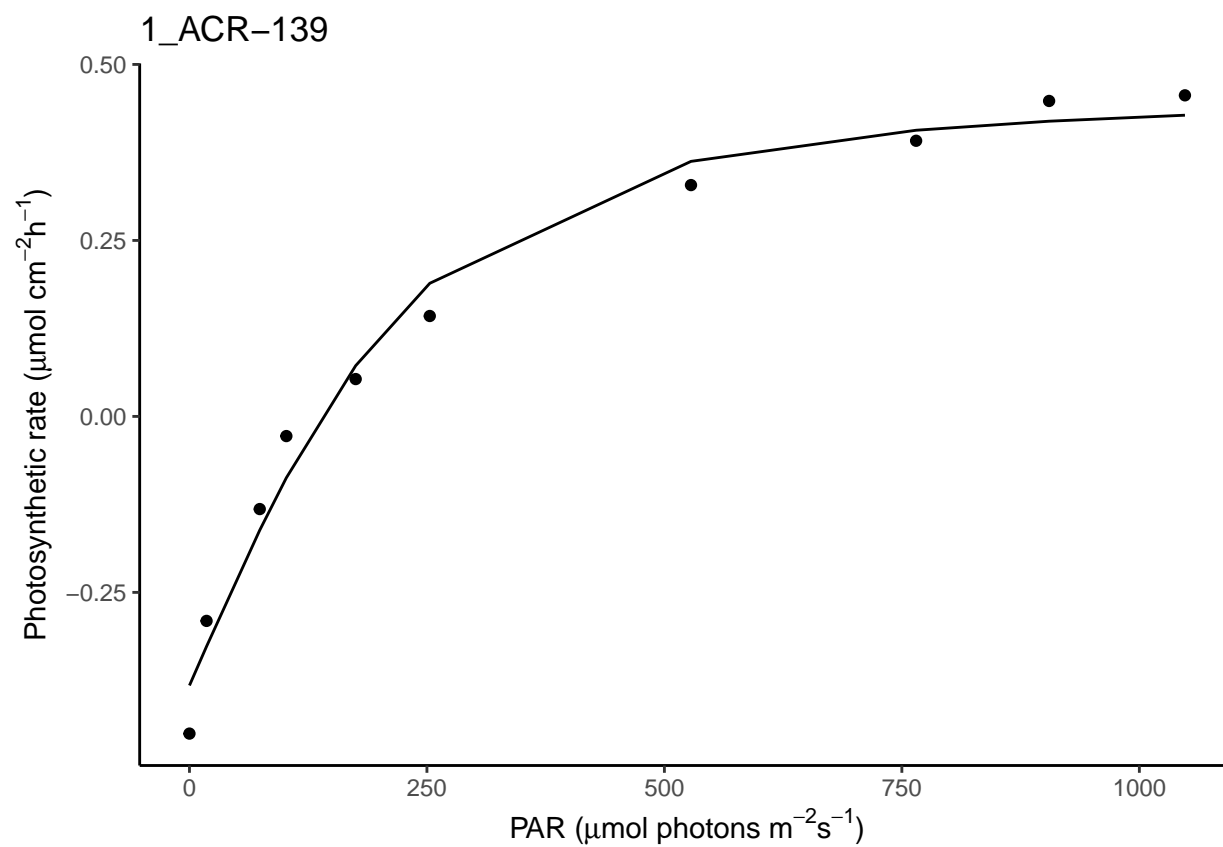
```
## -----  
## augmented$colony_id: ACR-210
```



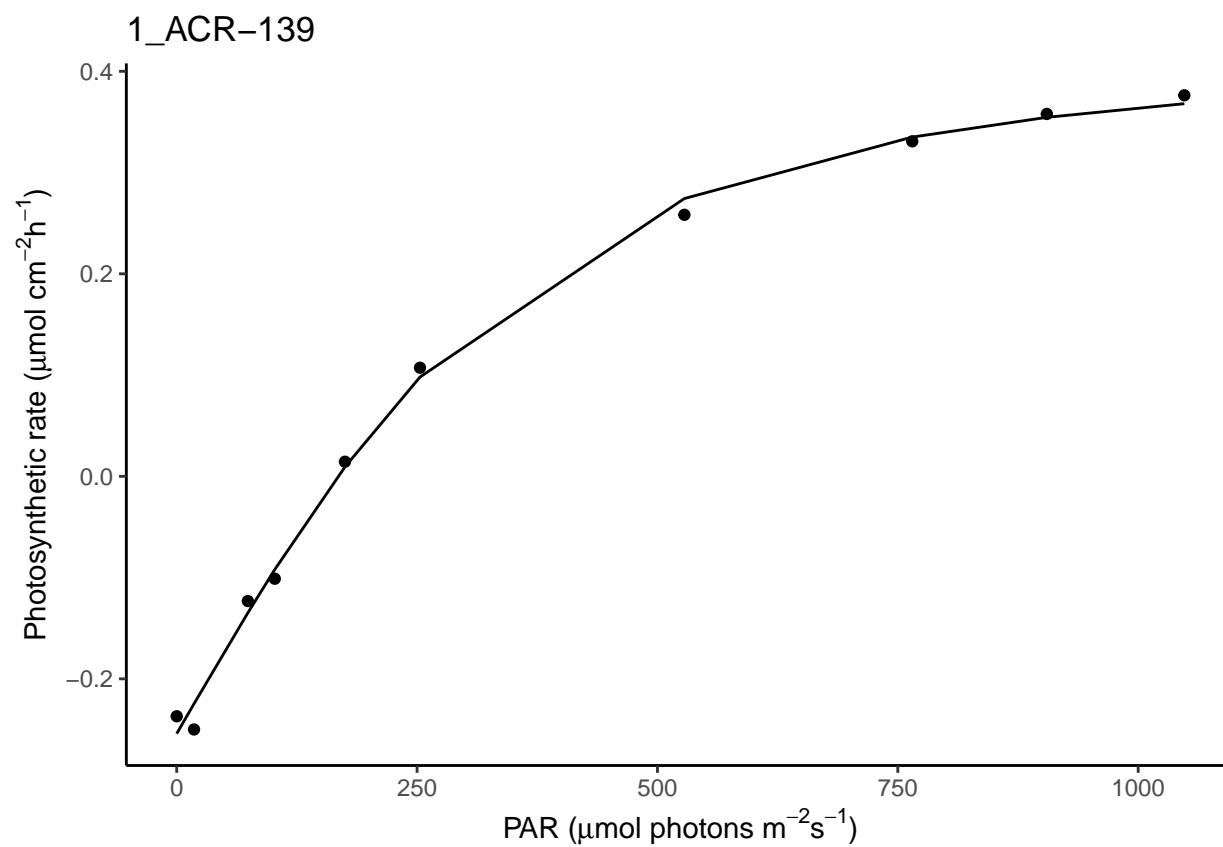
augmented\$colony_id: ACR-213



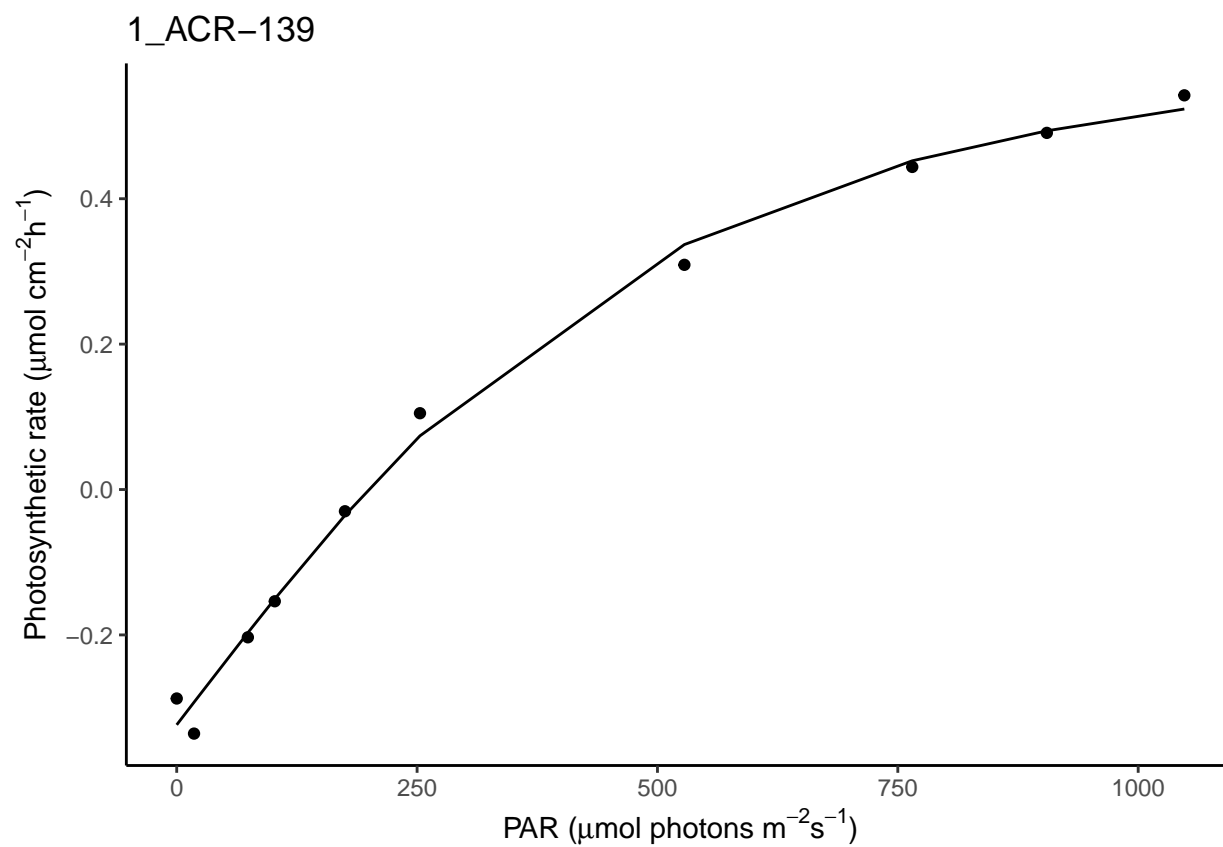
augmented\$colony_id: ACR-218



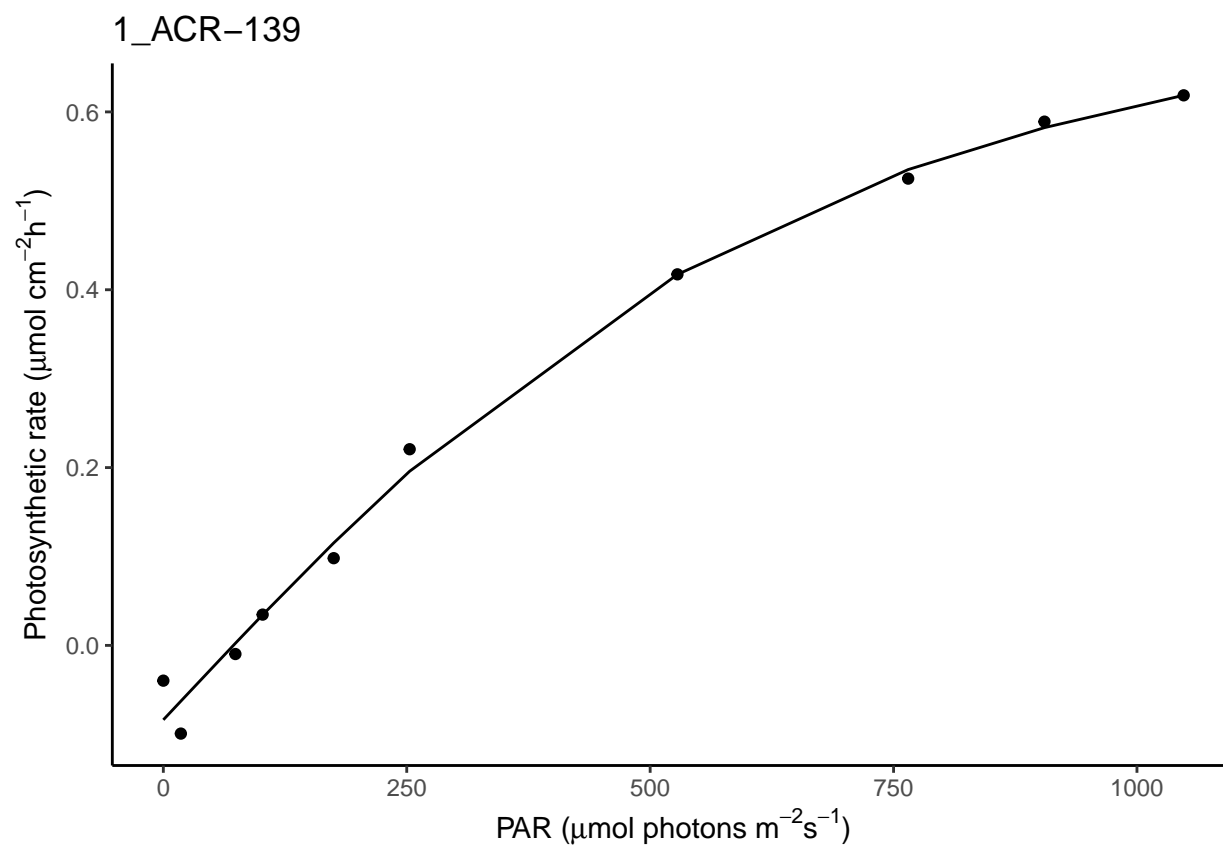
```
## -----  
## augmented$colony_id: ACR-220
```



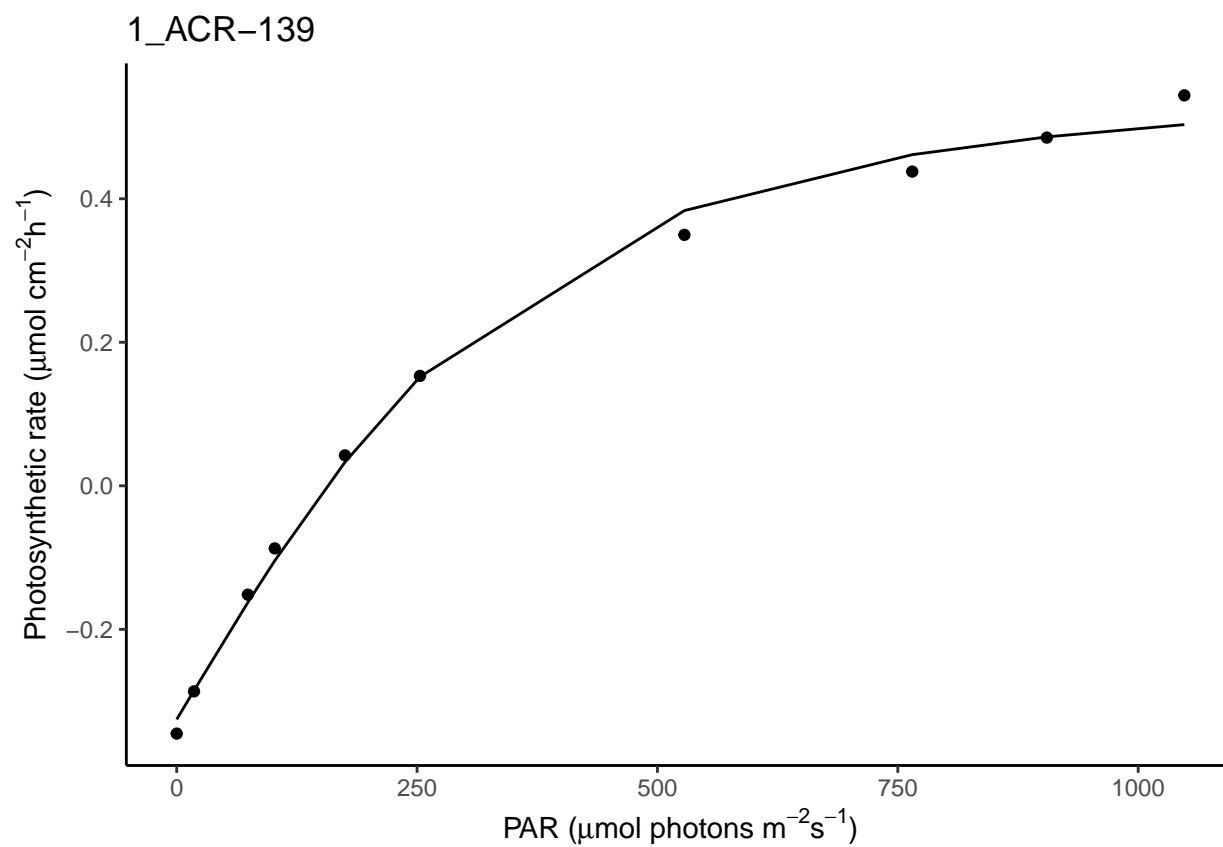
```
## -----  
## augmented$colony_id: ACR-225
```



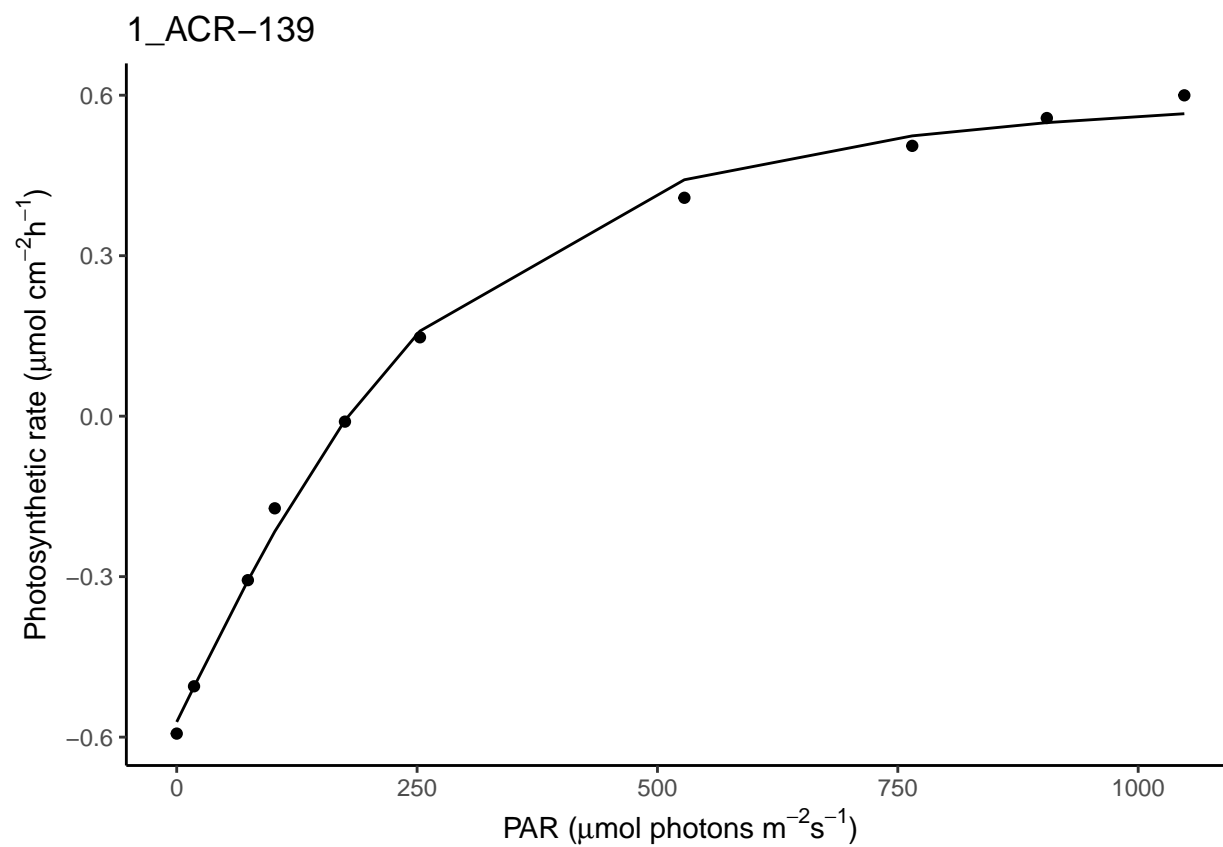
augmented\$colony_id: ACR-229



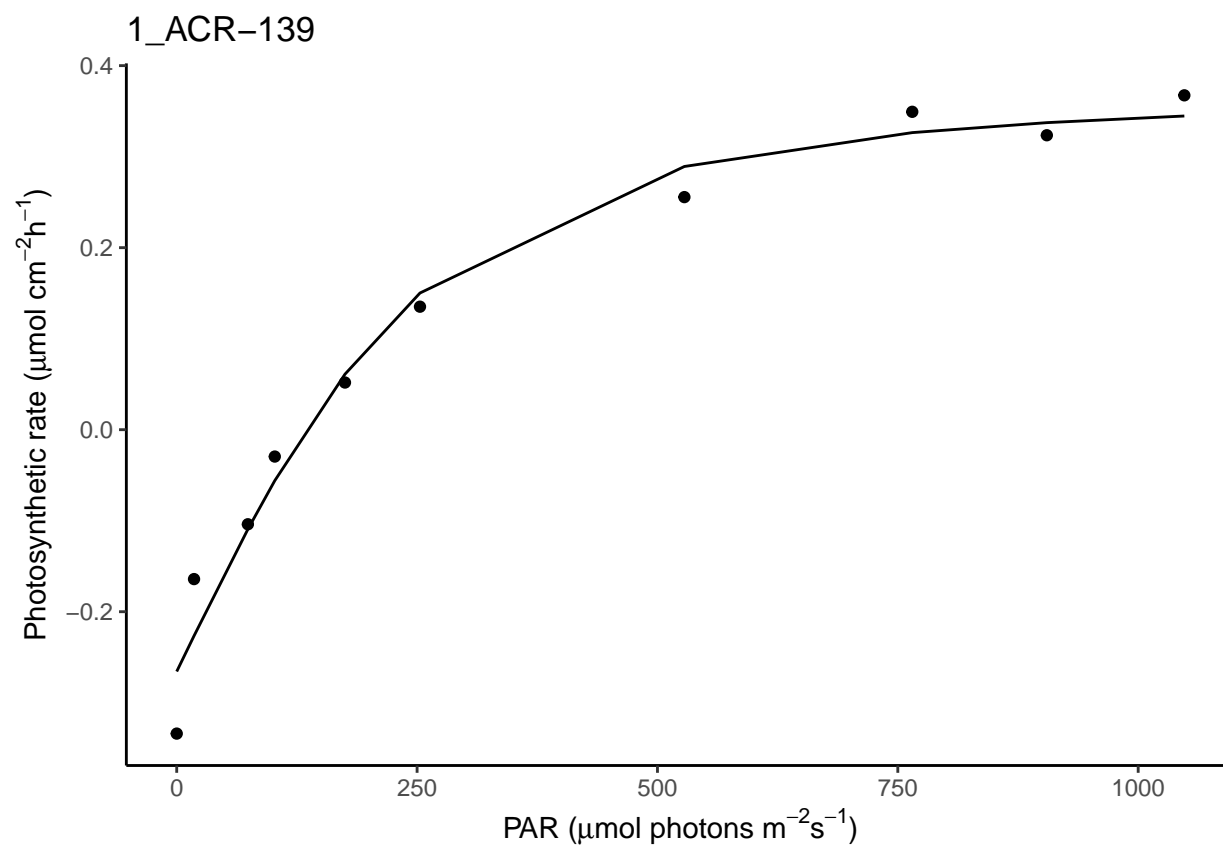
```
## -----  
## augmented$colony_id: ACR-234
```



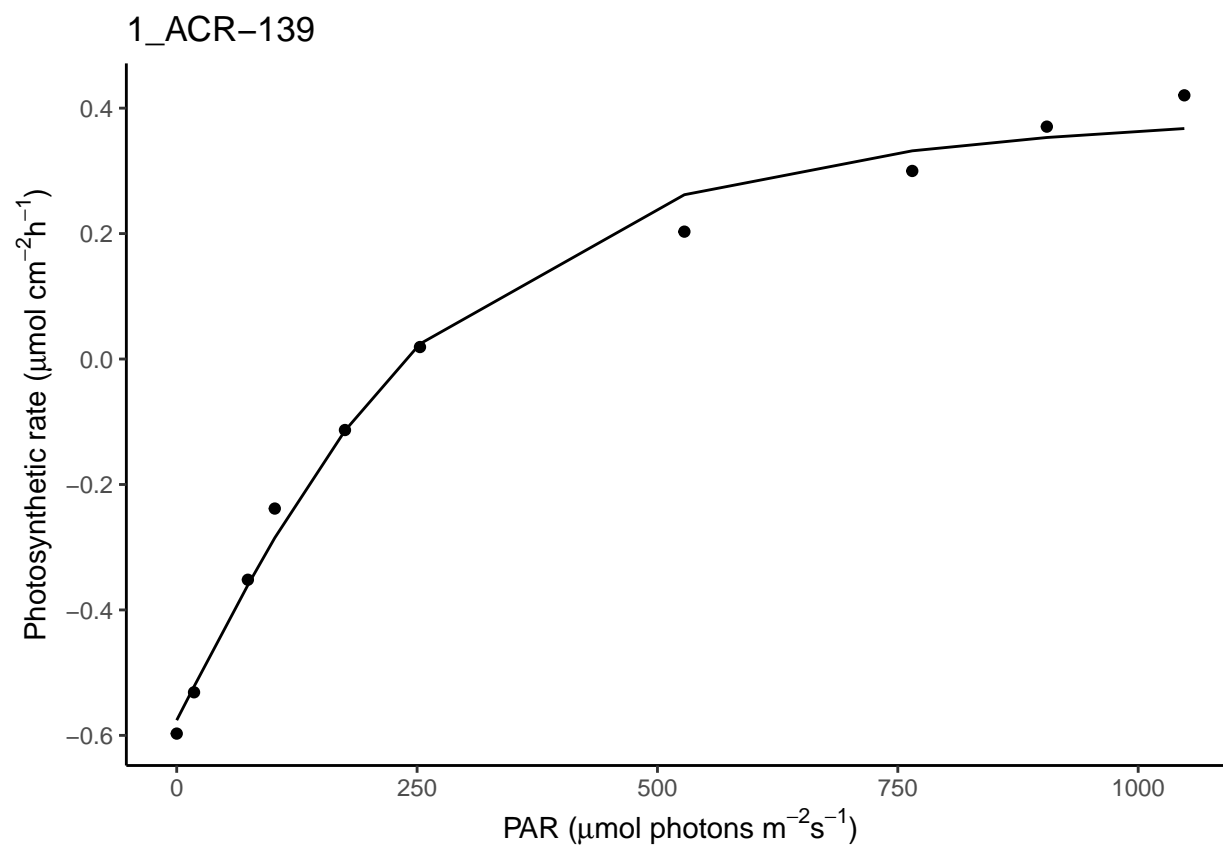
augmented\$colony_id: ACR-237



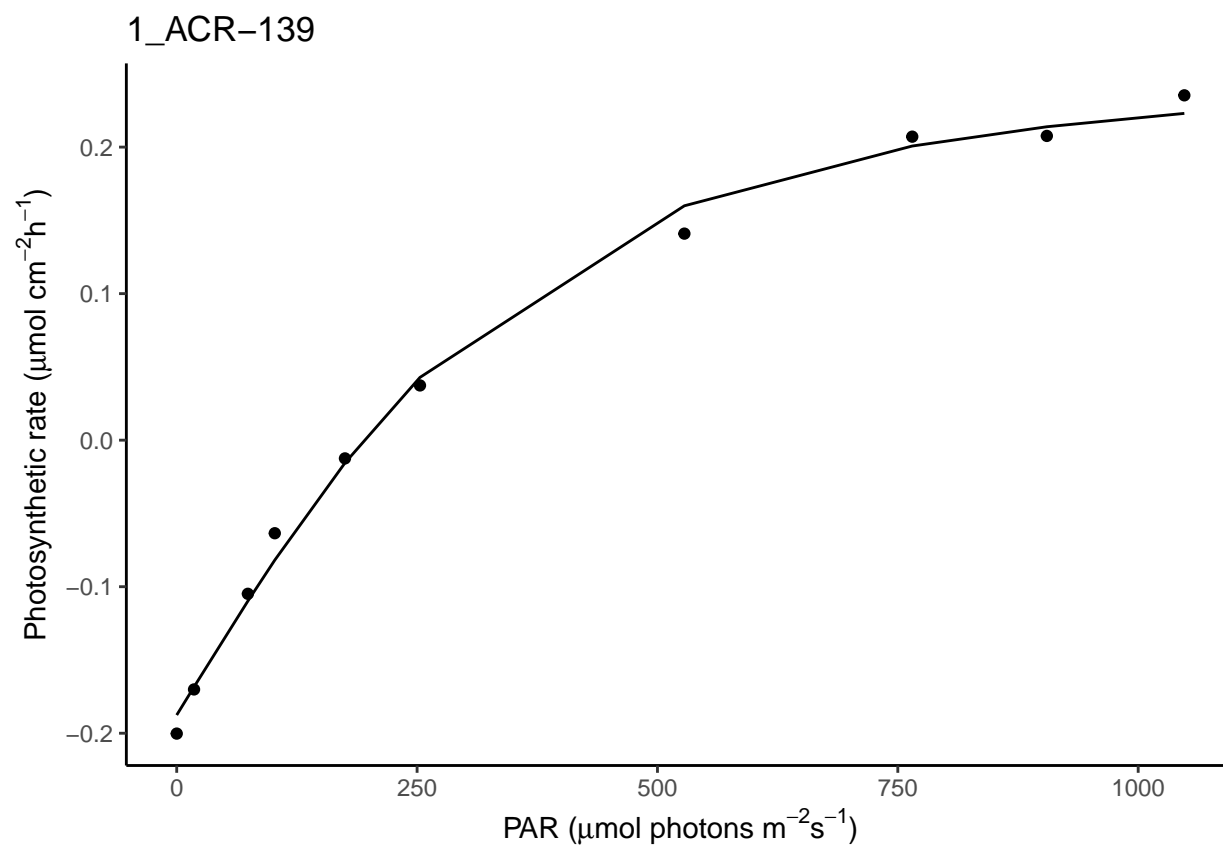
```
## -----  
## augmented$colony_id: ACR-241
```



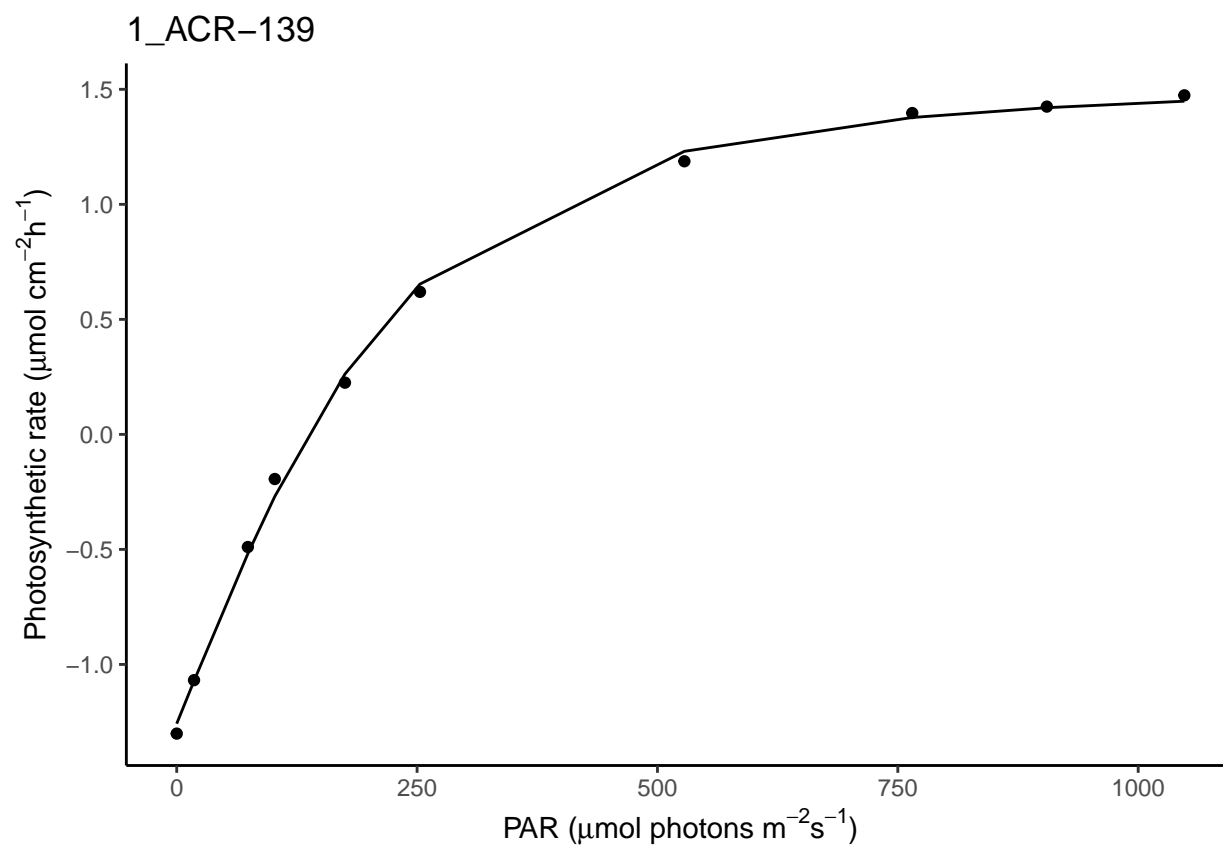
augmented\$colony_id: ACR-244



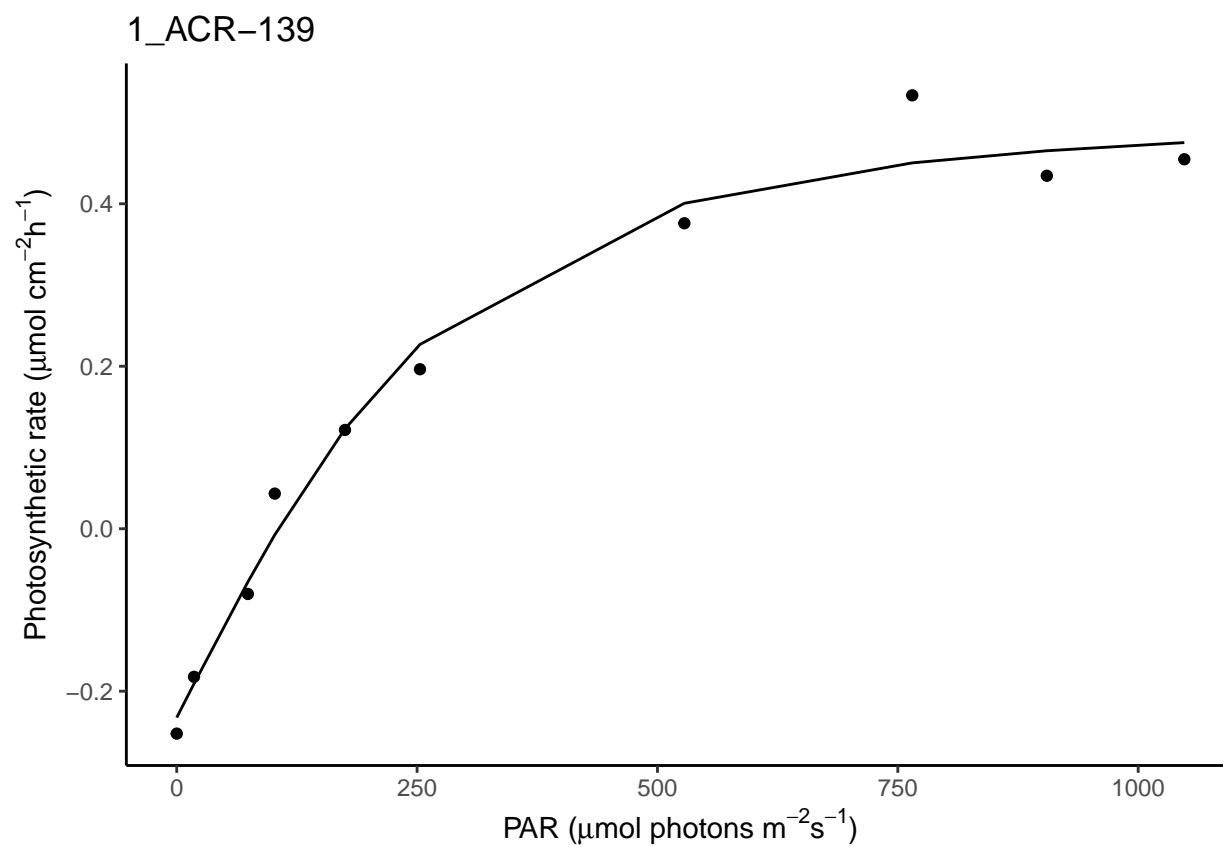
augmented\$colony_id: ACR-256



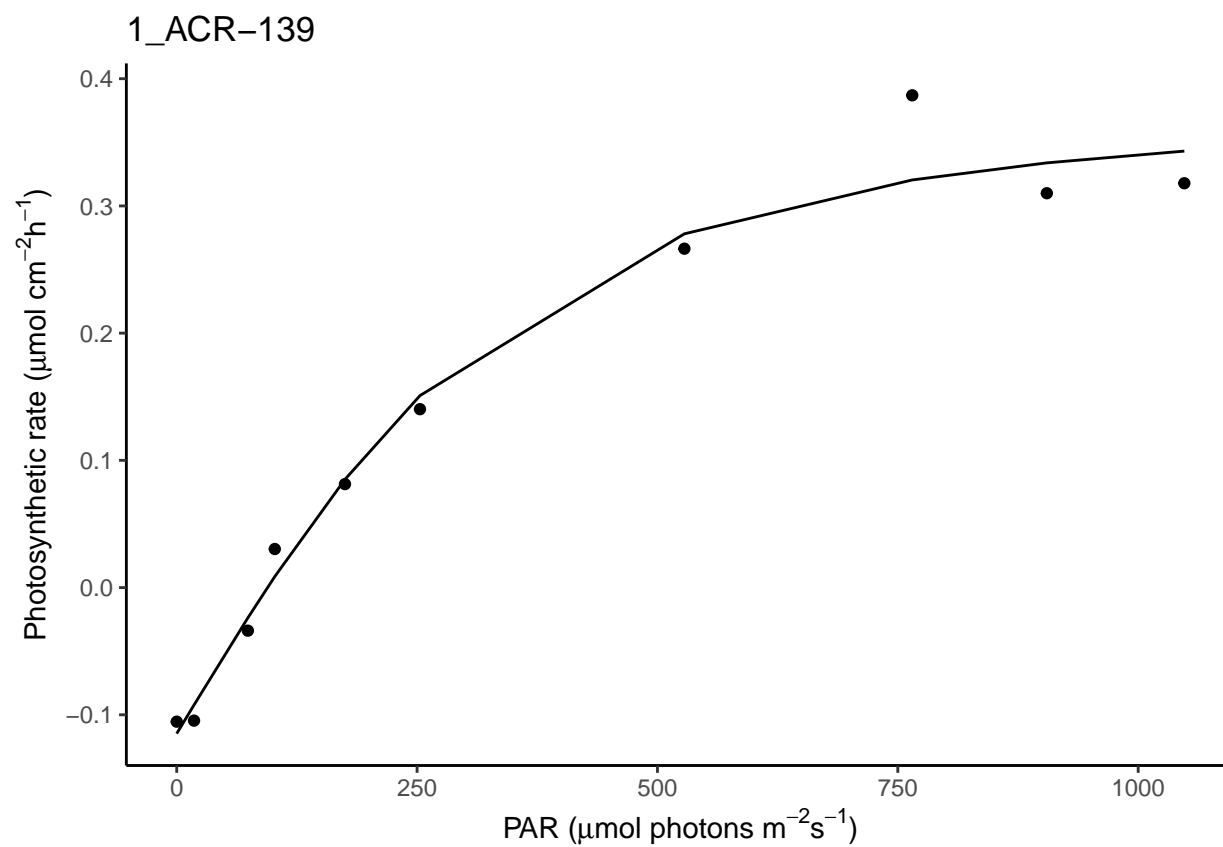
augmented\$colony_id: ACR-267



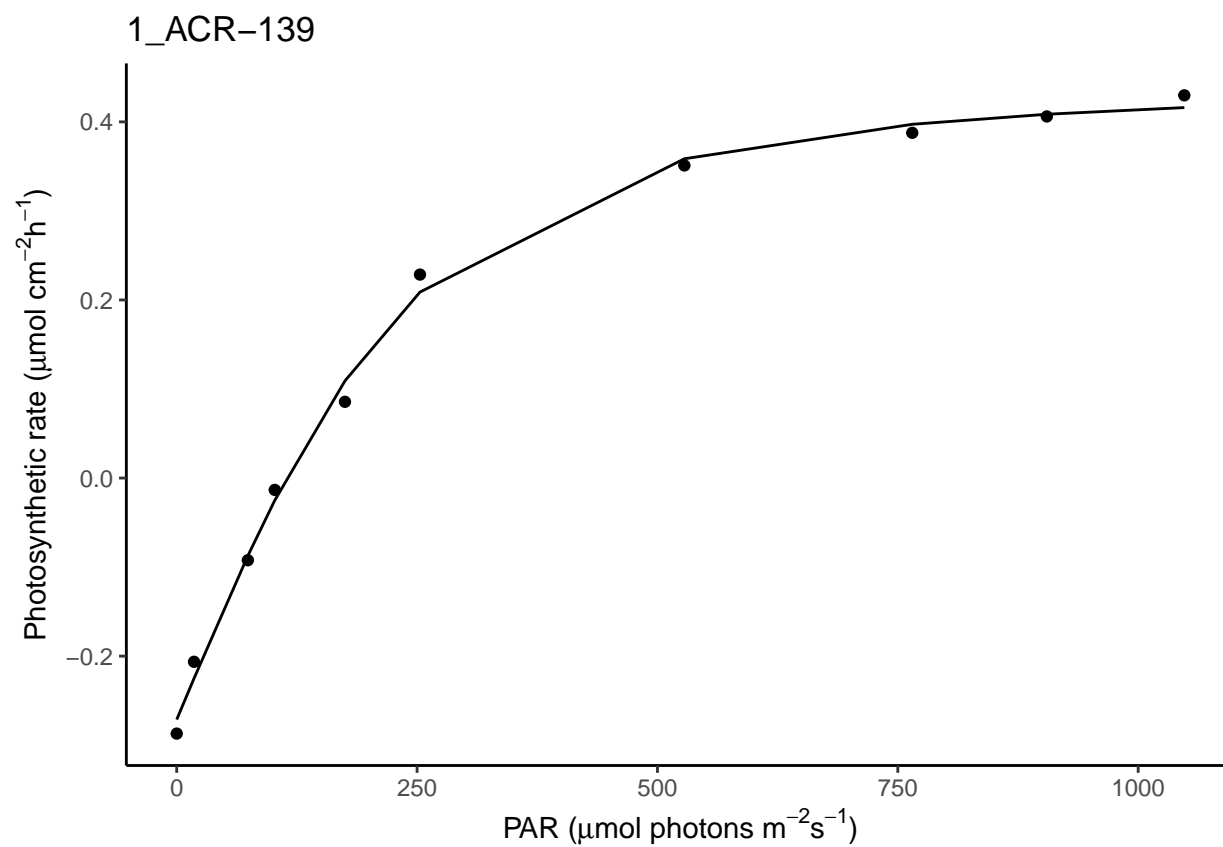
augmented\$colony_id: ACR-343



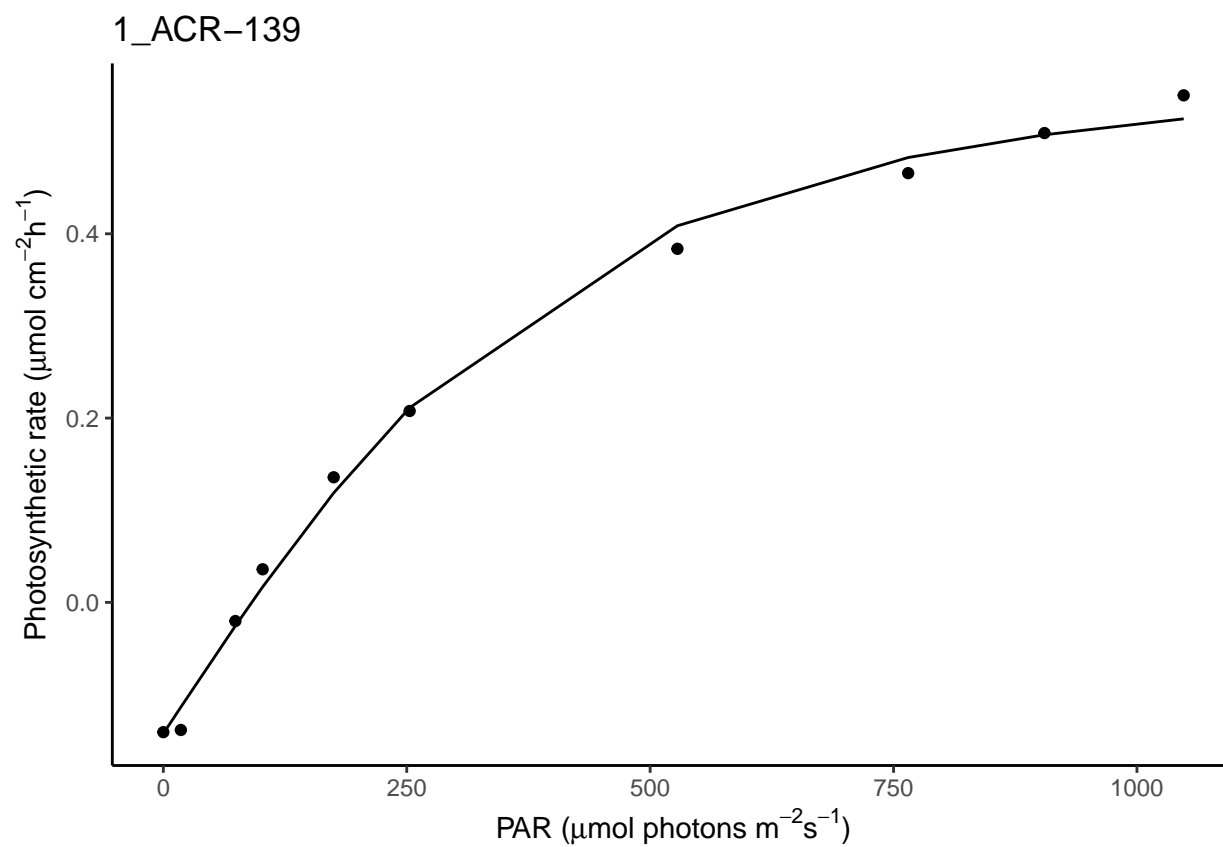
augmented\$colony_id: ACR-368



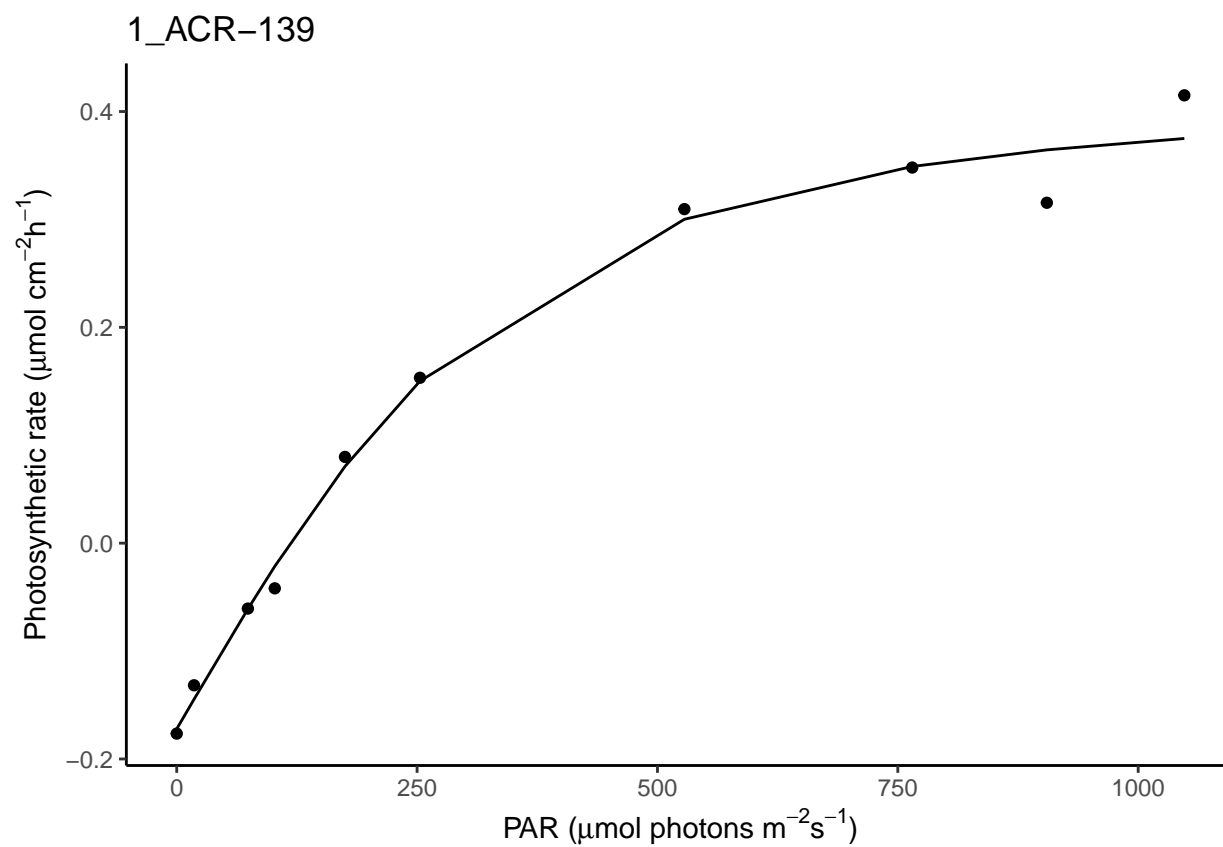
augmented\$colony_id: ACR-389



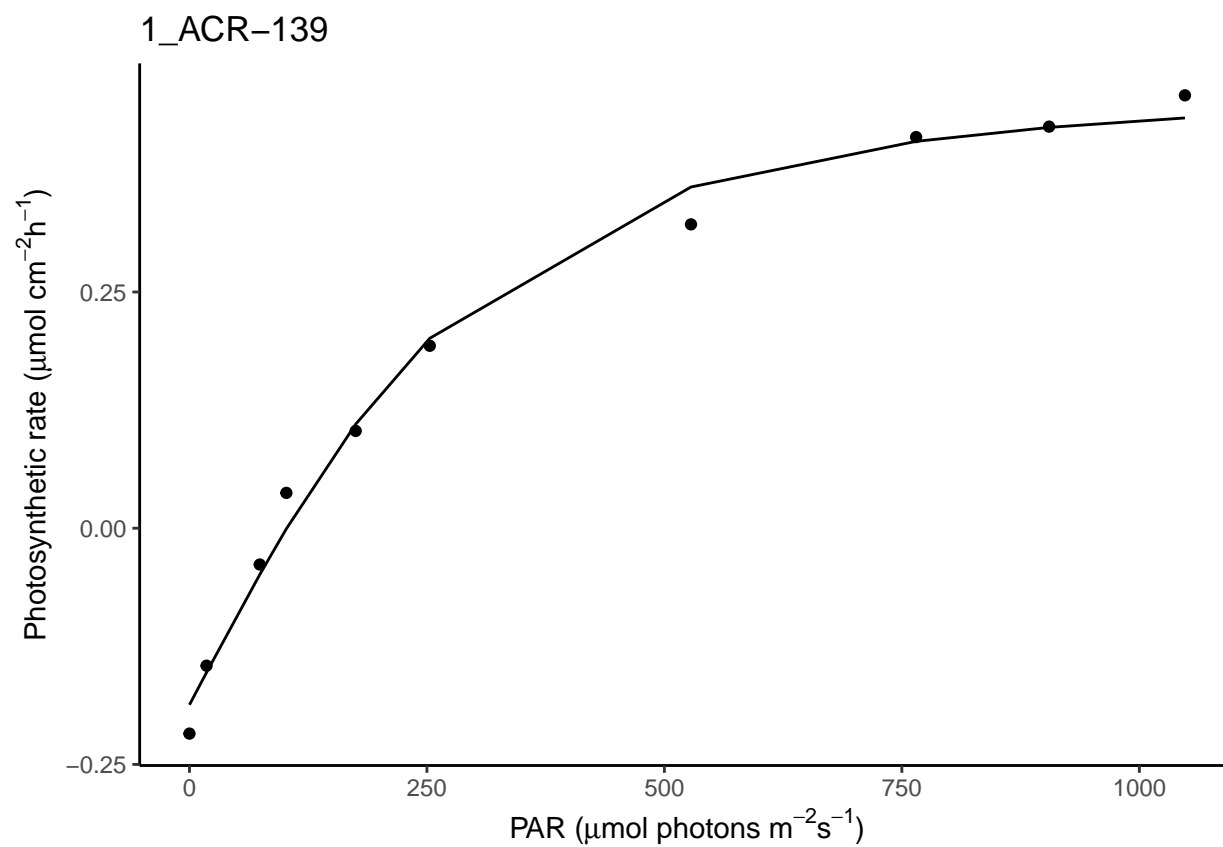
augmented\$colony_id: ACR-390



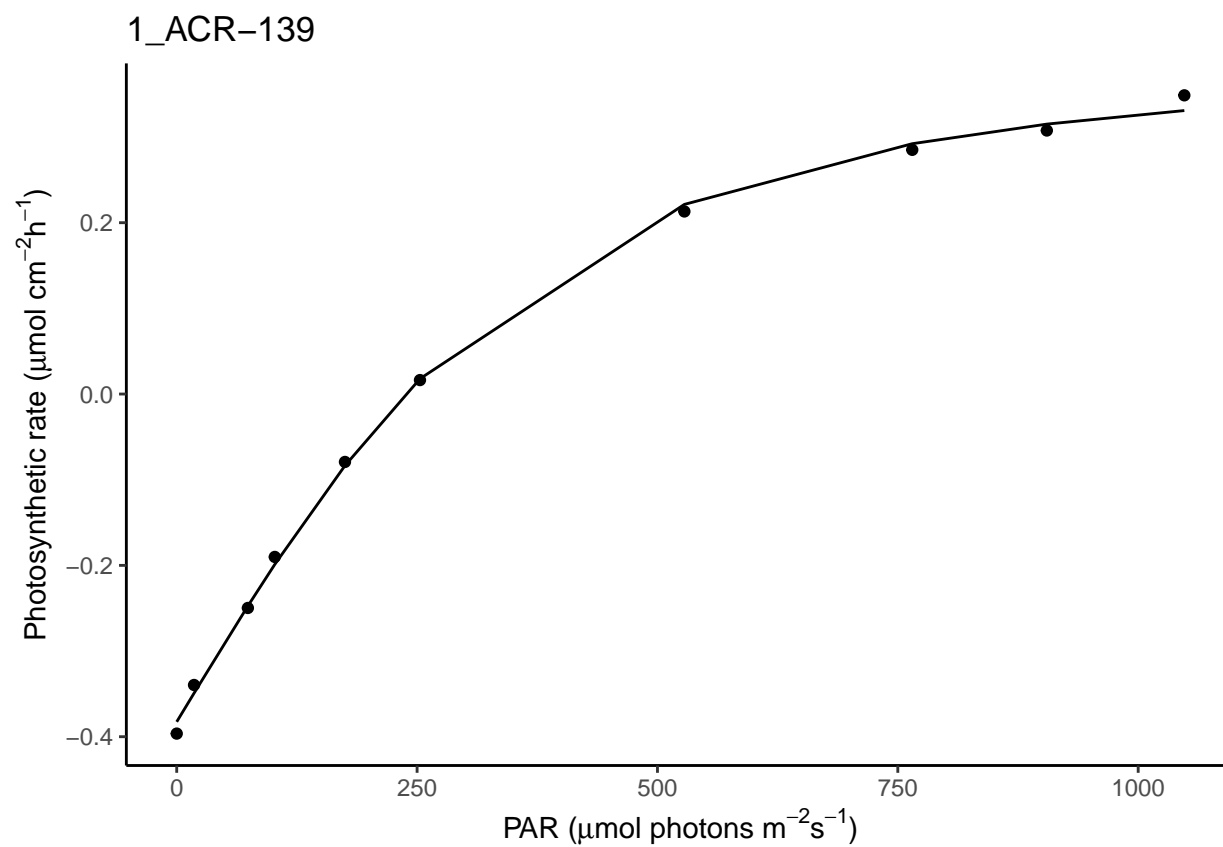
```
## -----  
## augmented$colony_id: ACR-393
```



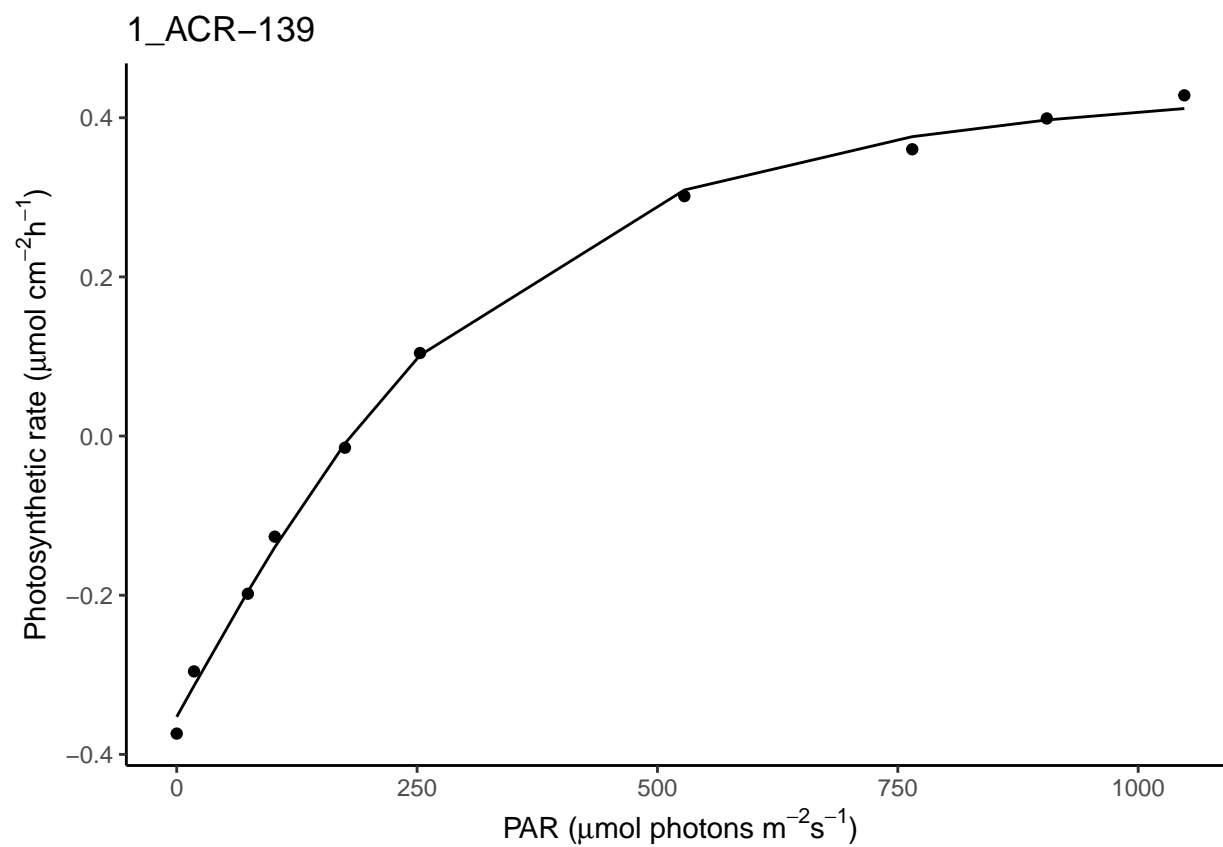
augmented\$colony_id: ACR-396



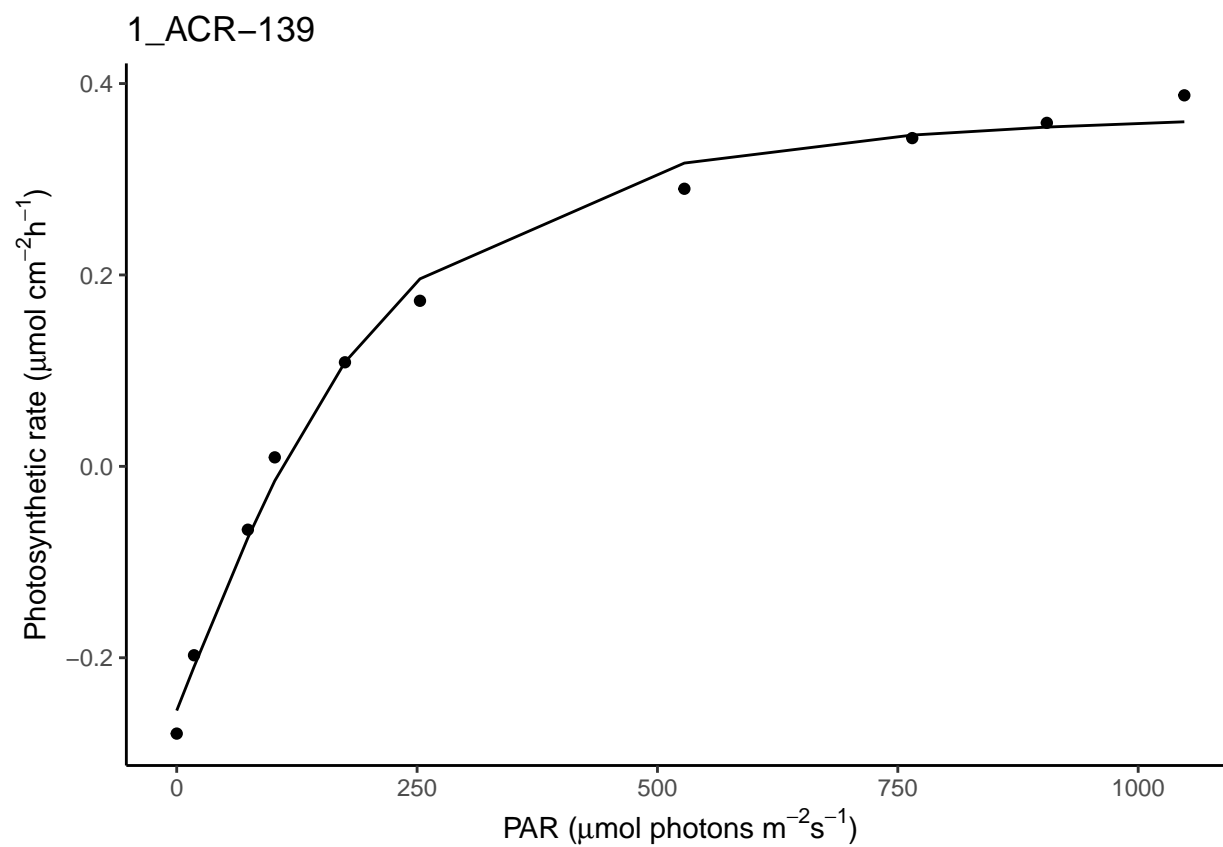
augmented\$colony_id: POC-200



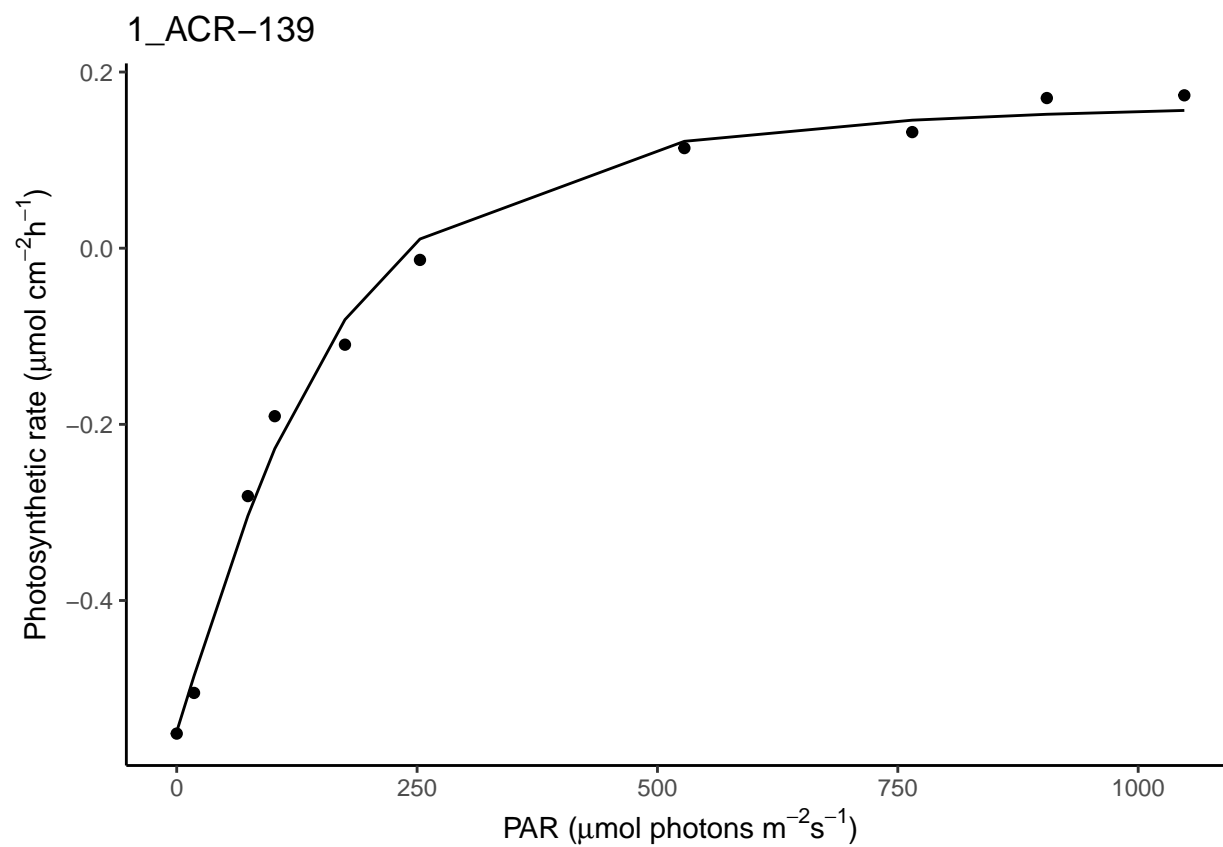
augmented\$colony_id: POC-205



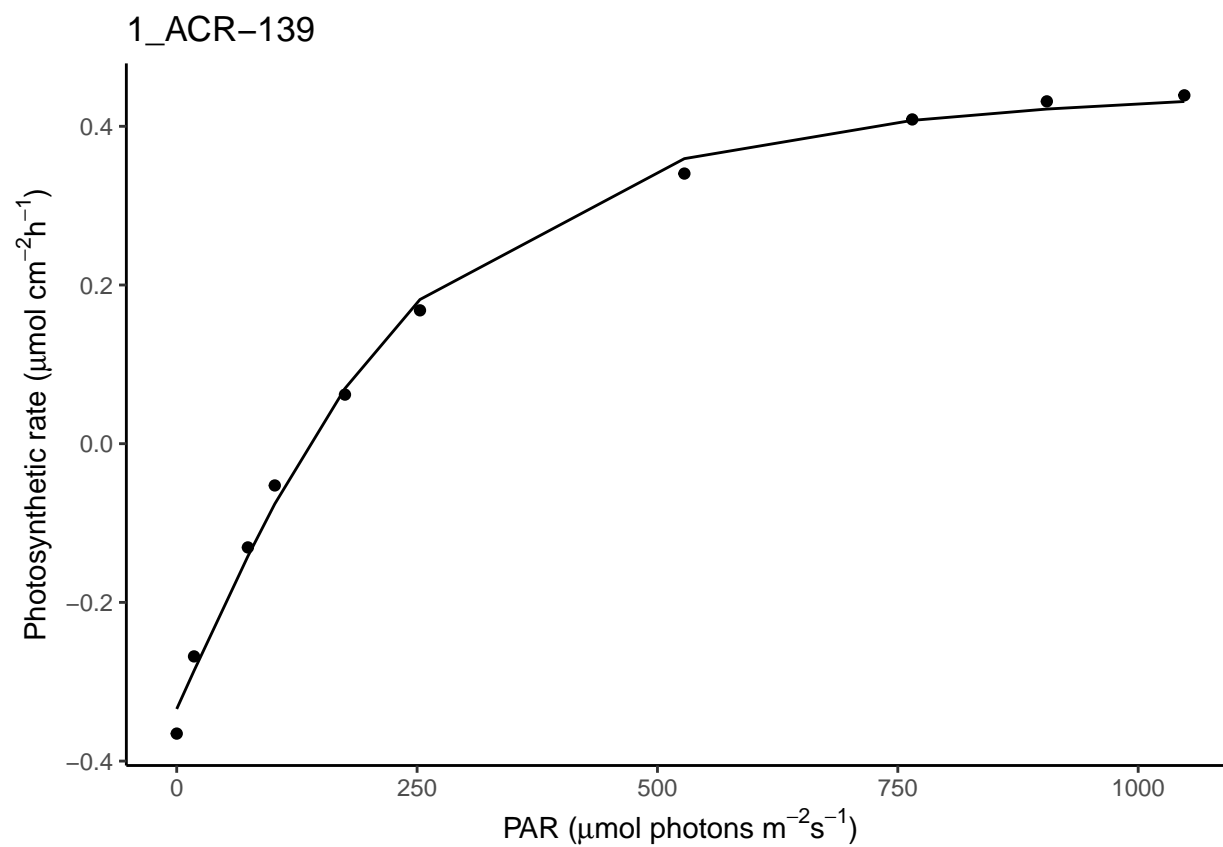
augmented\$colony_id: POC-207



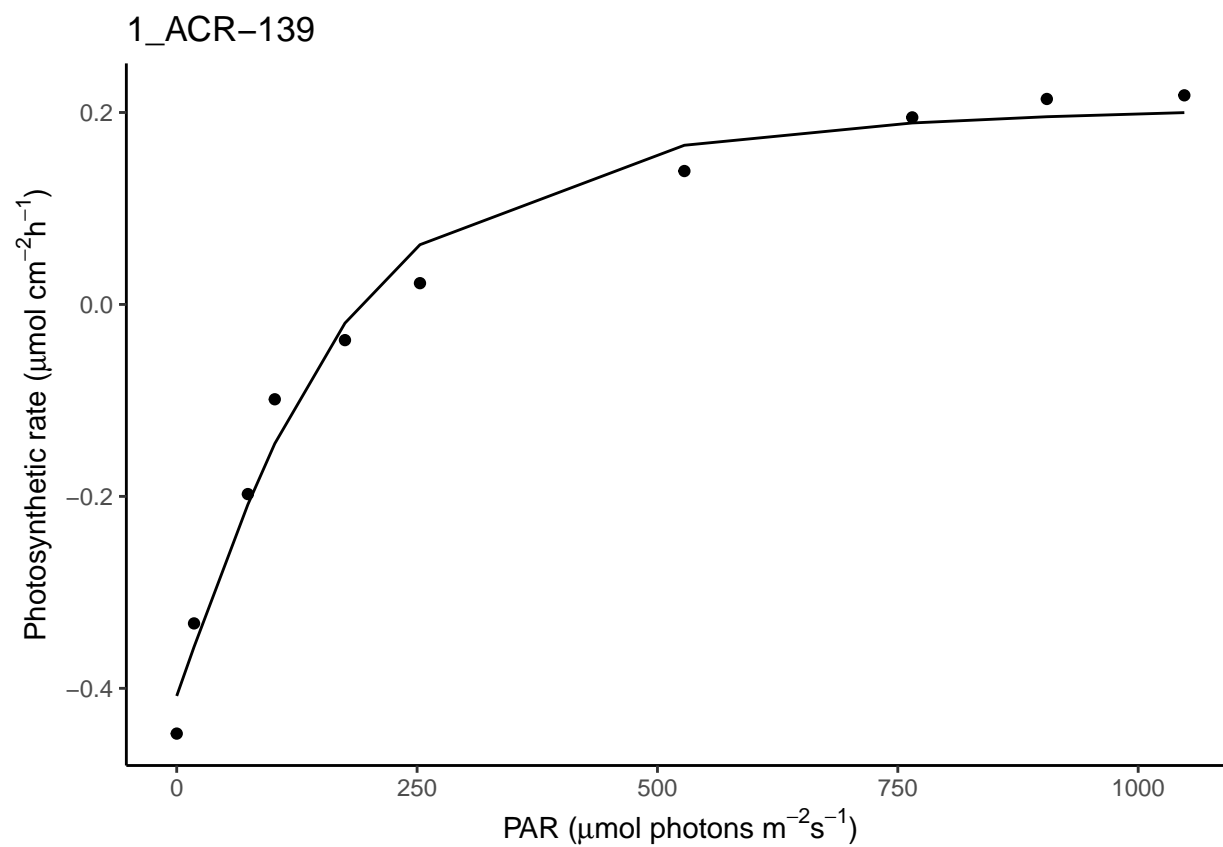
augmented\$colony_id: POC-219



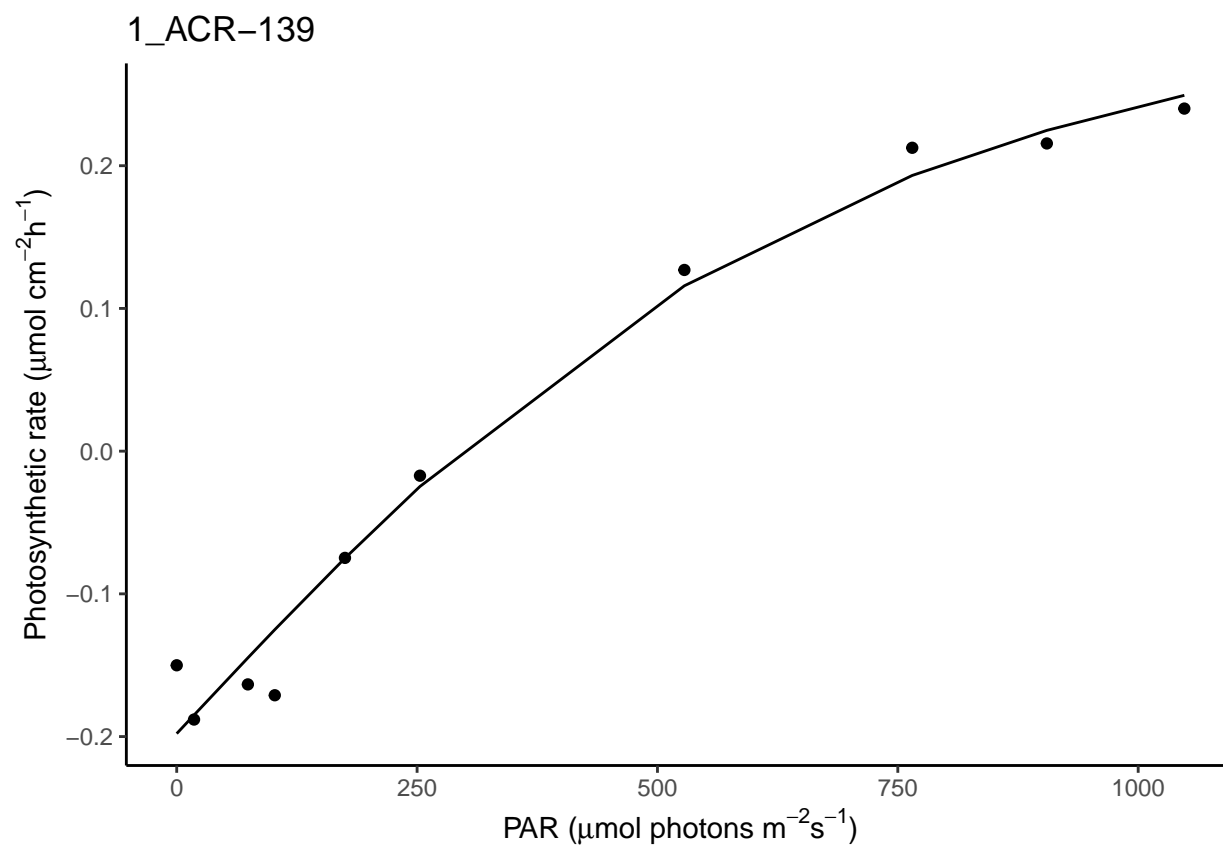
```
## -----  
## augmented$colony_id: P0C-222
```



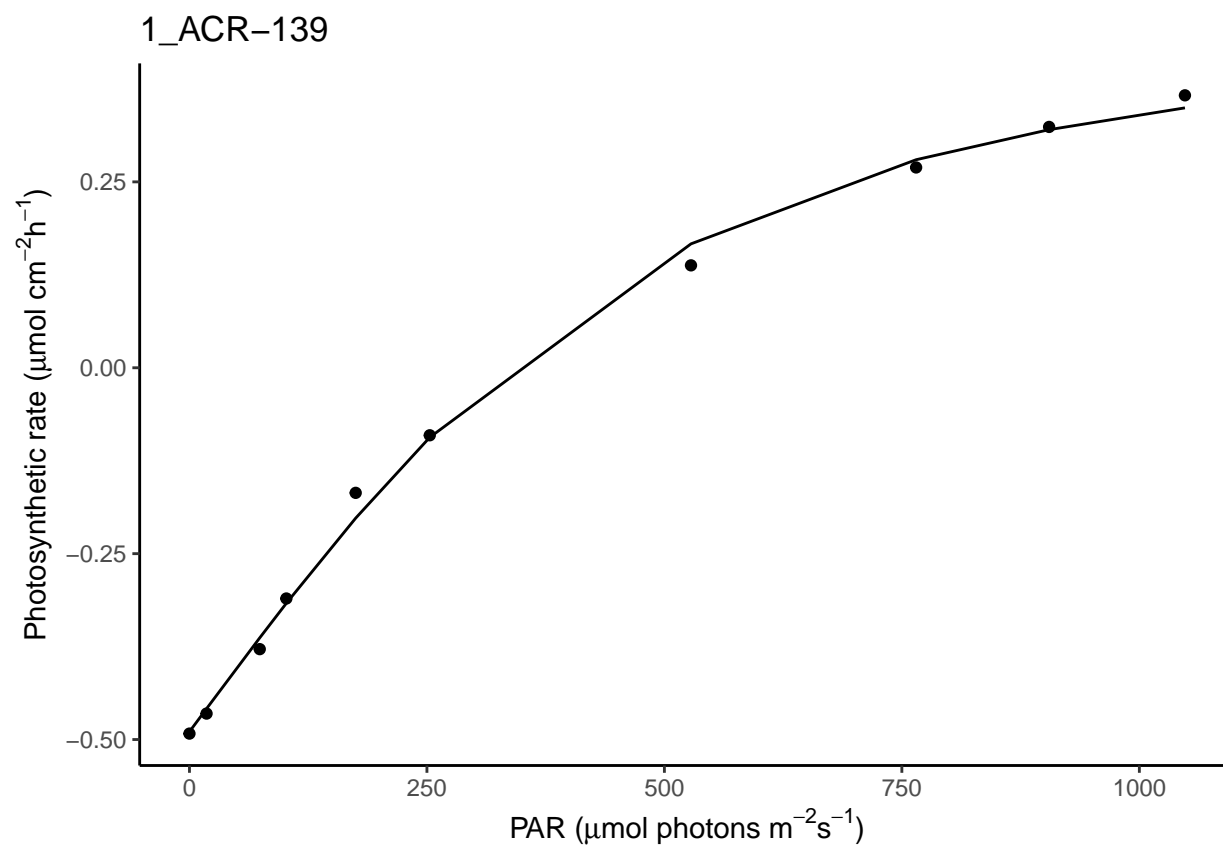
augmented\$colony_id: P0C-238



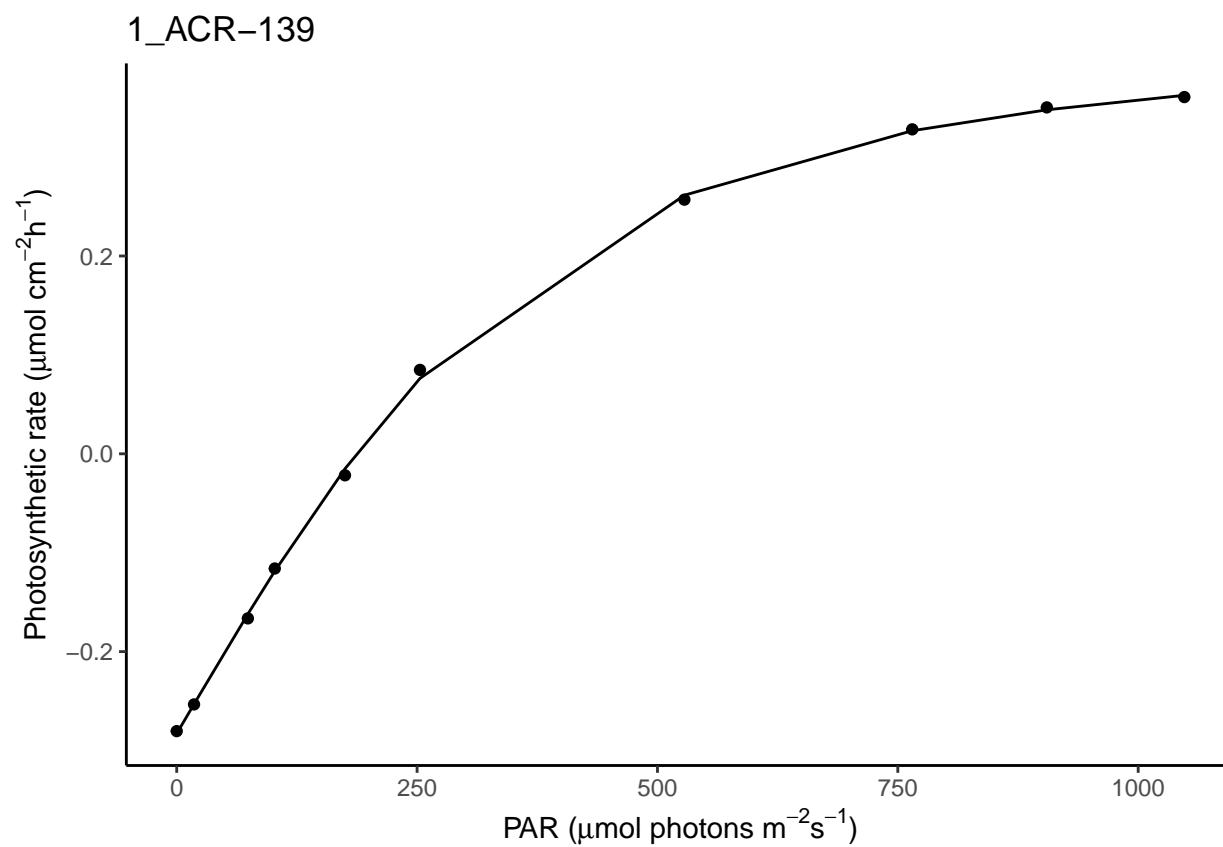
augmented\$colony_id: P0C-239



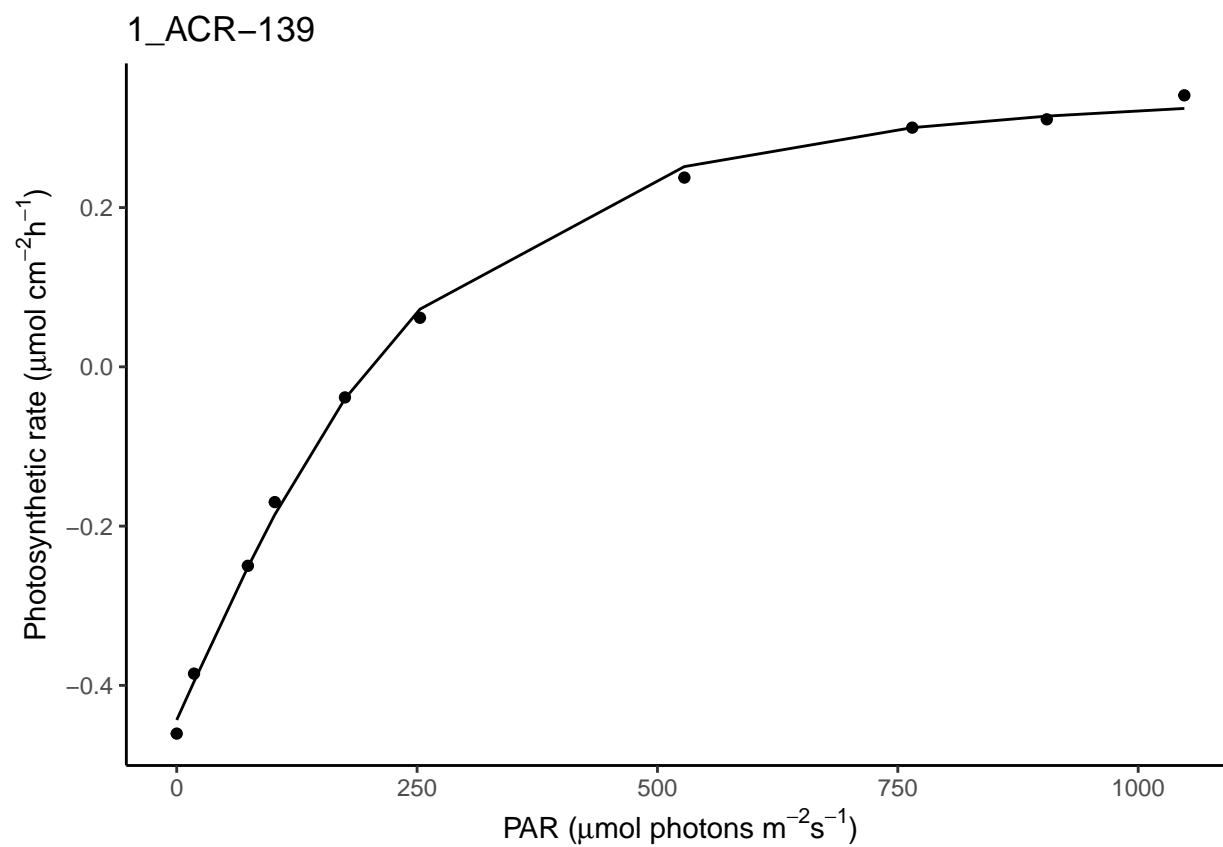
```
## -----  
## augmented$colony_id: POC-248
```



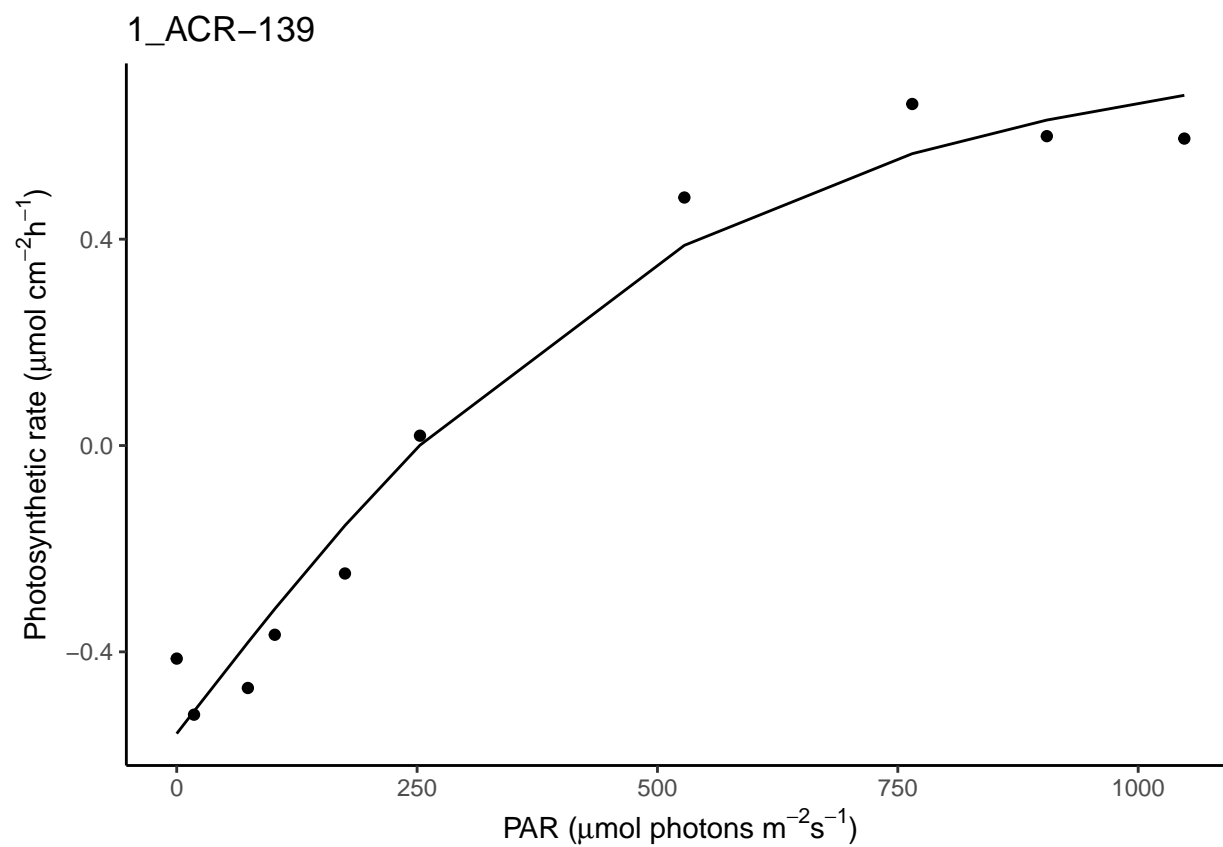
augmented\$colony_id: P0C-254



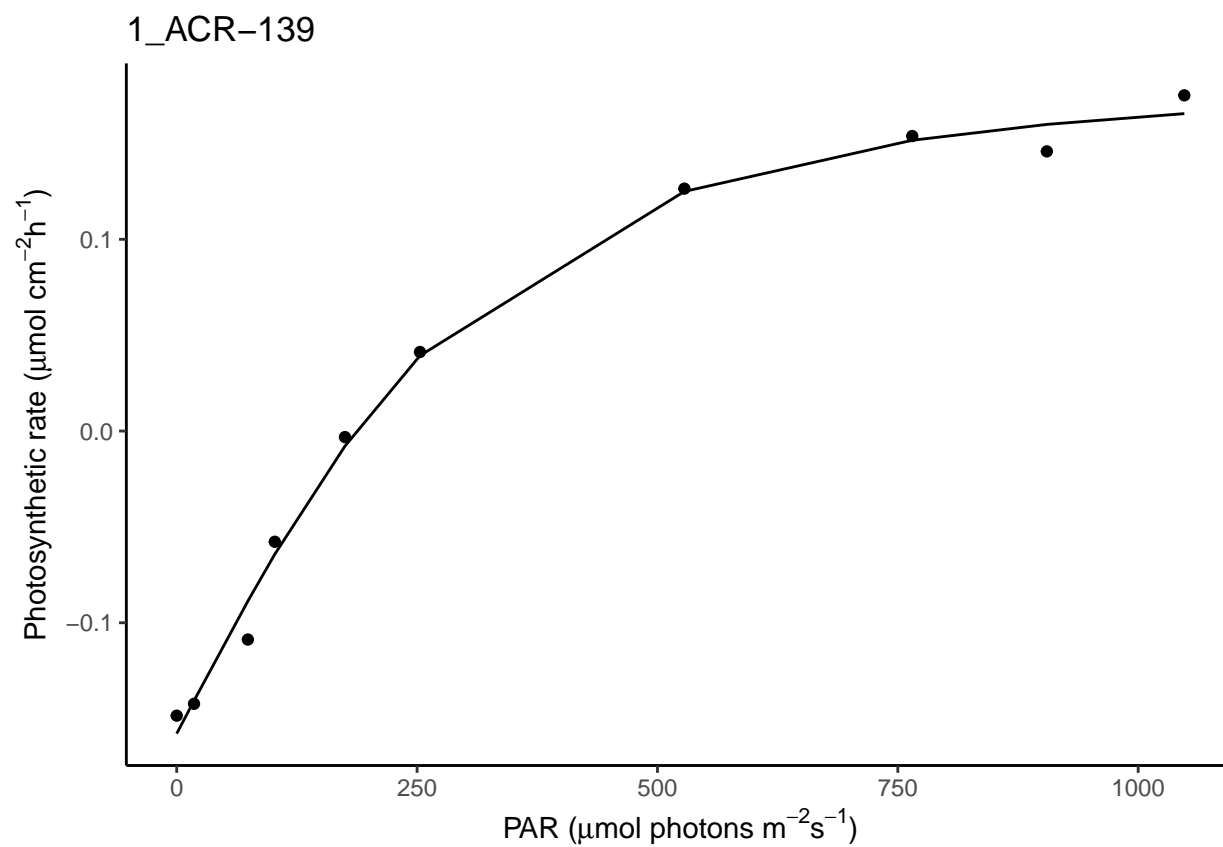
augmented\$colony_id: P0C-255



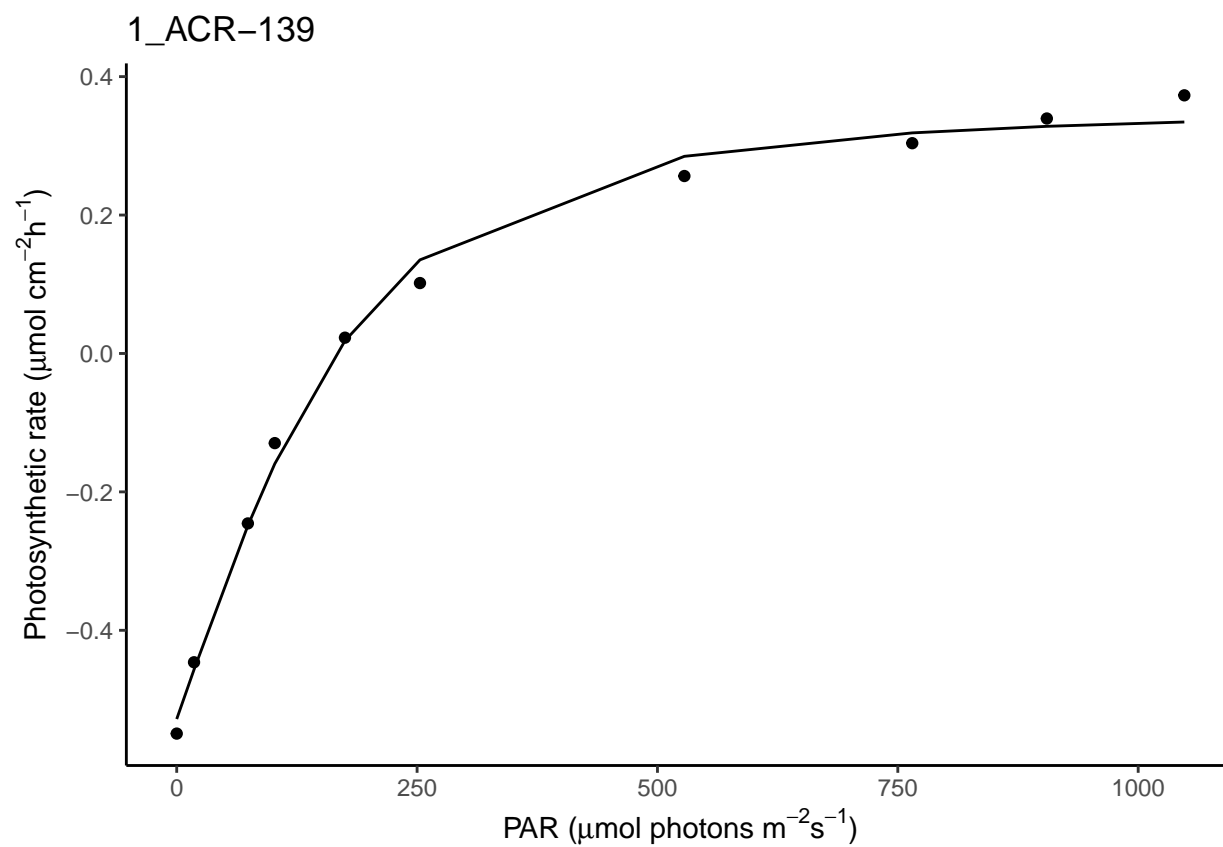
augmented\$colony_id: P0C-257



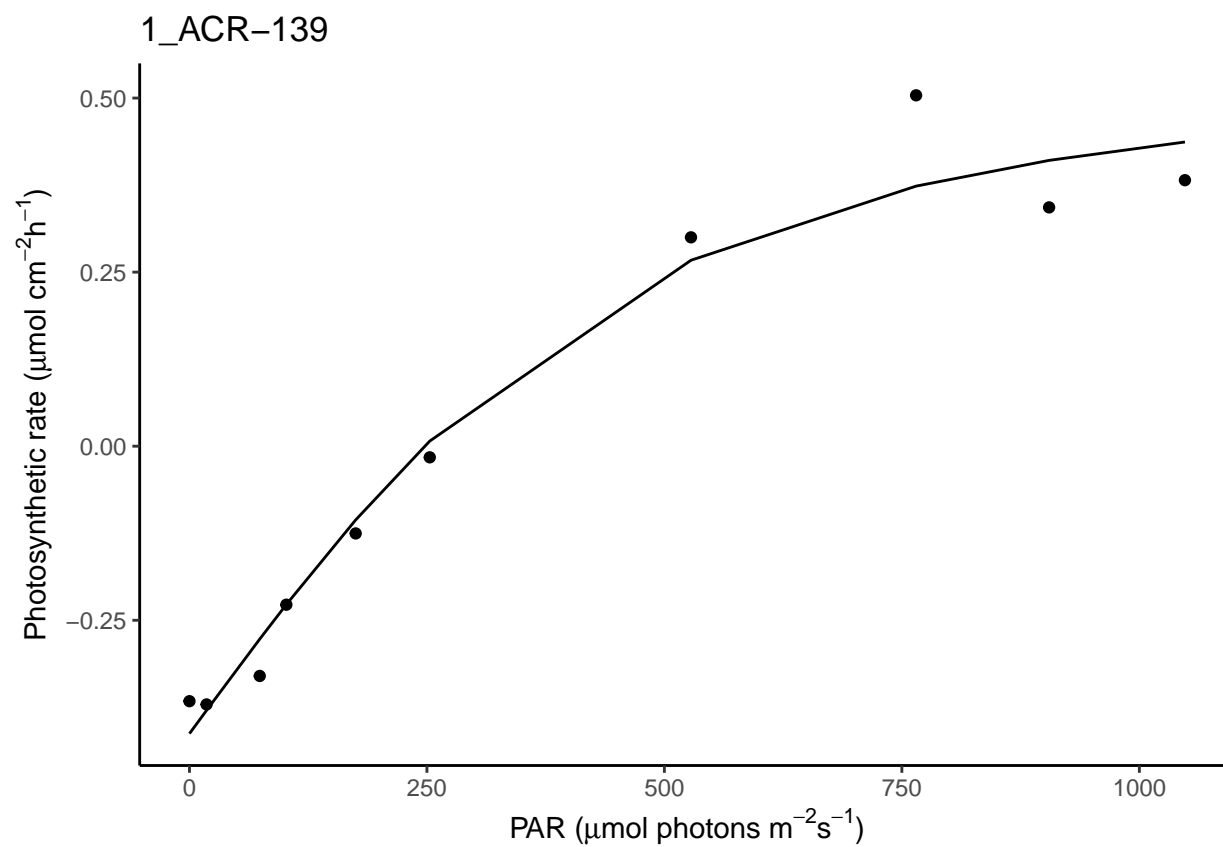
```
## -----  
## augmented$colony_id: P0C-259
```



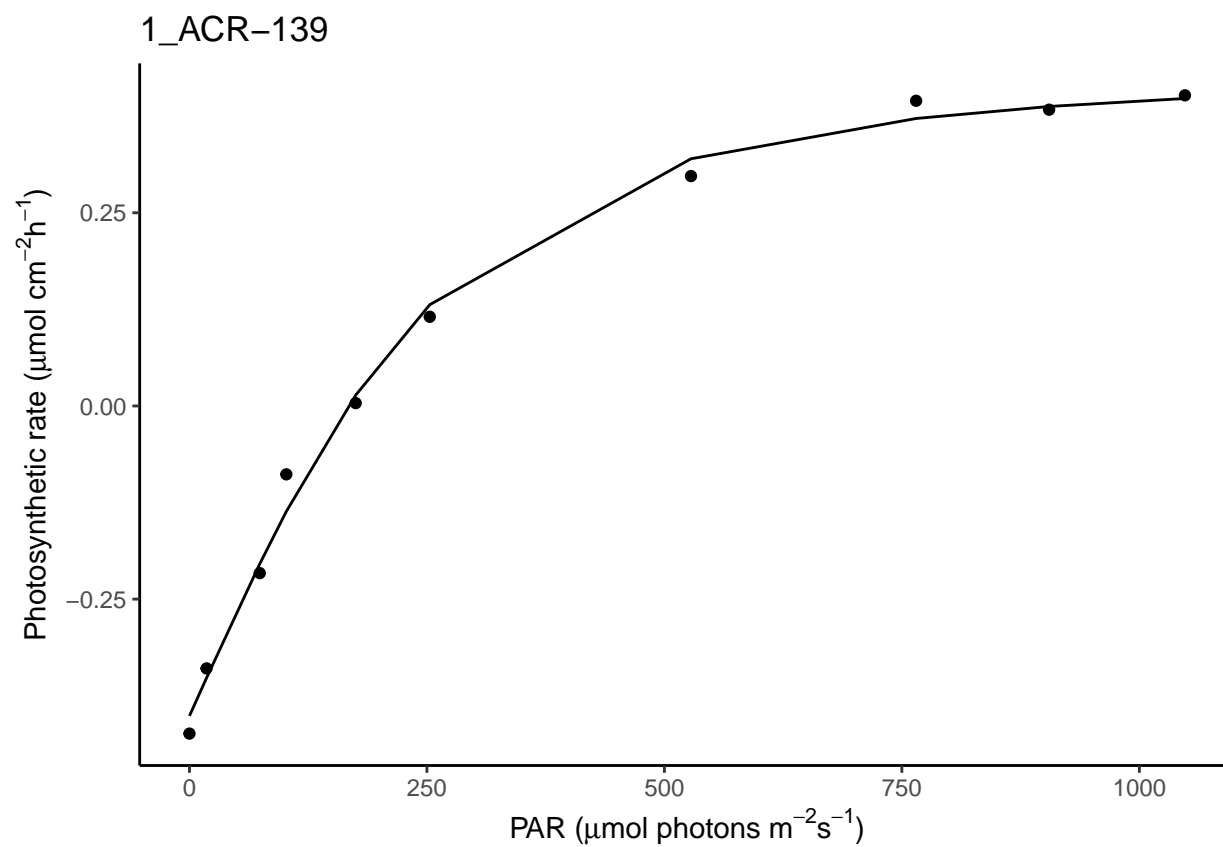
augmented\$colony_id: POC-346



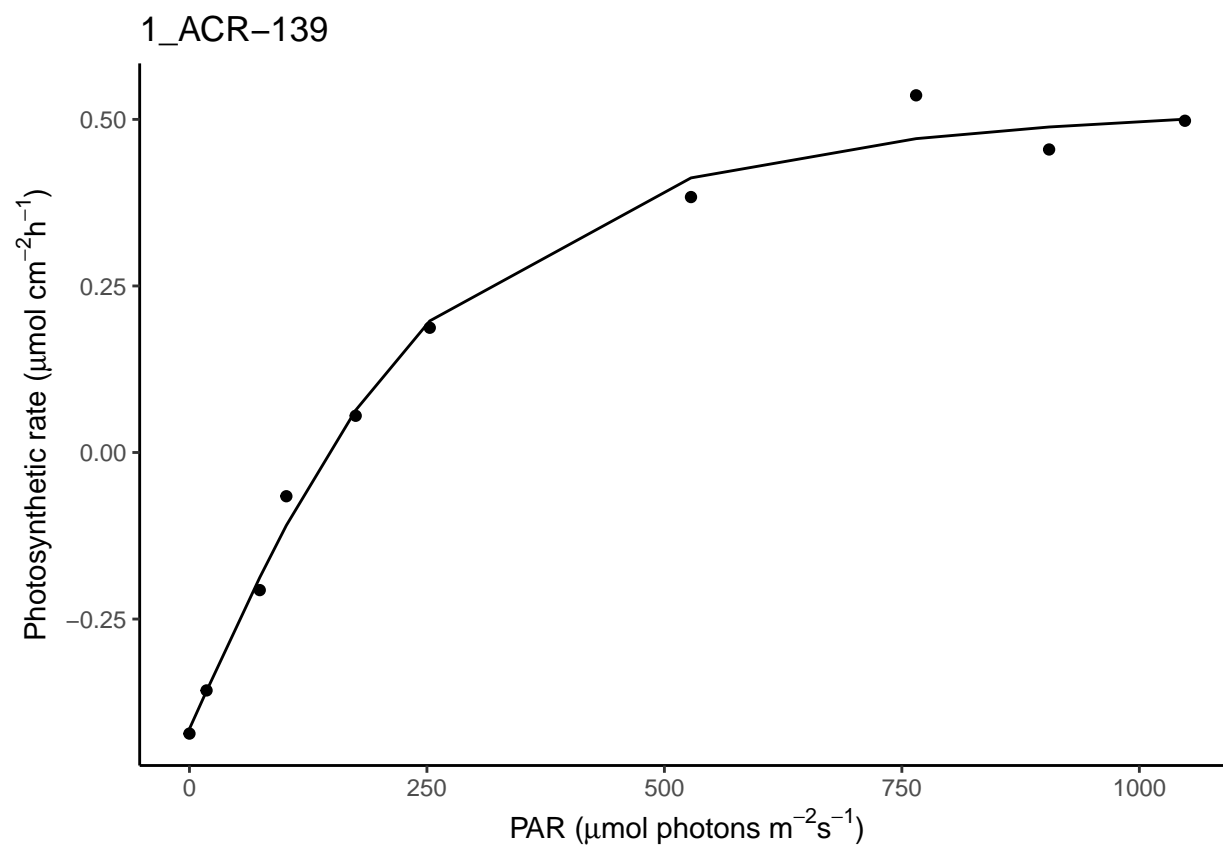
augmented\$colony_id: POC-358



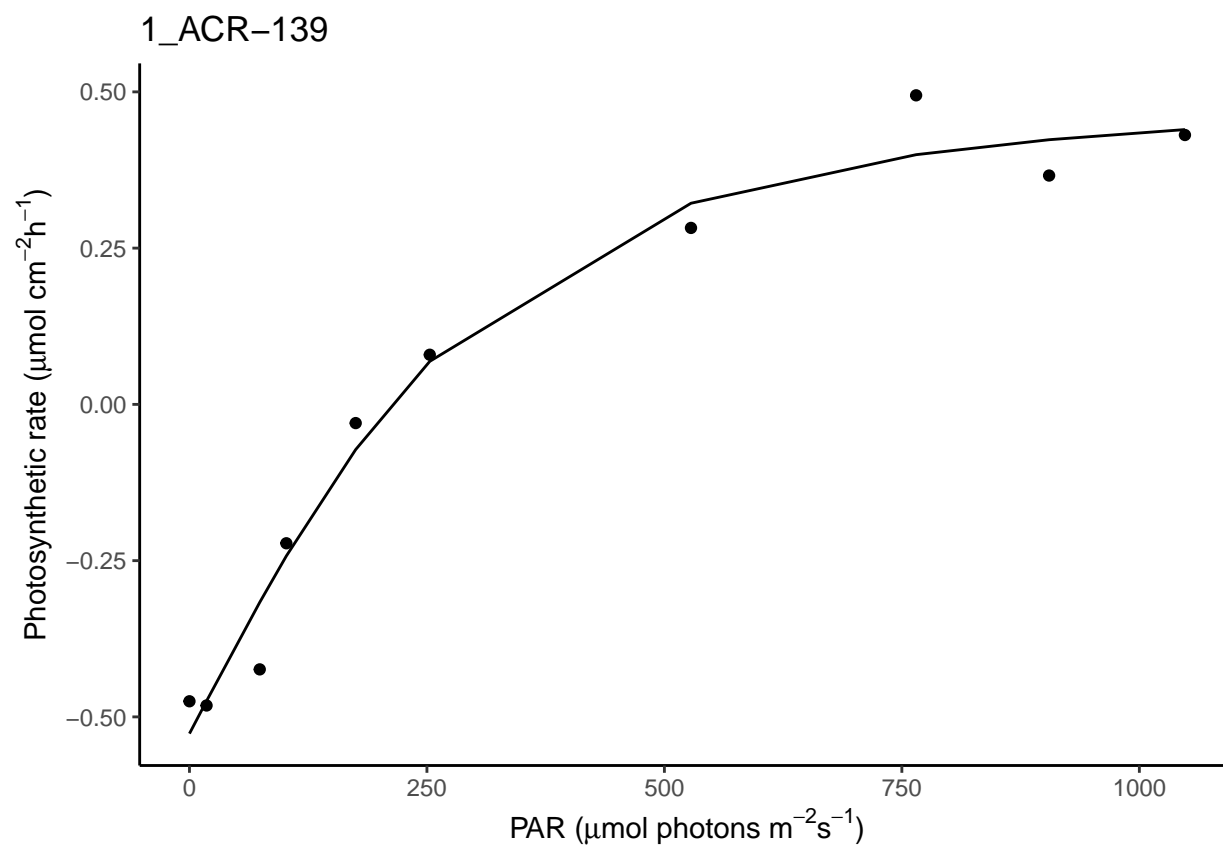
```
## -----  
## augmented$colony_id: P0C-359
```



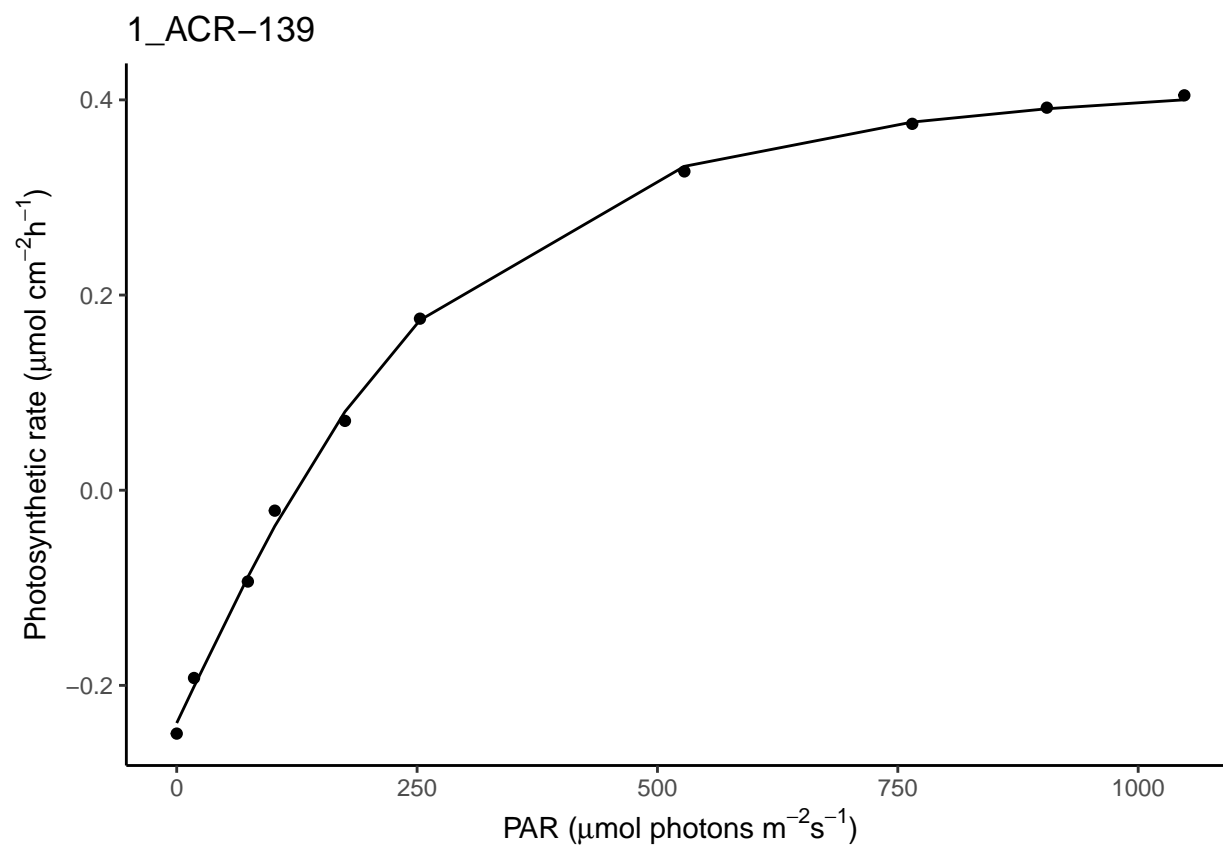
augmented\$colony_id: POC-366



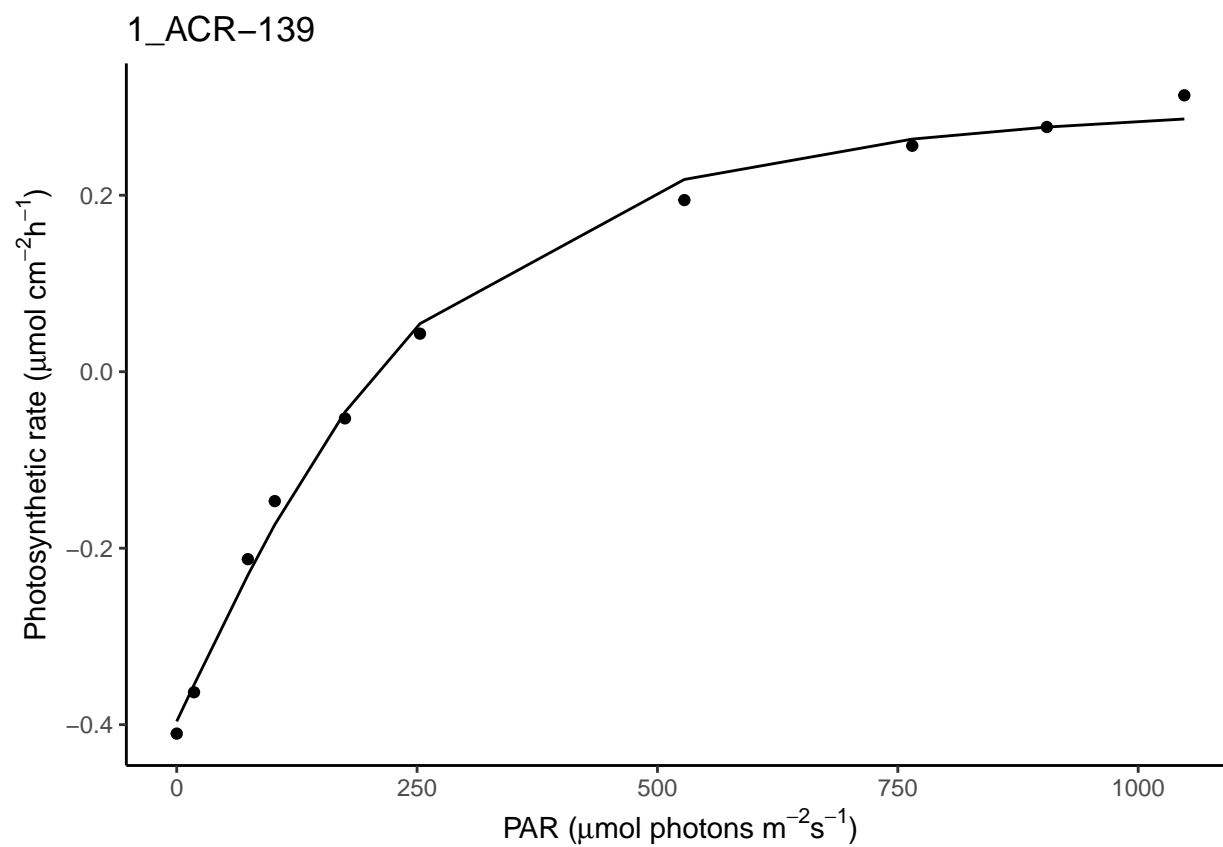
augmented\$colony_id: P0C-369



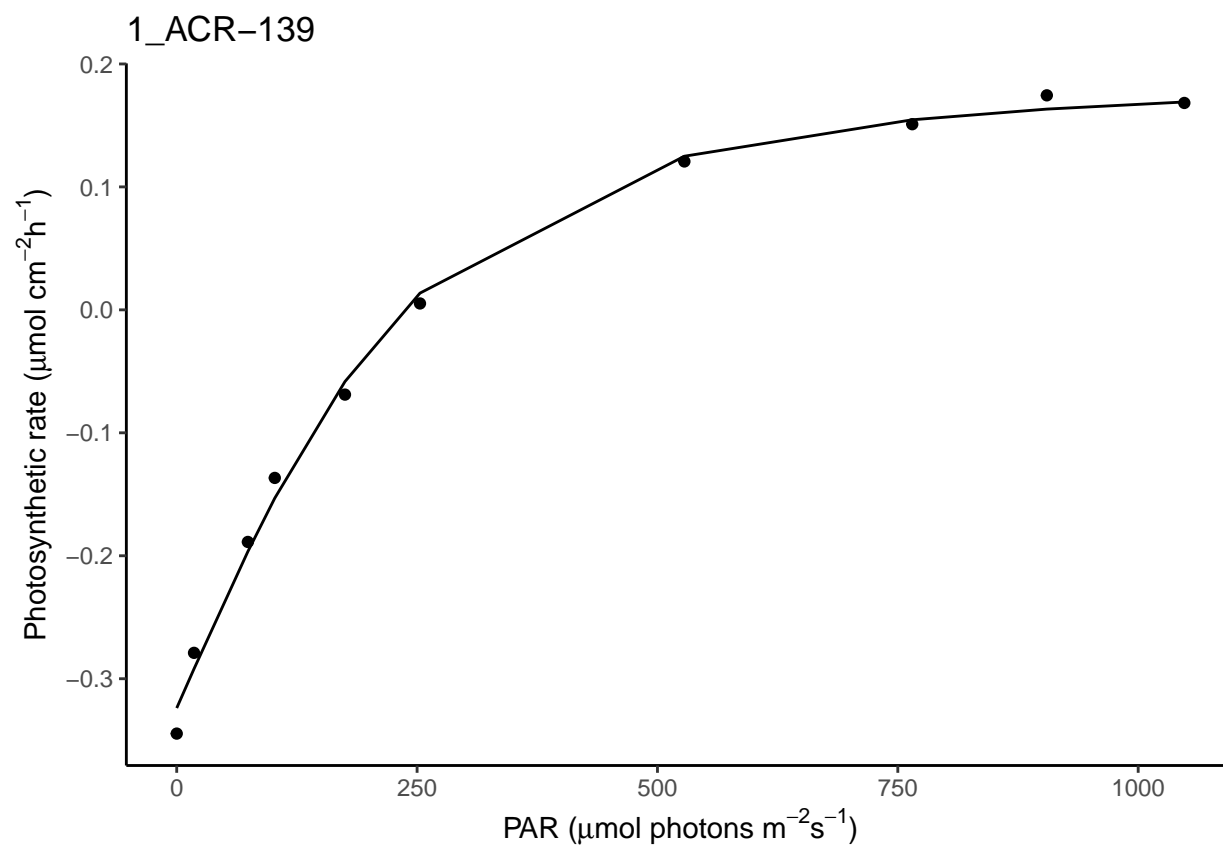
augmented\$colony_id: P0C-371



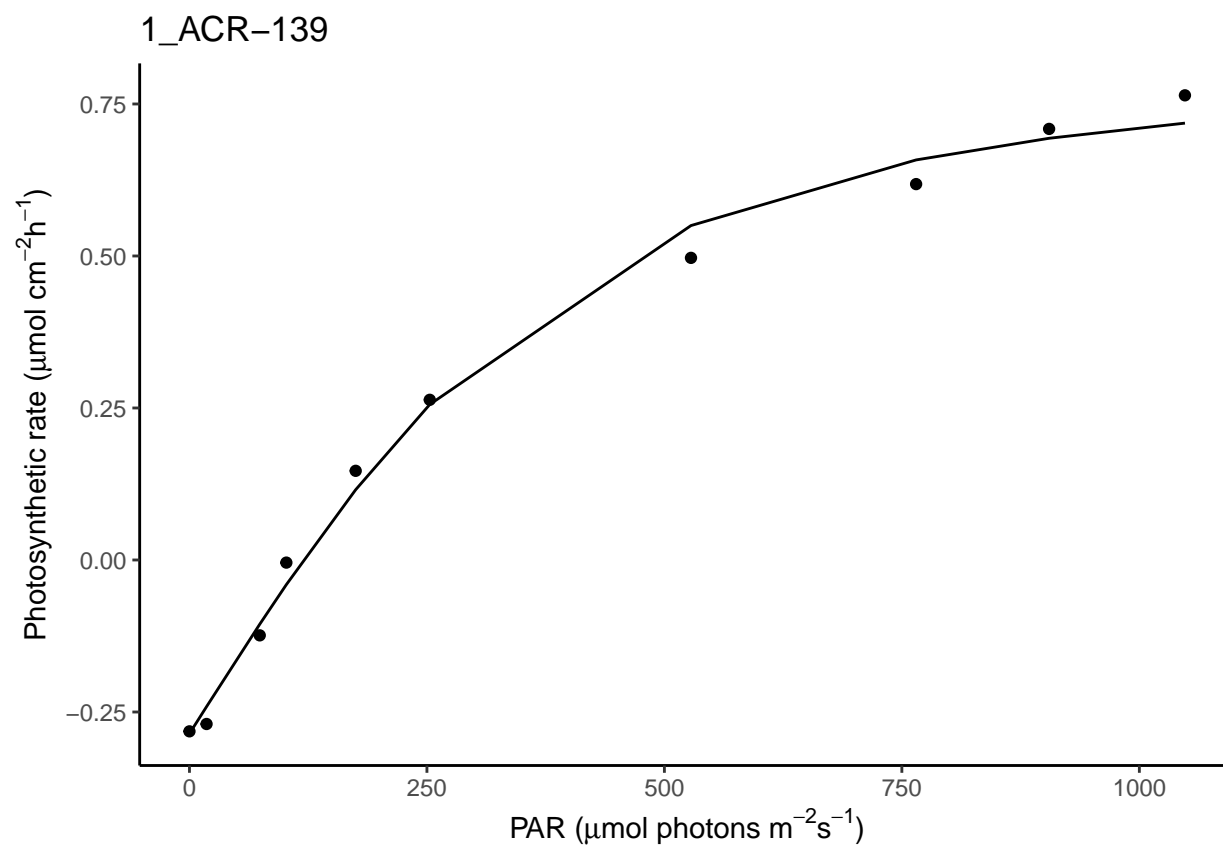
augmented\$colony_id: P0C-372



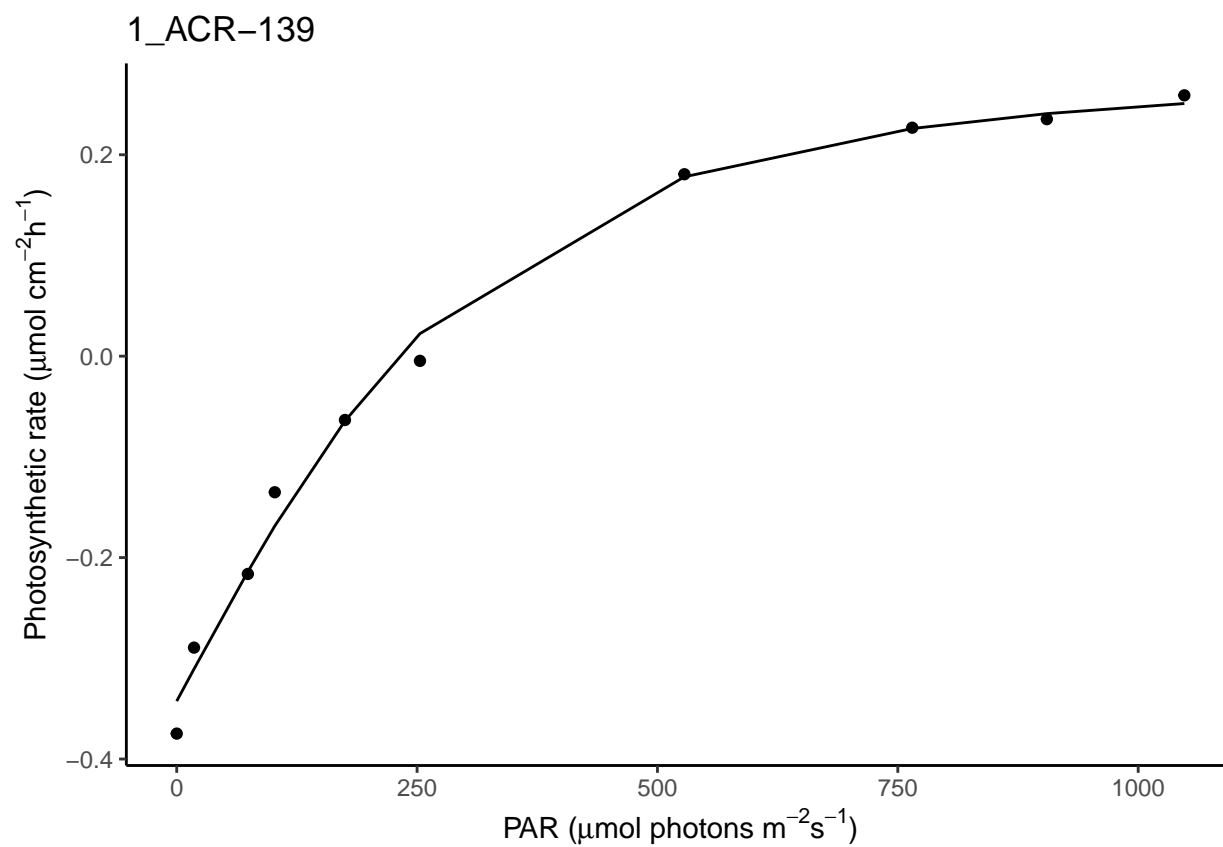
augmented\$colony_id: P0C-373



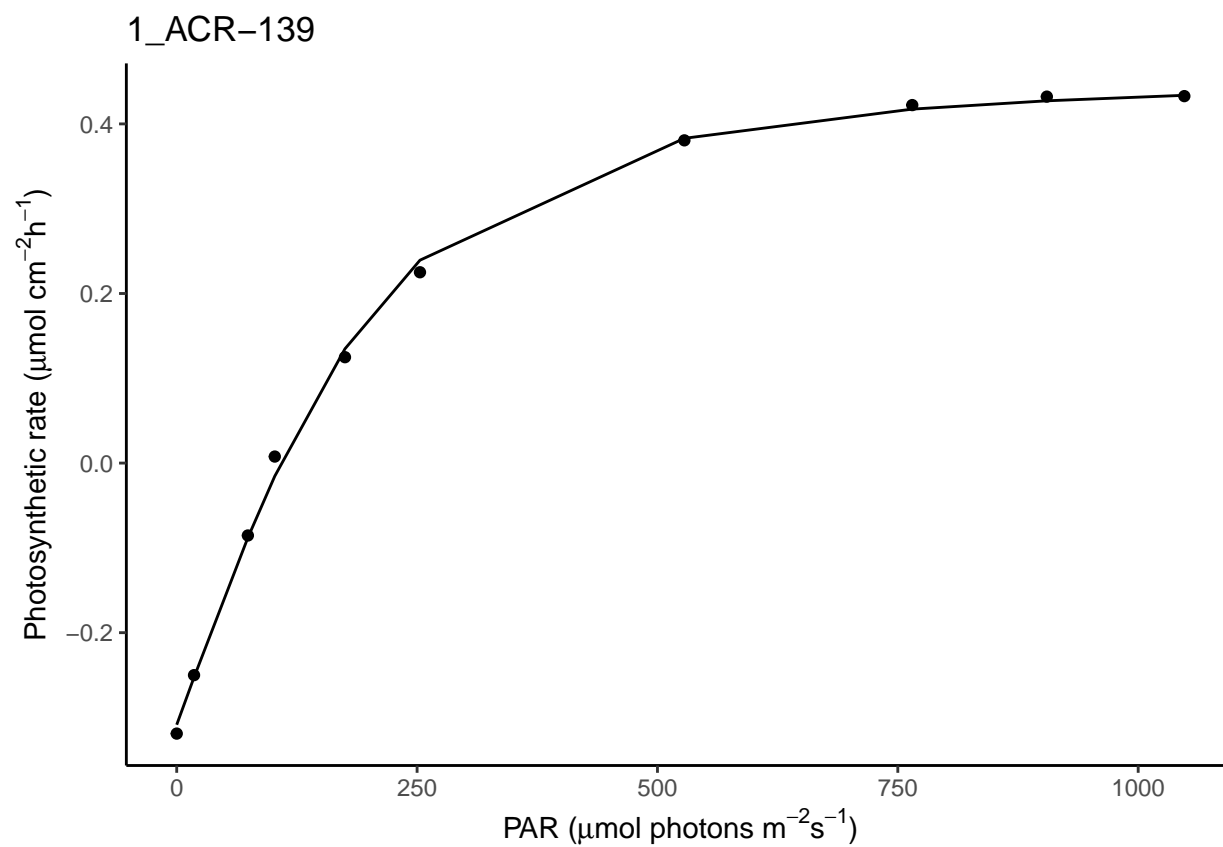
augmented\$colony_id: P0C-375



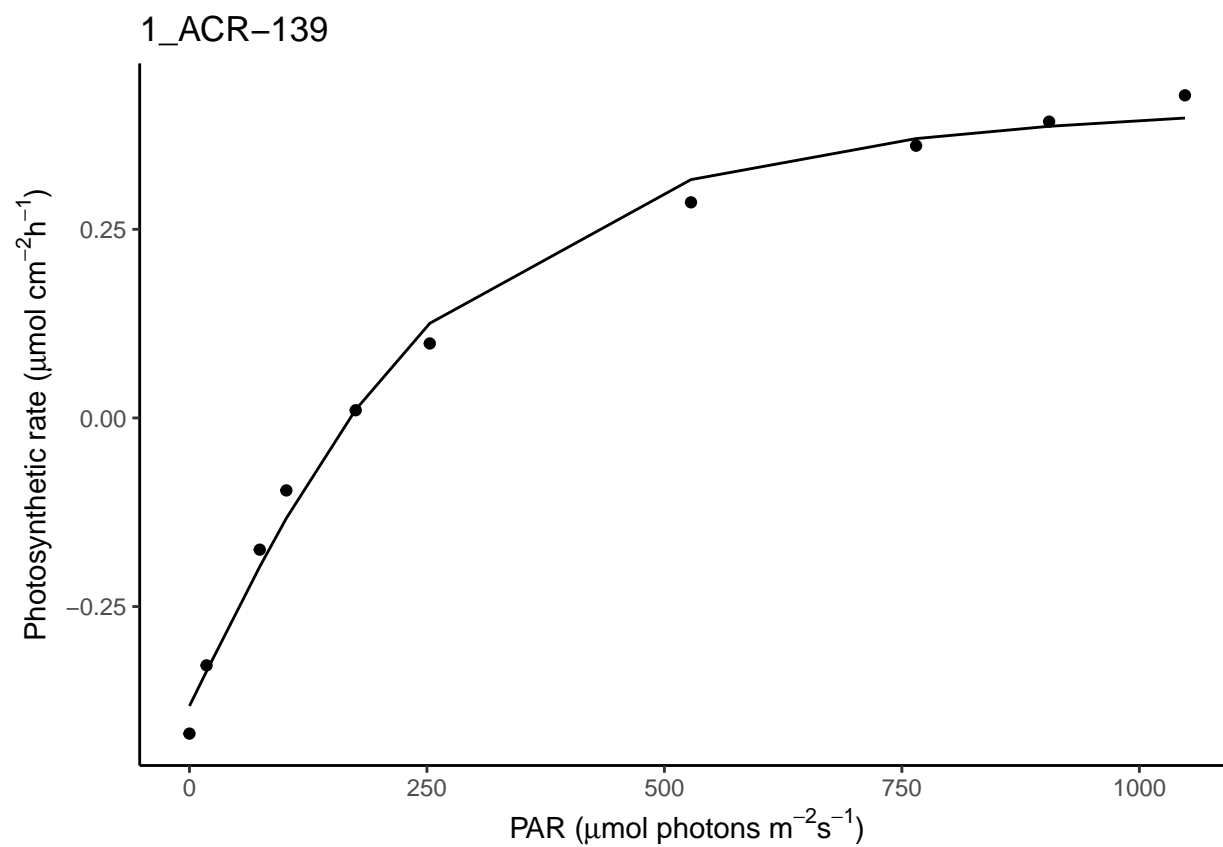
augmented\$colony_id: P0C-377



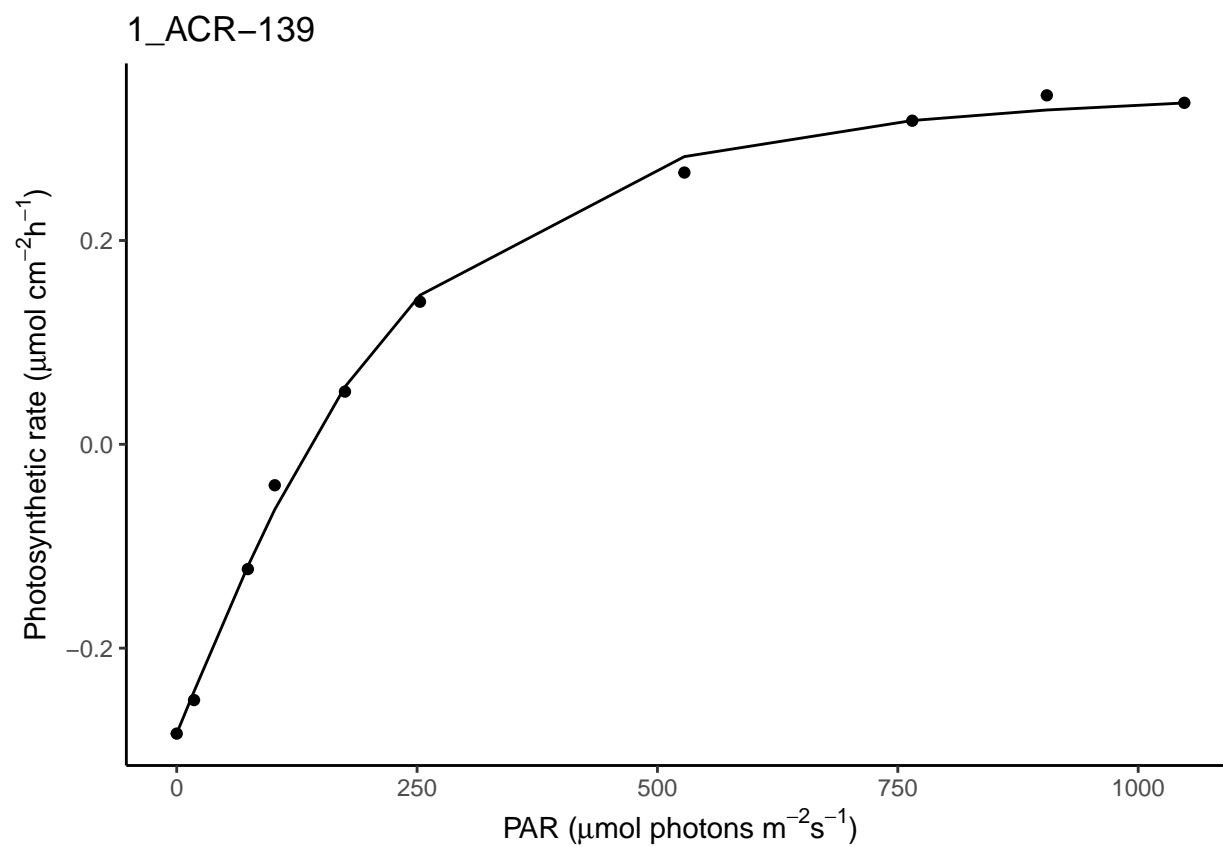
augmented\$colony_id: POC-378



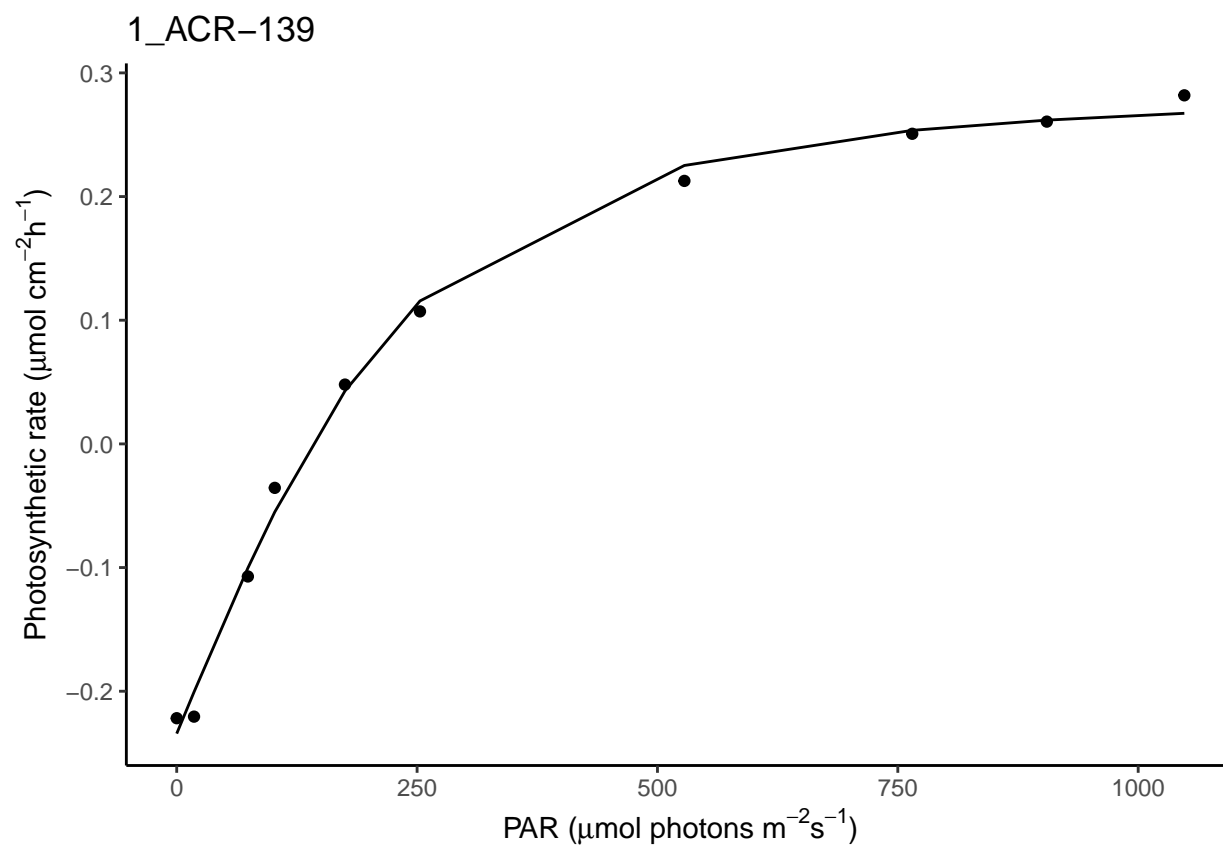
augmented\$colony_id: P0C-386



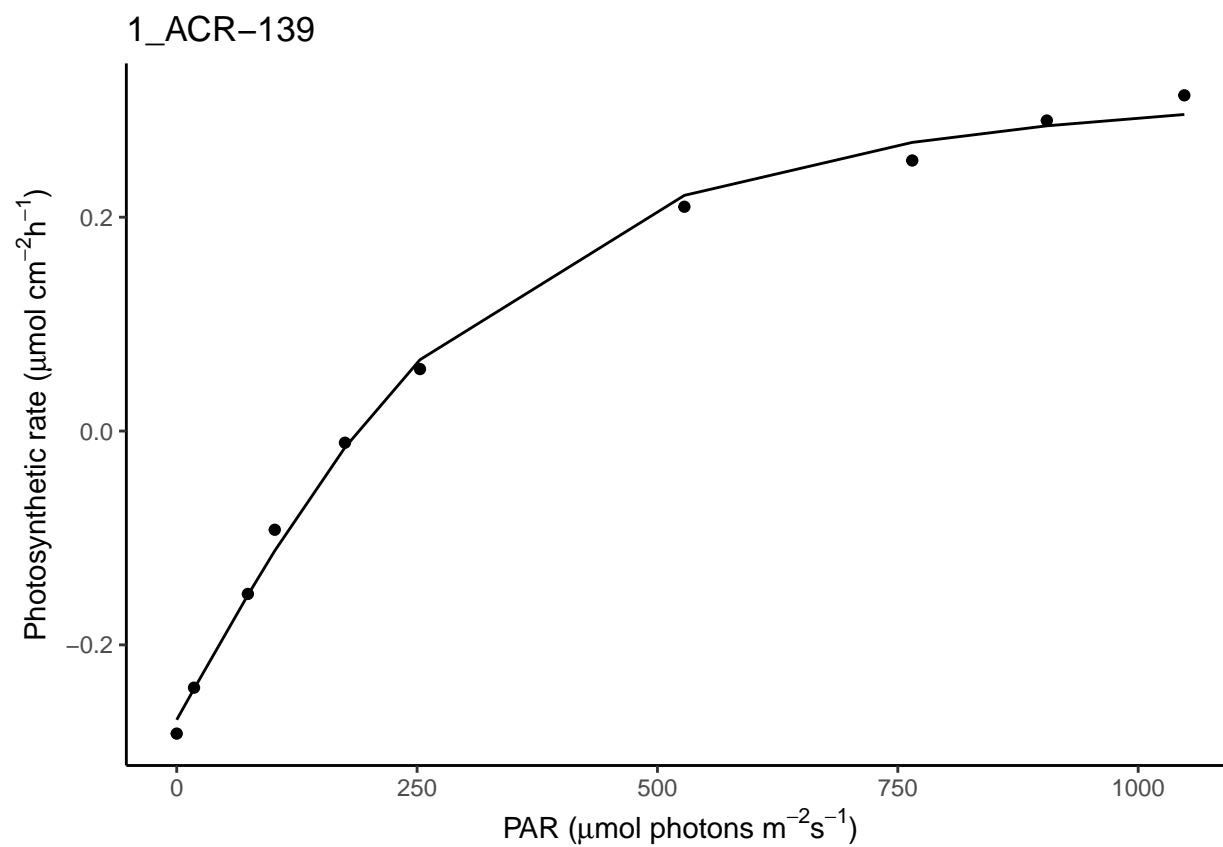
```
## -----  
## augmented$colony_id: P0C-391
```

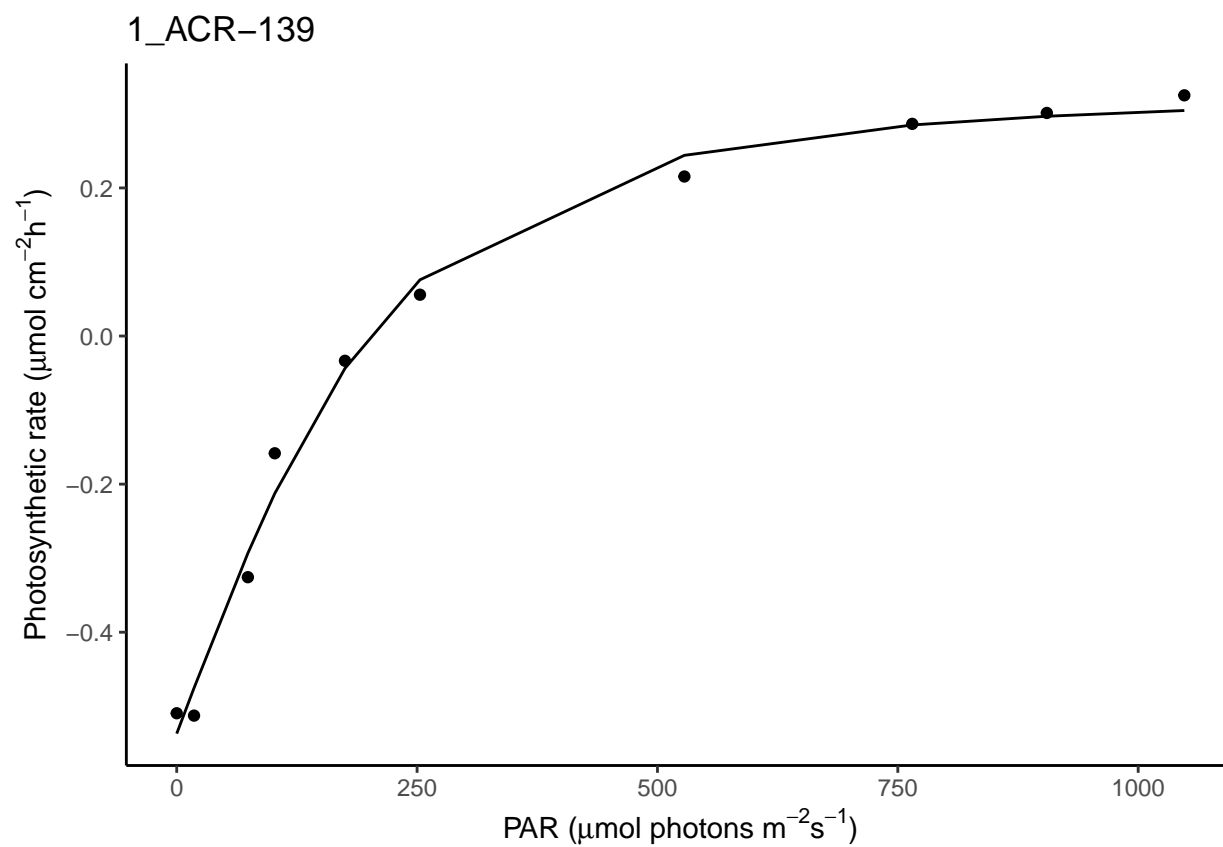
augmented\$colony_id: P0C-394



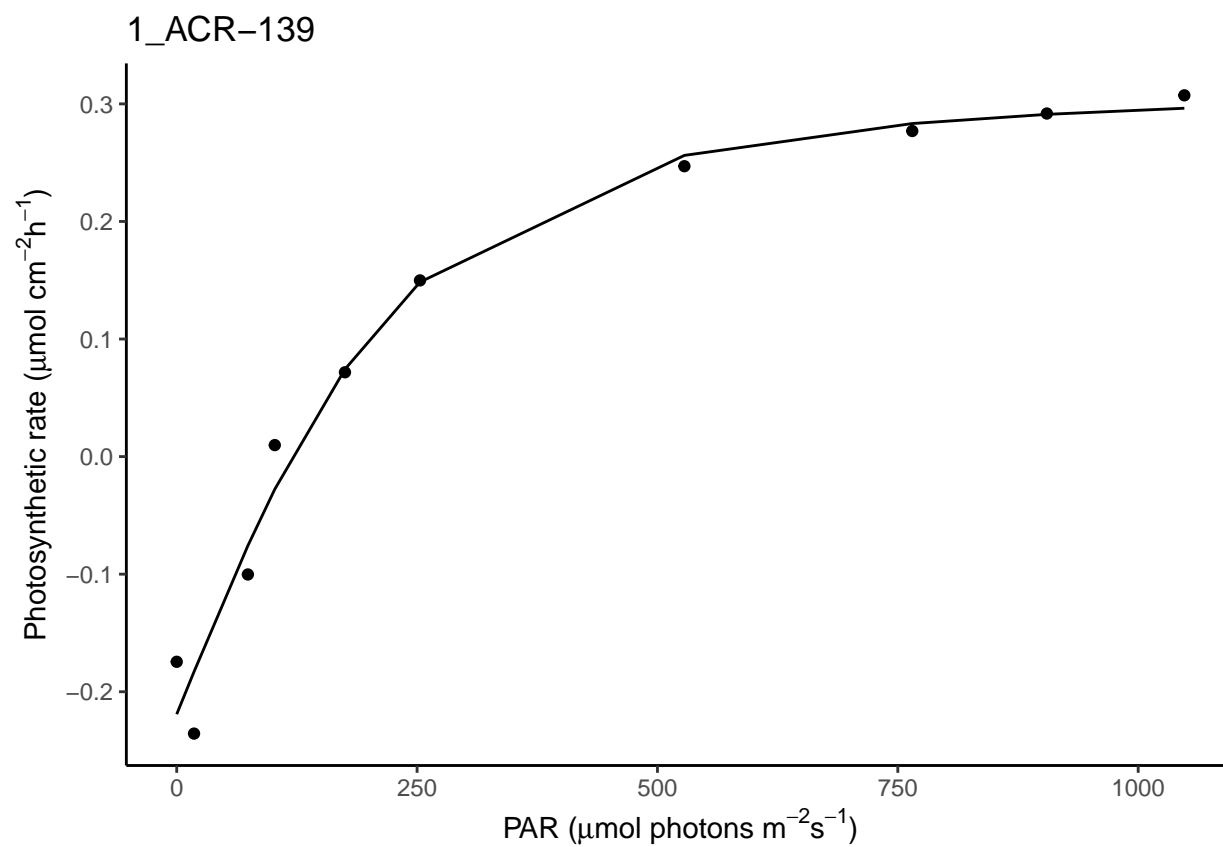
```
## -----  
## augmented$colony_id: P0C-395
```



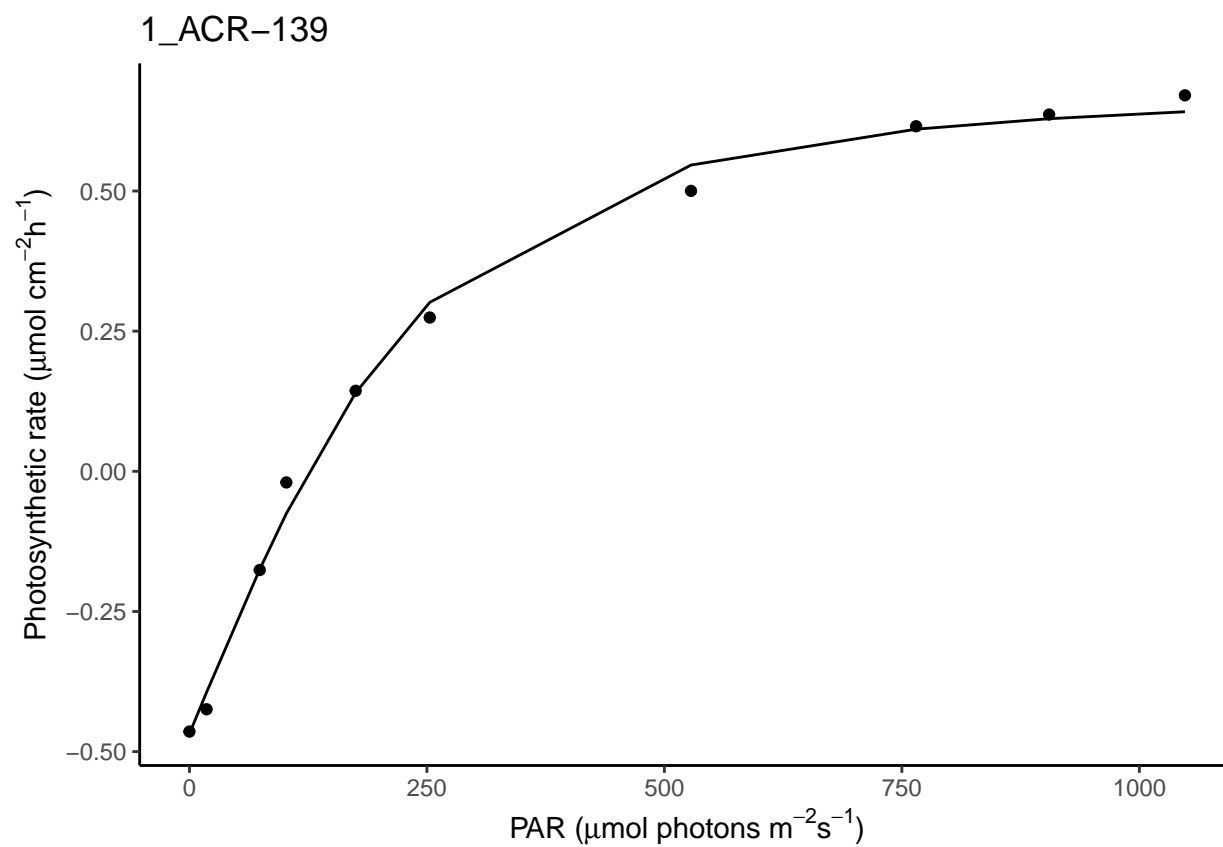
augmented\$colony_id: POC-40



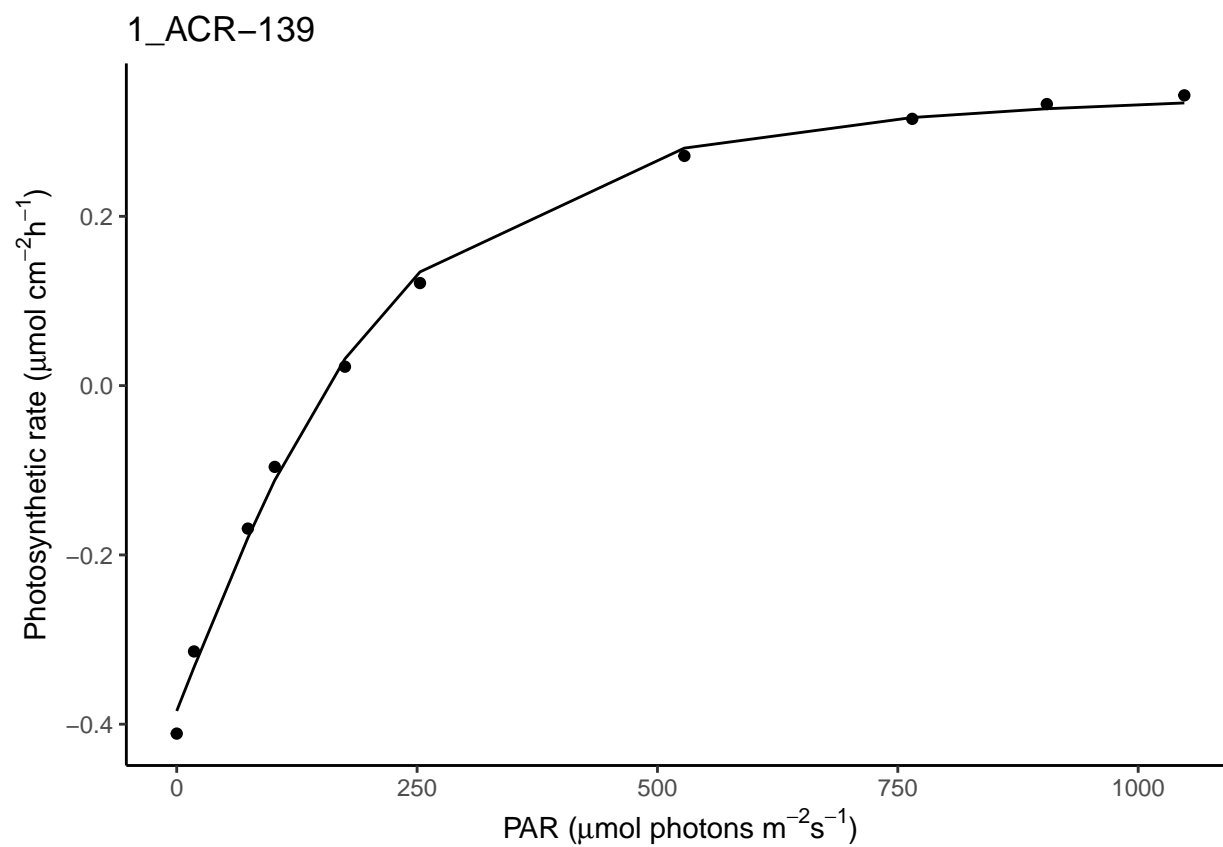
```
## -----  
## augmented$colony_id: POC-42
```



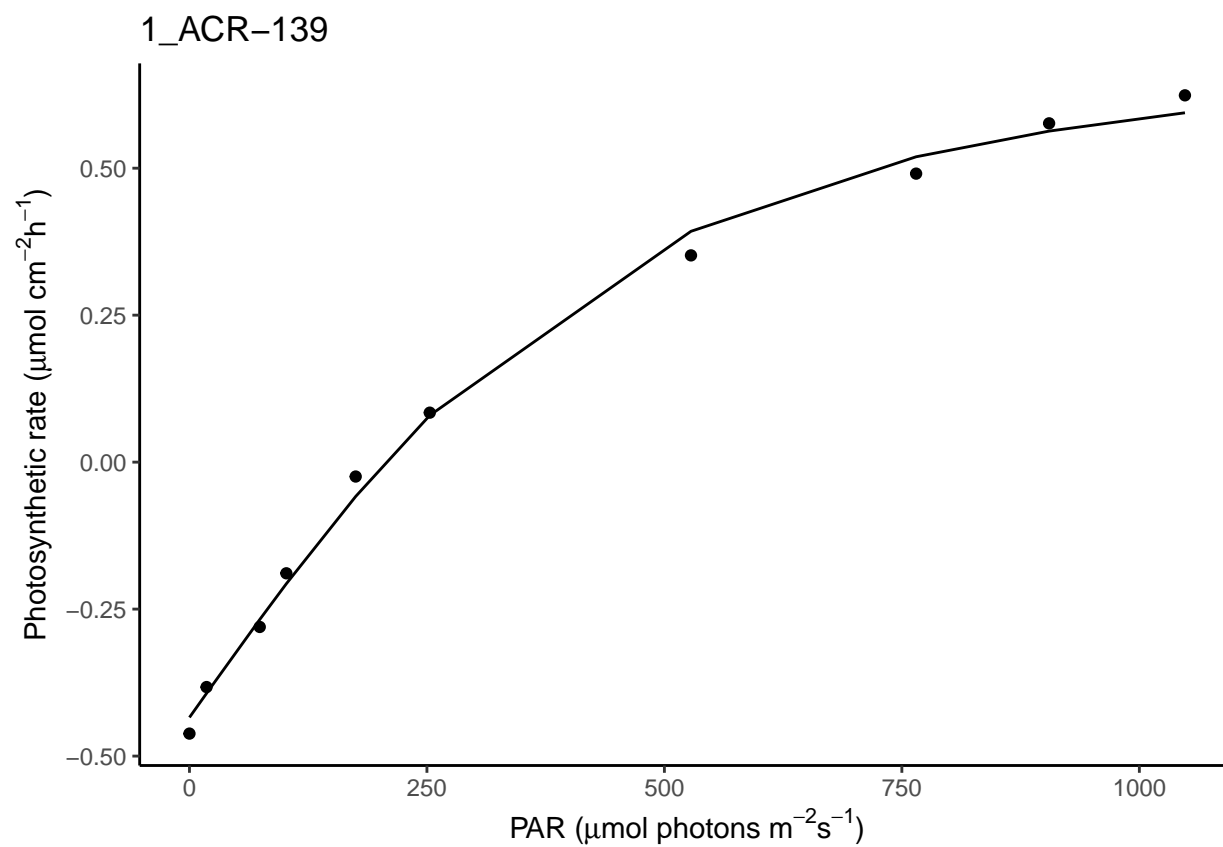
augmented\$colony_id: POC-43



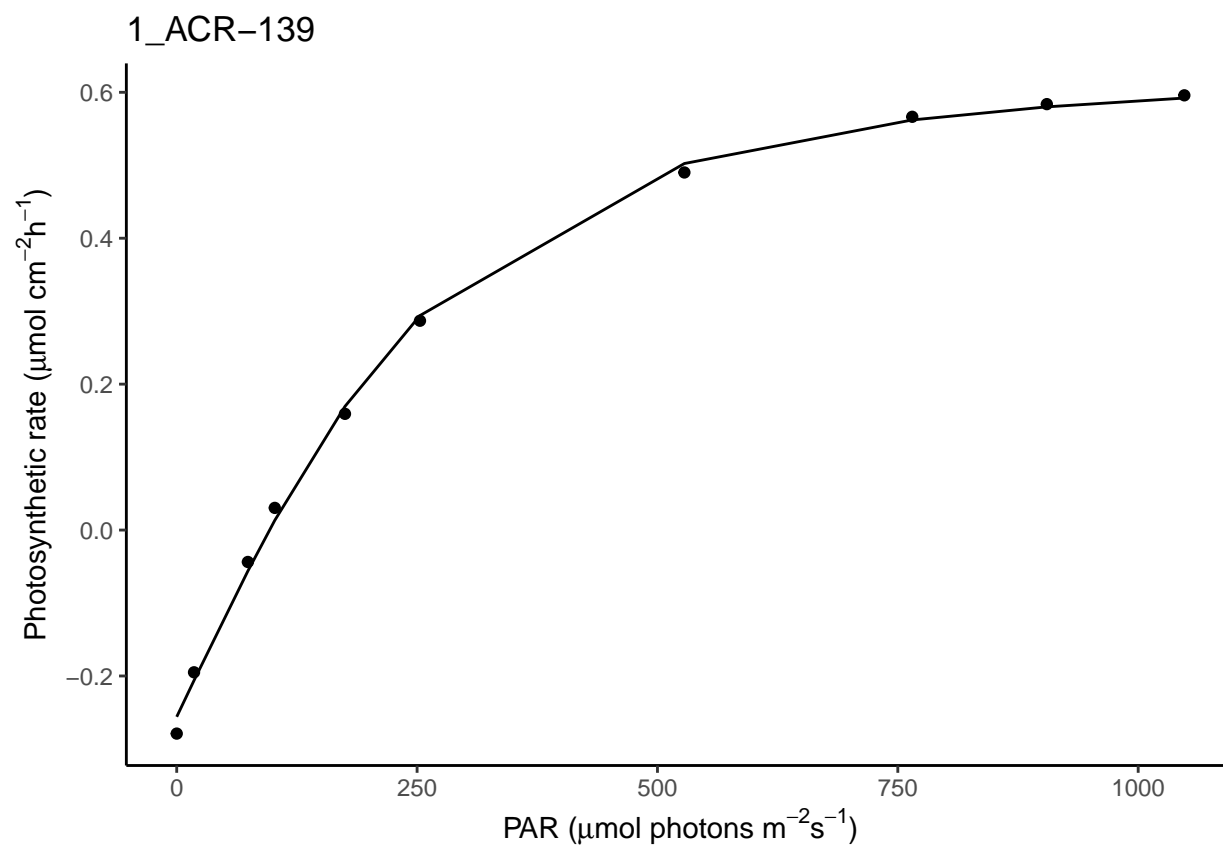
augmented\$colony_id: POC-44



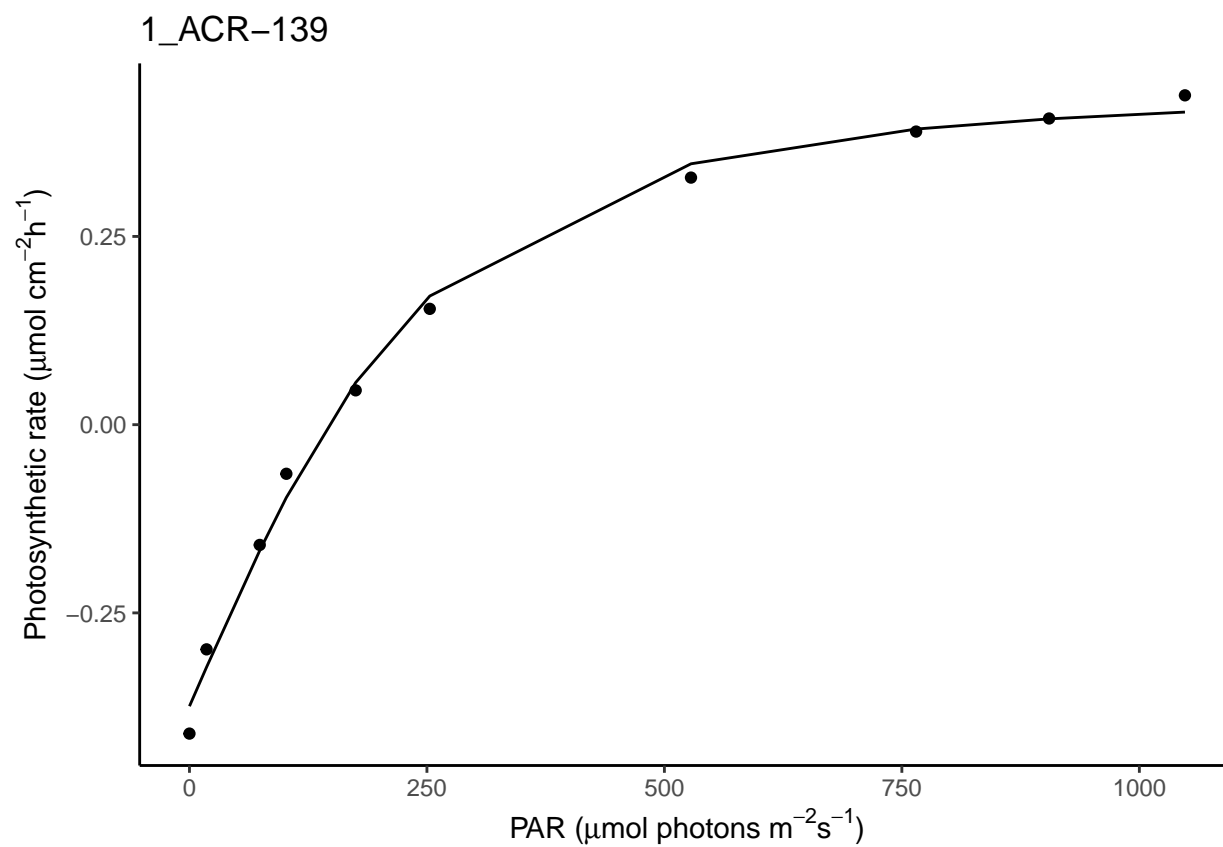
```
## -----  
## augmented$colony_id: POC-45
```



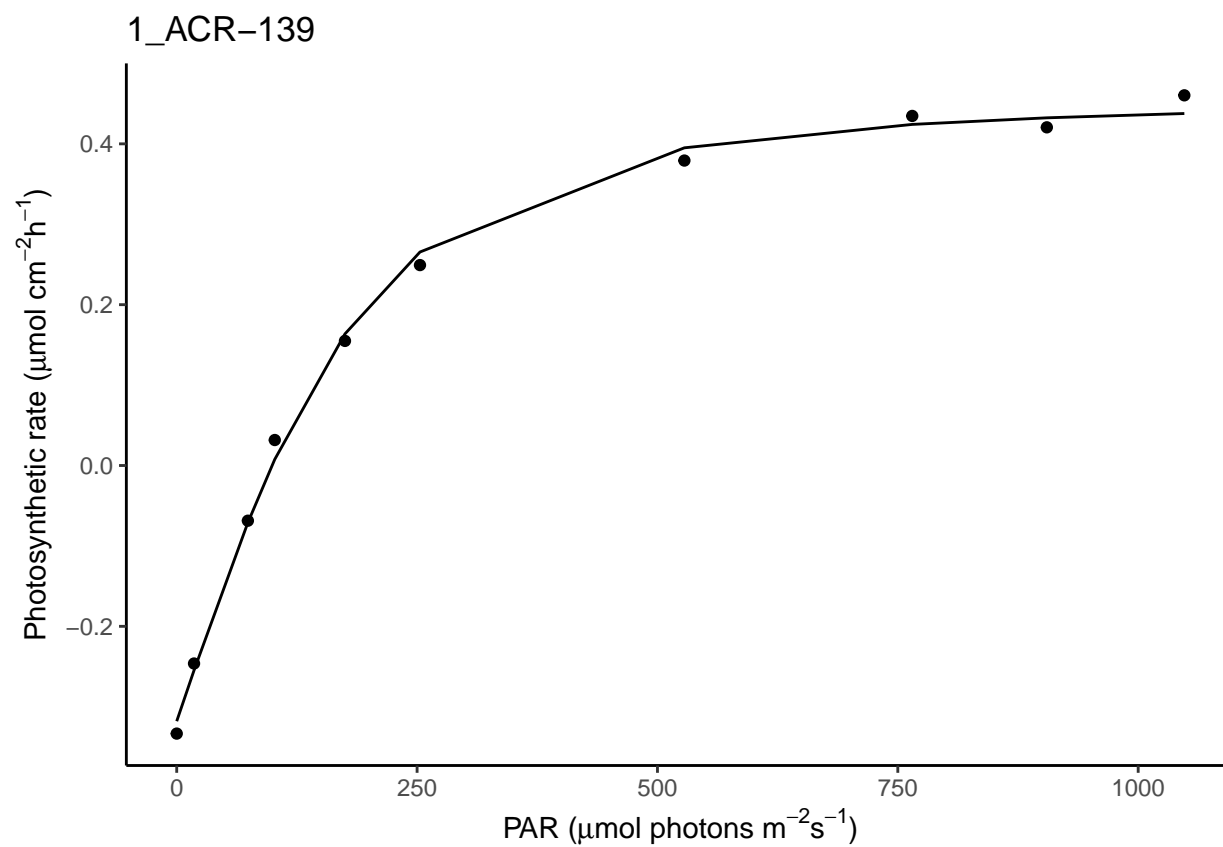
augmented\$colony_id: POC-47



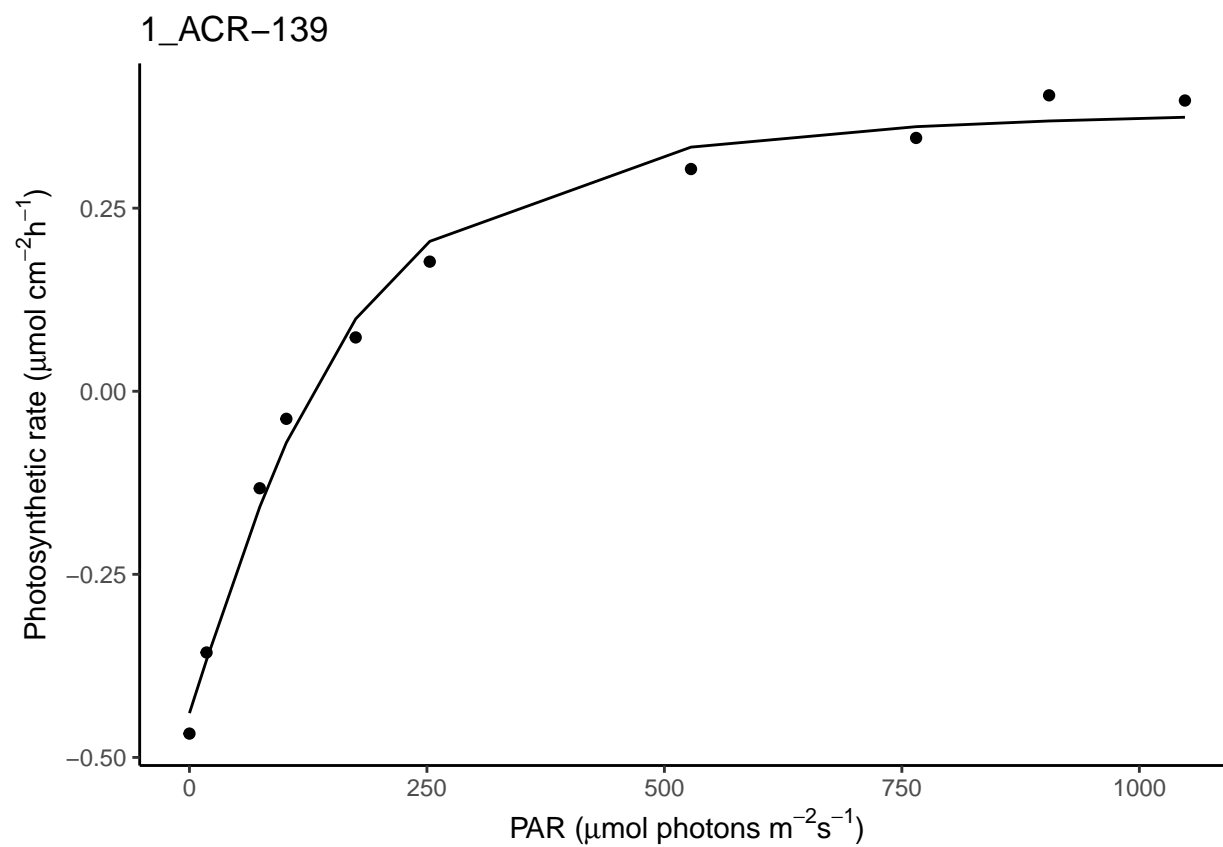
augmented\$colony_id: POC-48



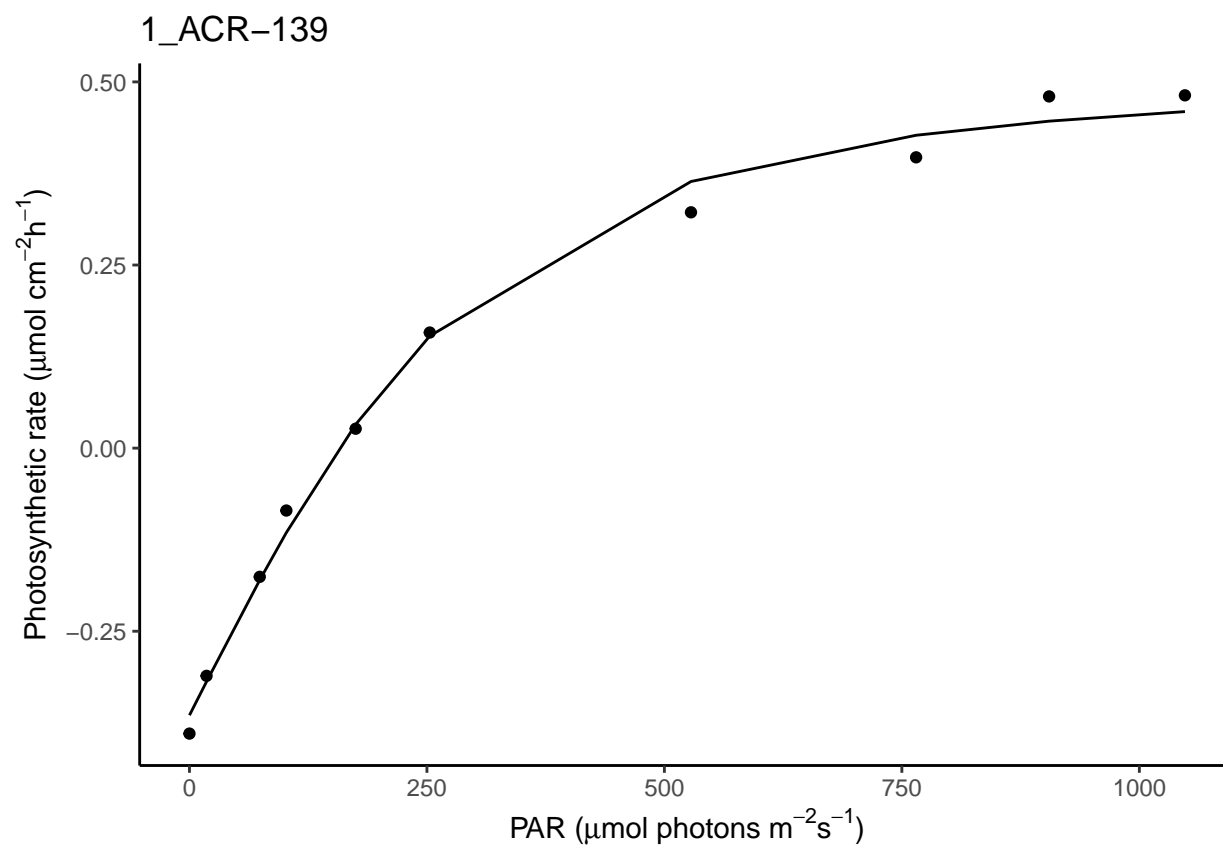
augmented\$colony_id: POC-50



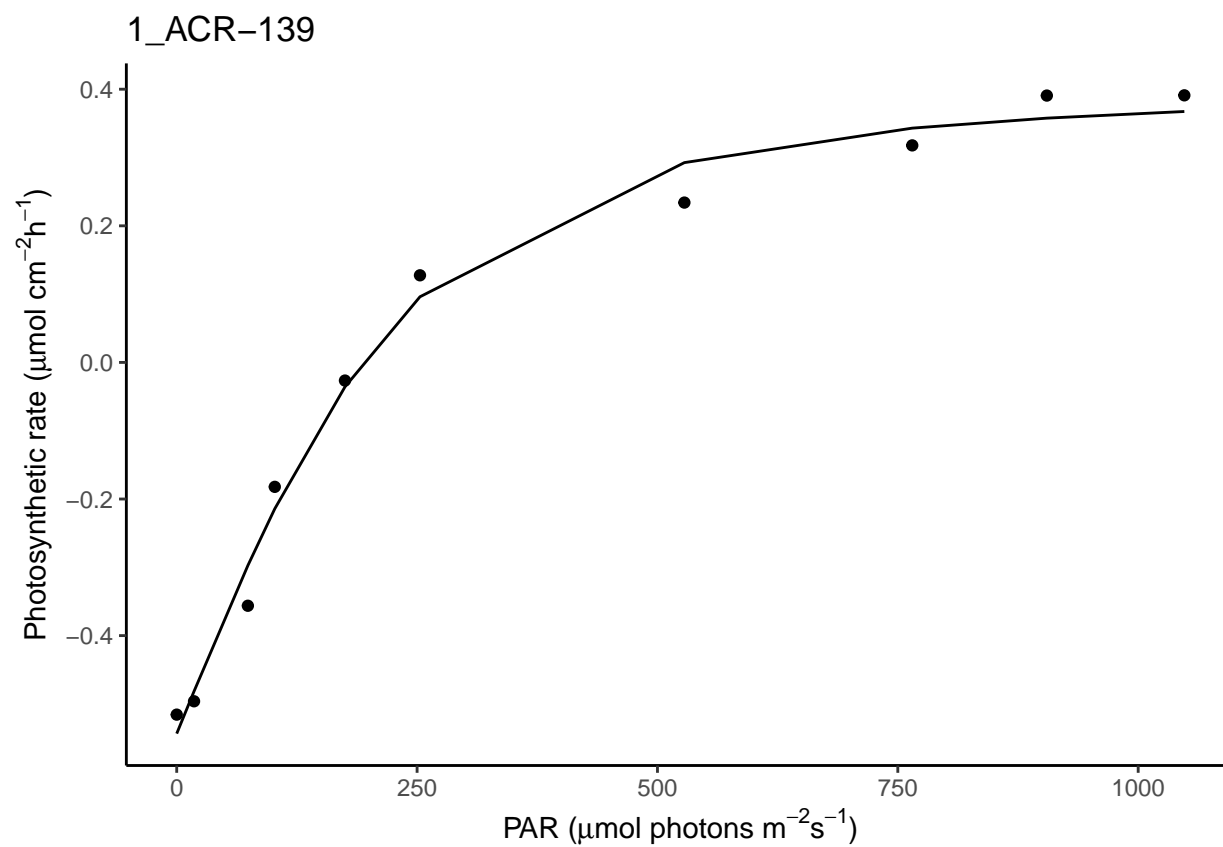
augmented\$colony_id: P0C-52



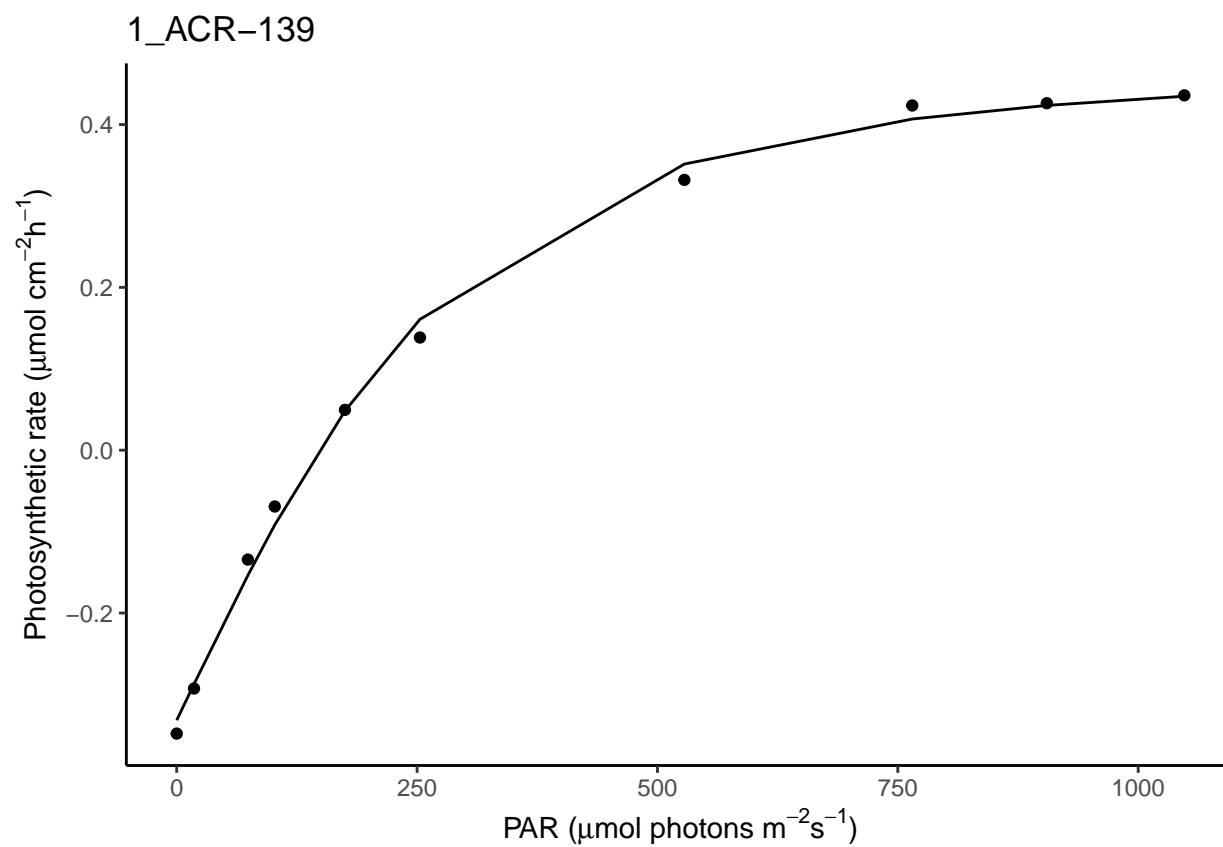
augmented\$colony_id: POC-53



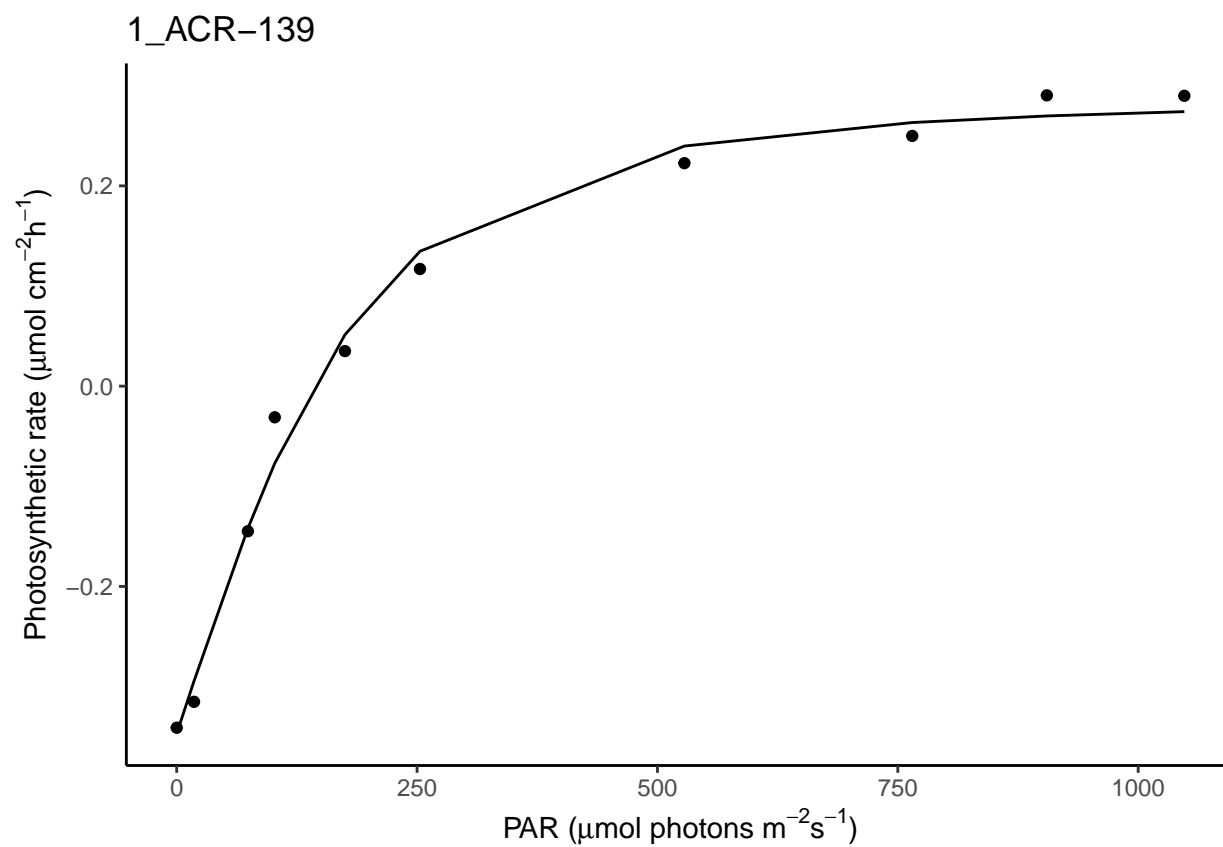
augmented\$colony_id: P0C-55



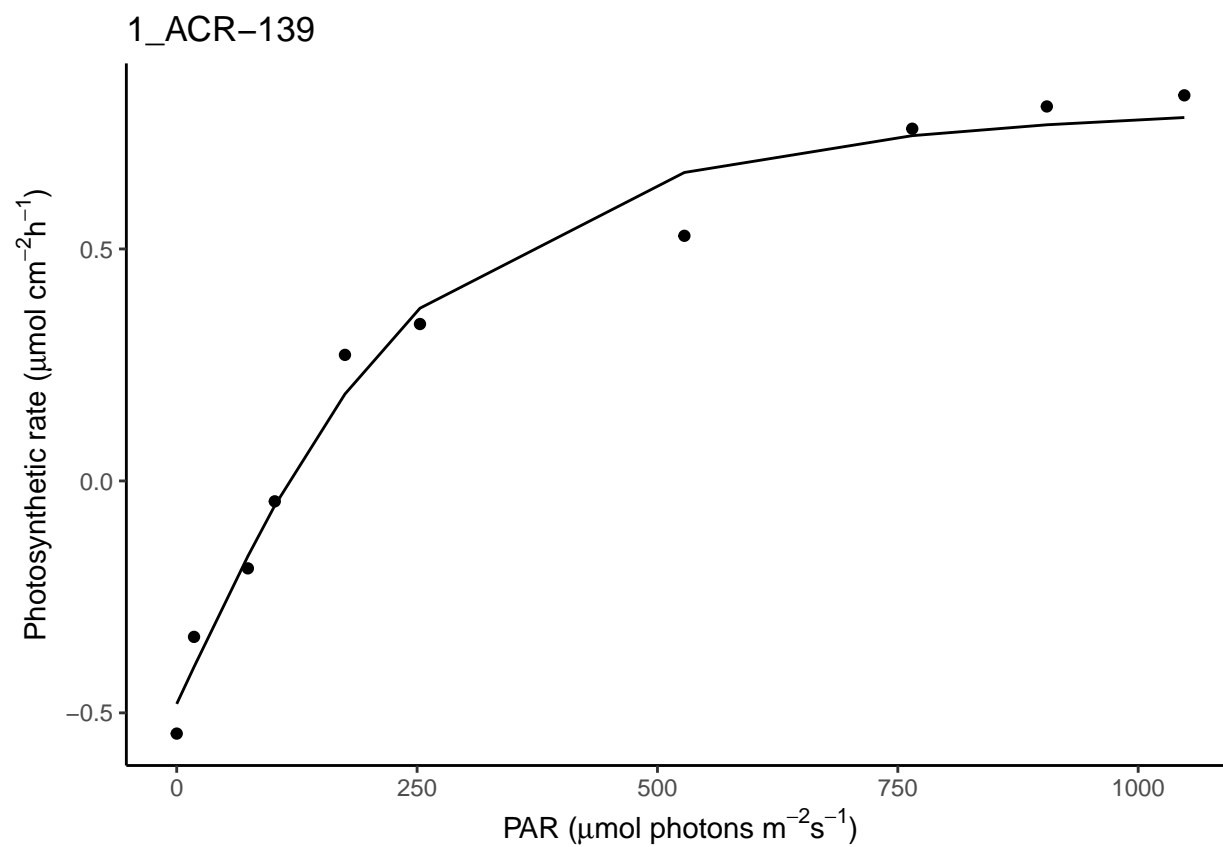
augmented\$colony_id: POC-57



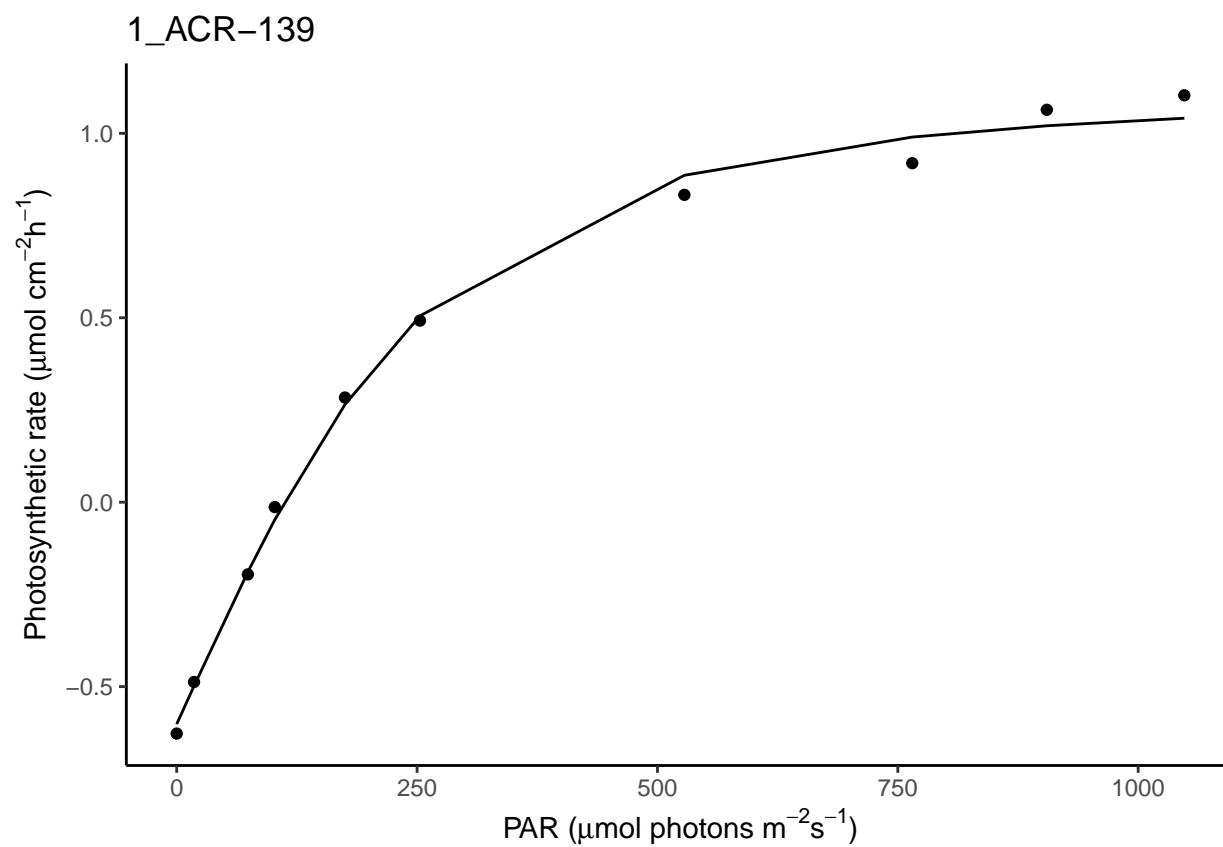
augmented\$colony_id: POC-68



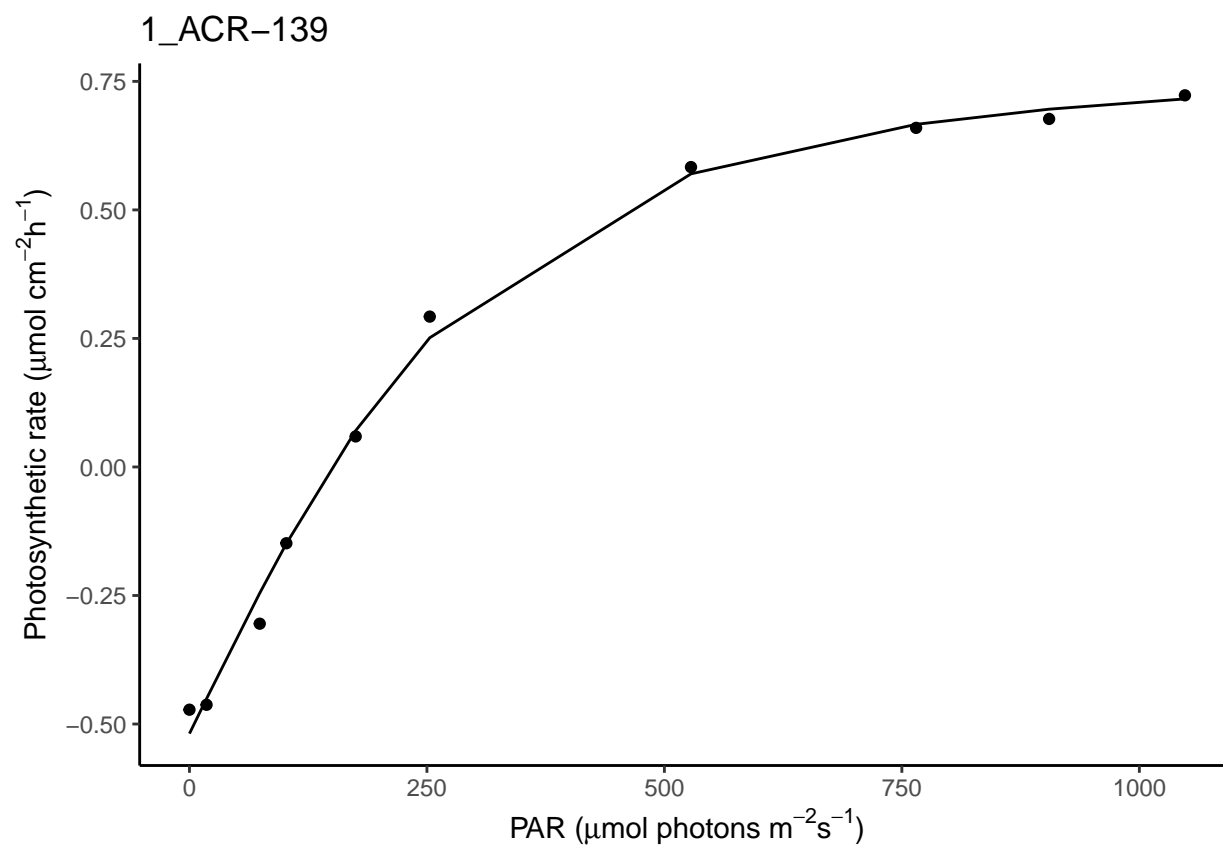
augmented\$colony_id: POR-209



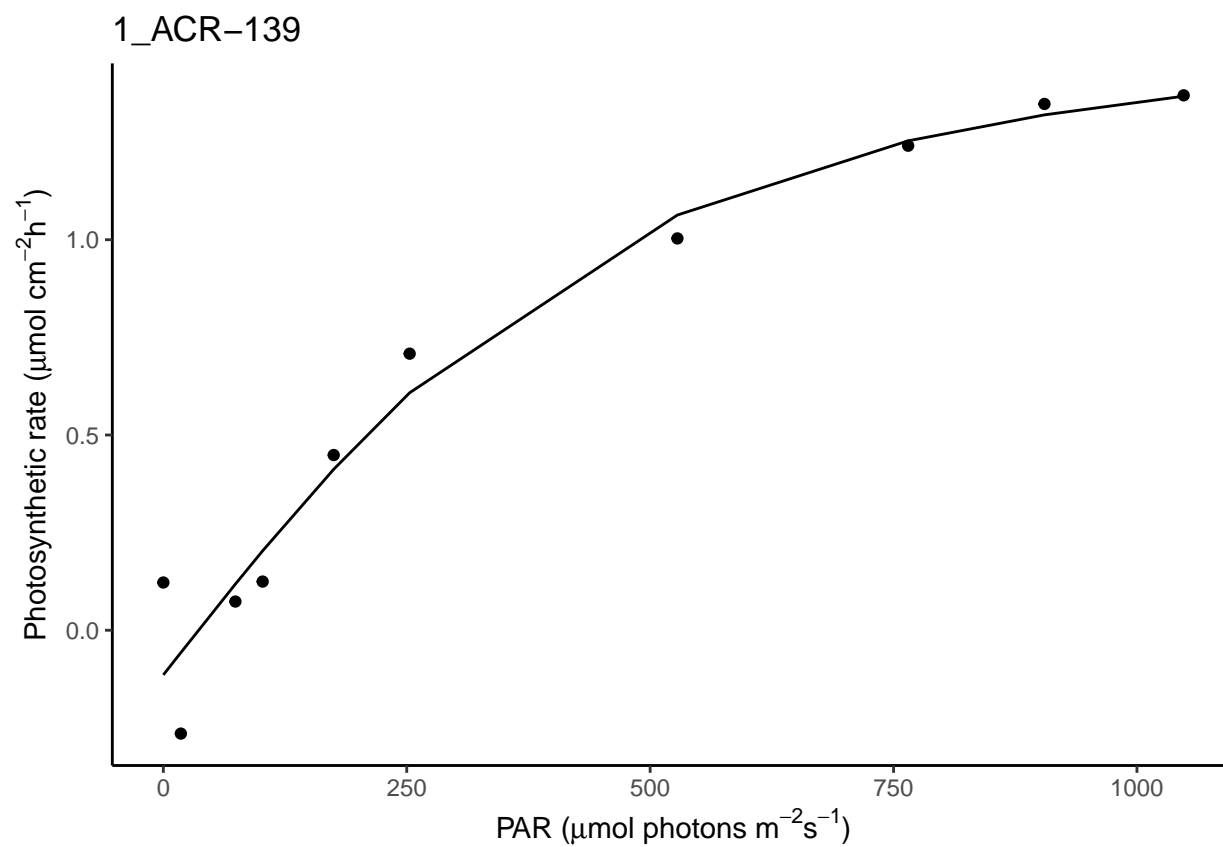
augmented\$colony_id: POR-214



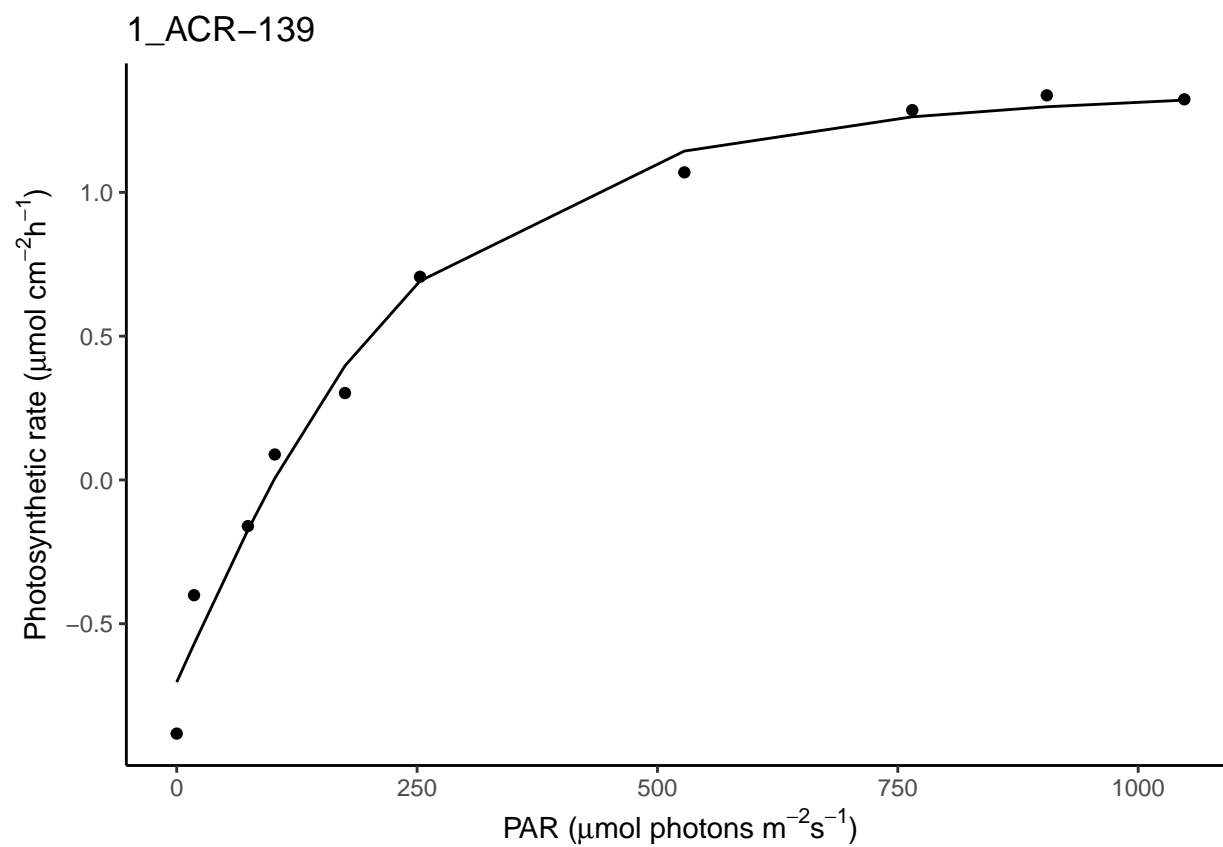
augmented\$colony_id: POR-216



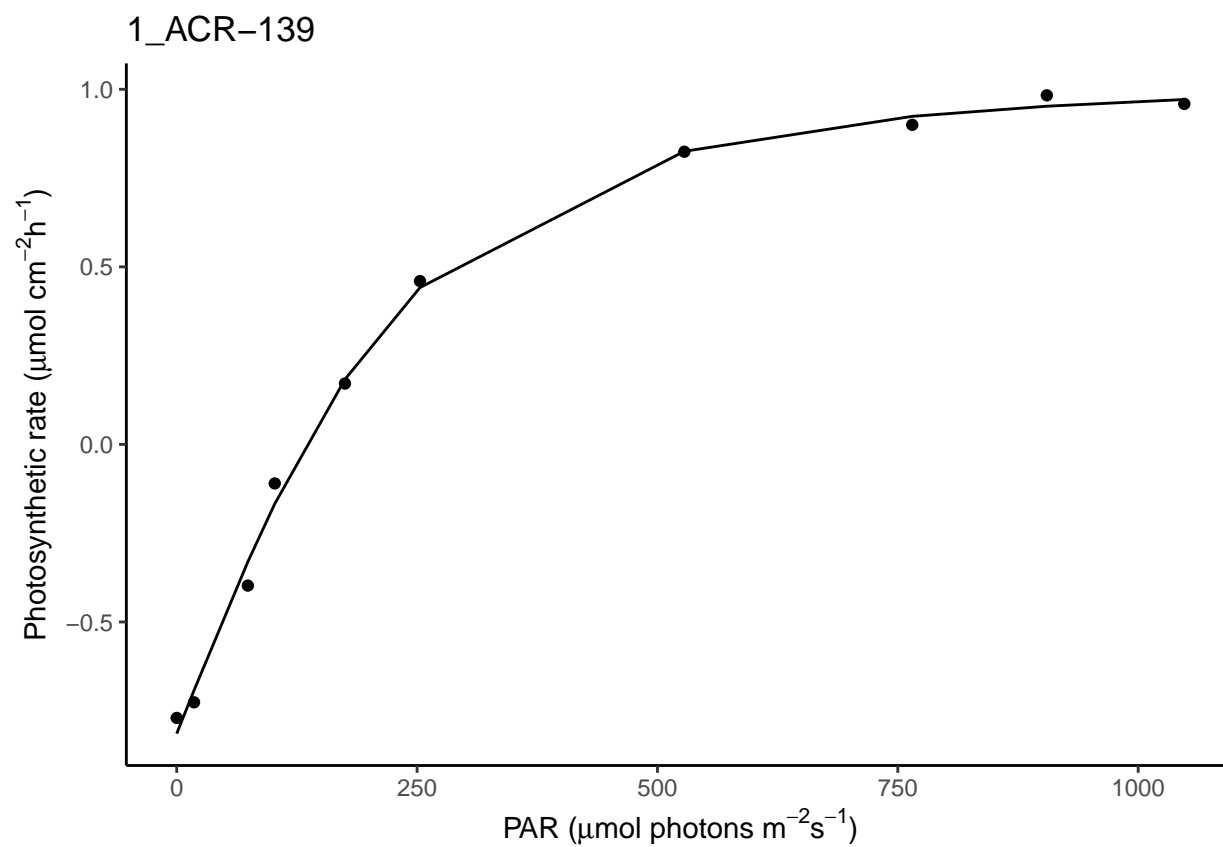
augmented\$colony_id: POR-221



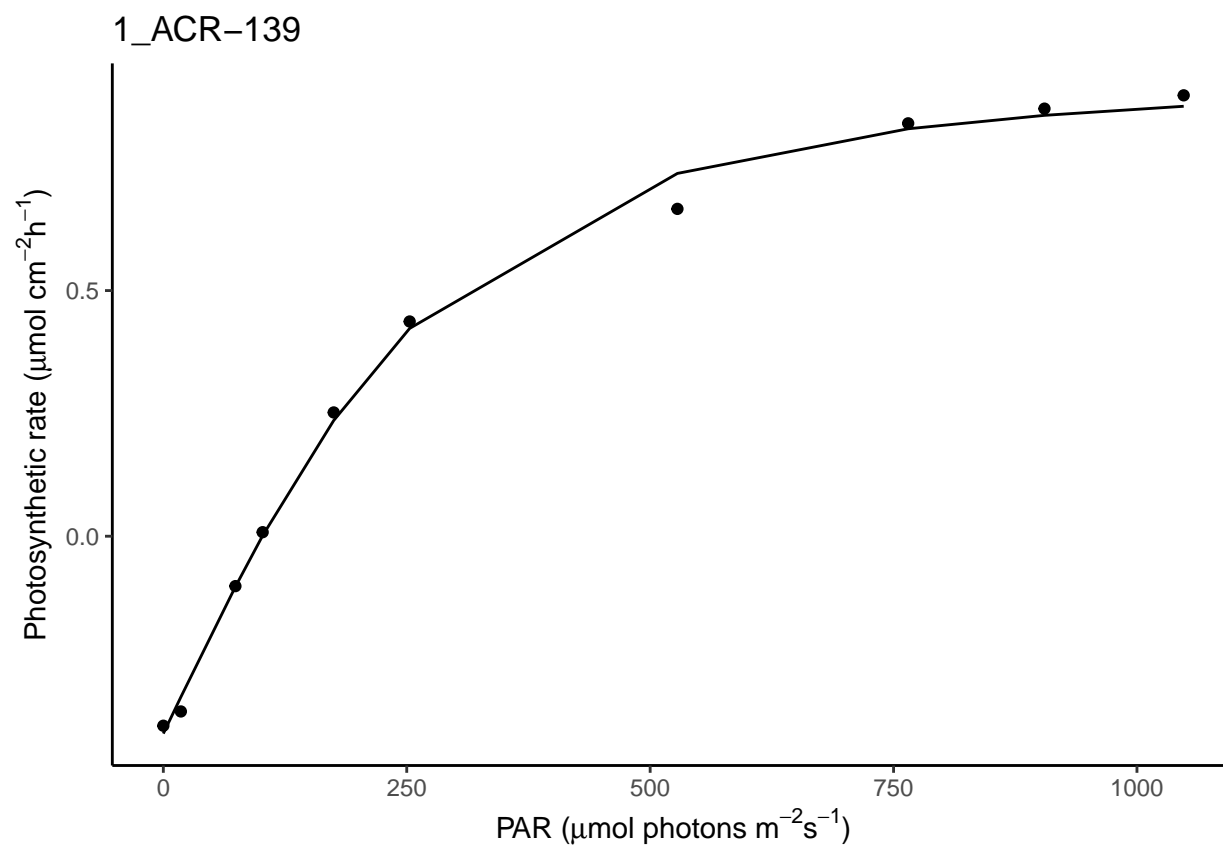
```
## -----  
## augmented$colony_id: POR-224
```



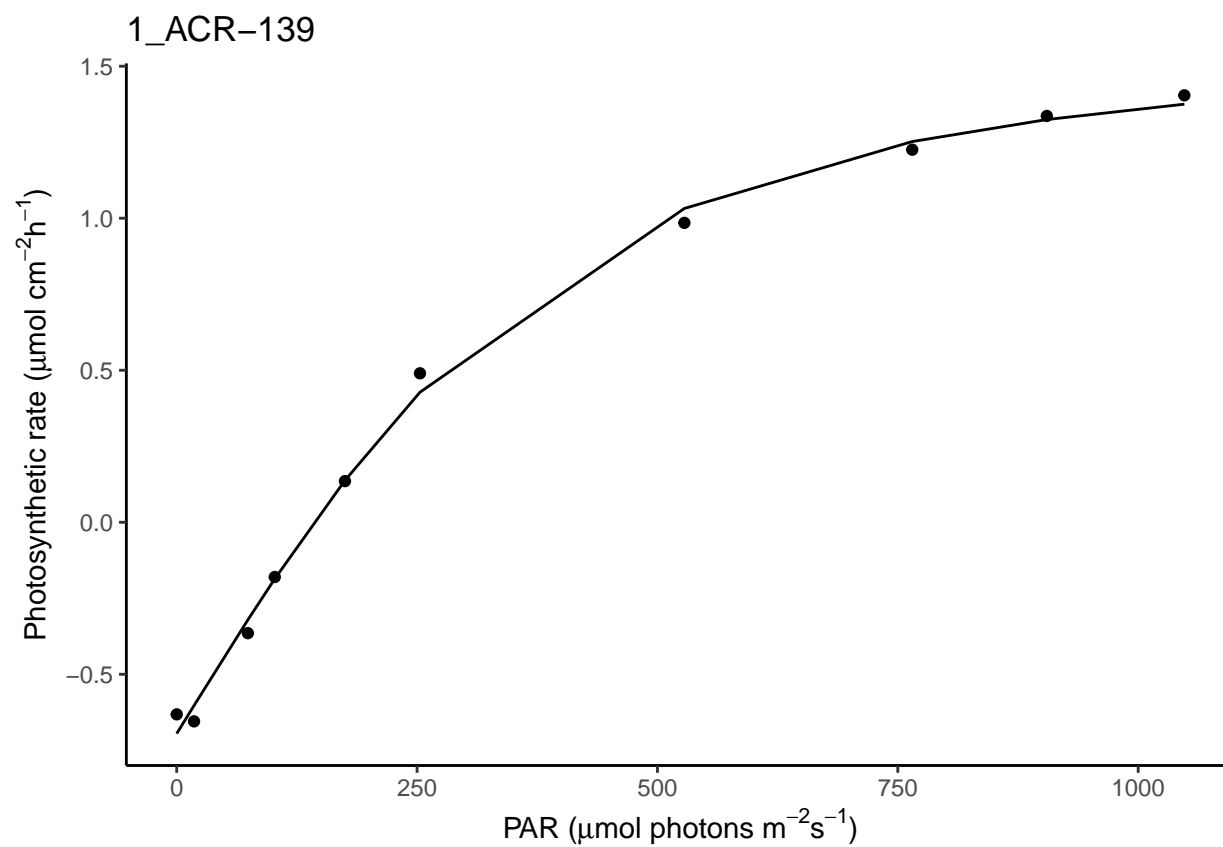
augmented\$colony_id: POR-240



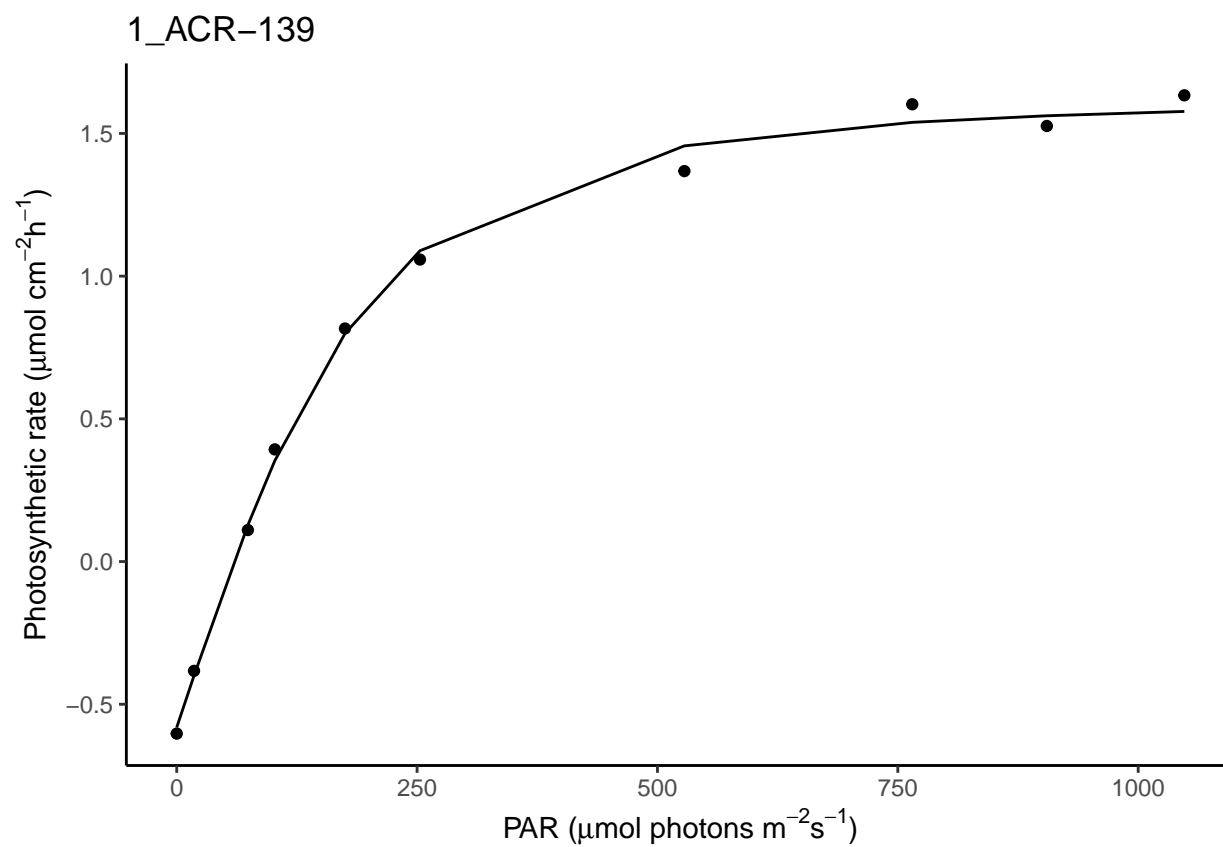
augmented\$colony_id: POR-242



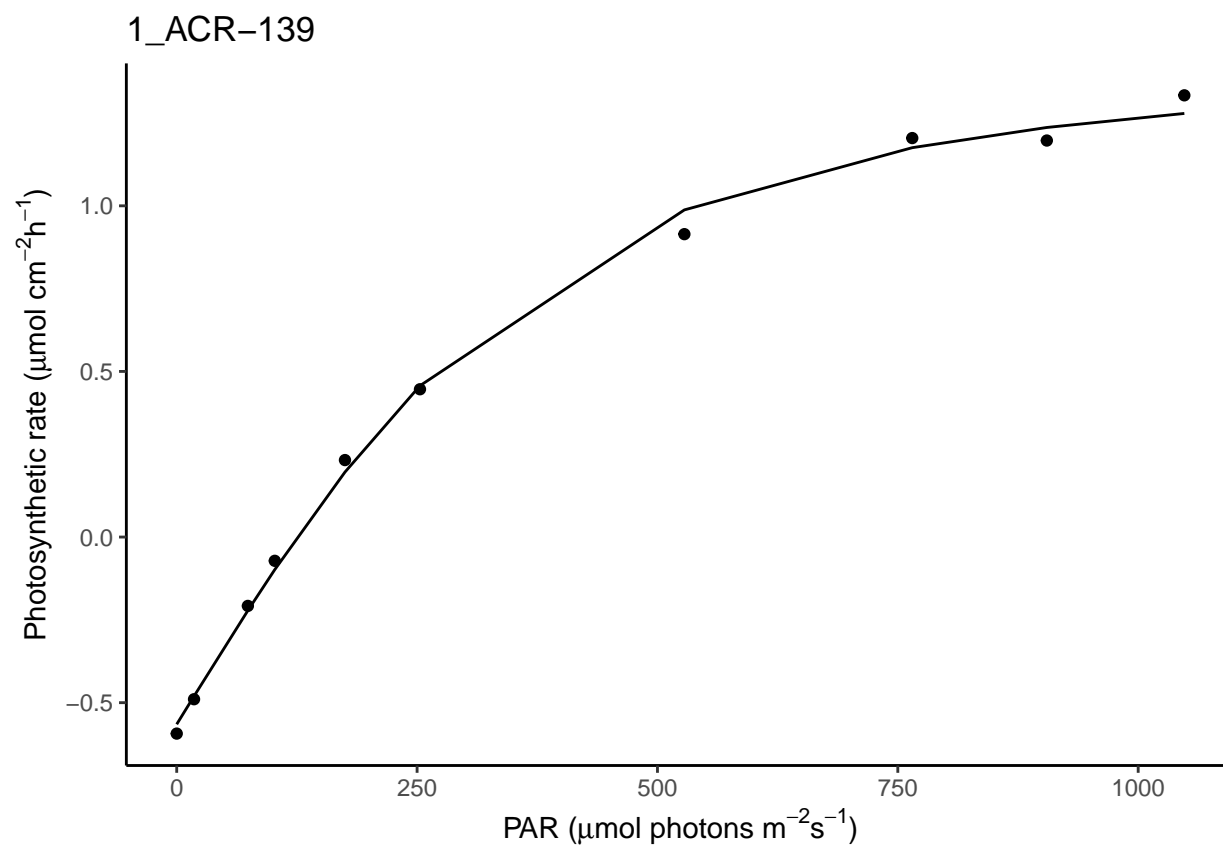
```
## -----  
## augmented$colony_id: POR-245
```



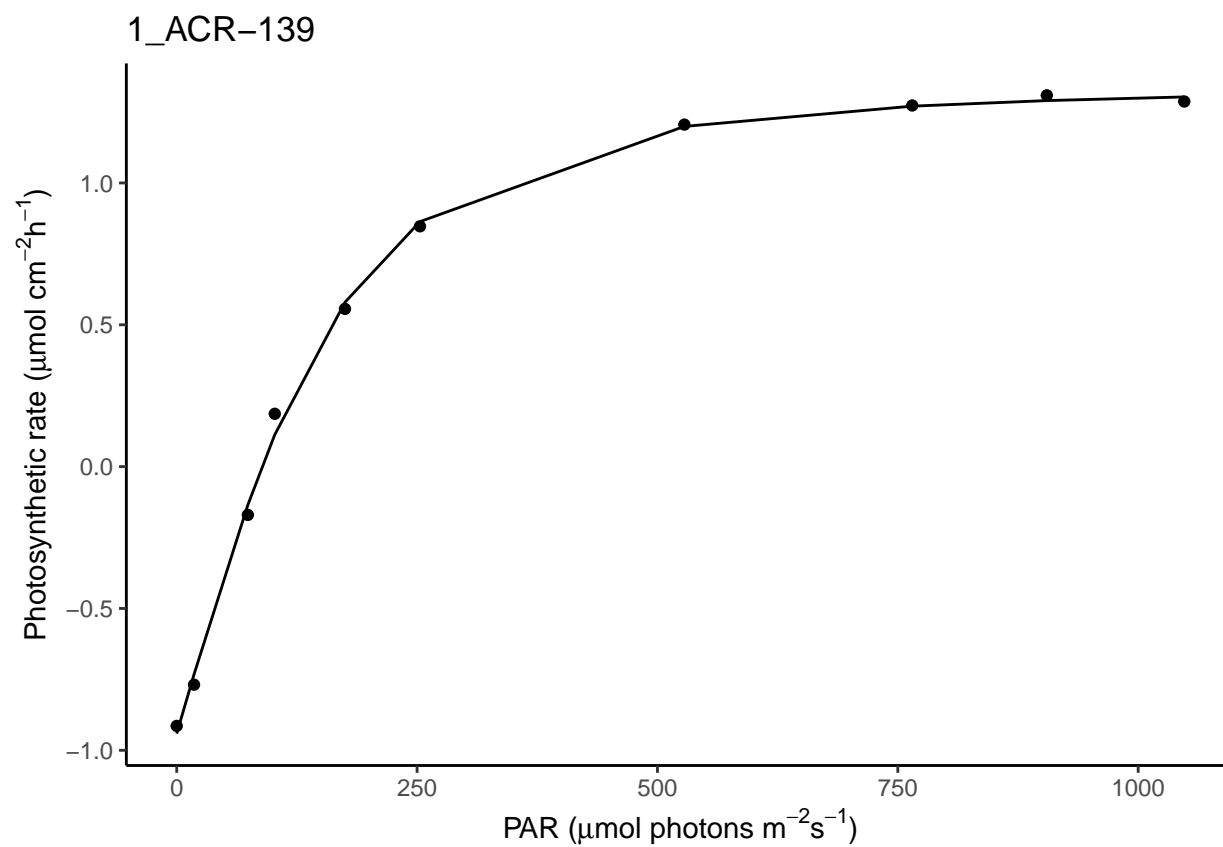
augmented\$colony_id: POR-251



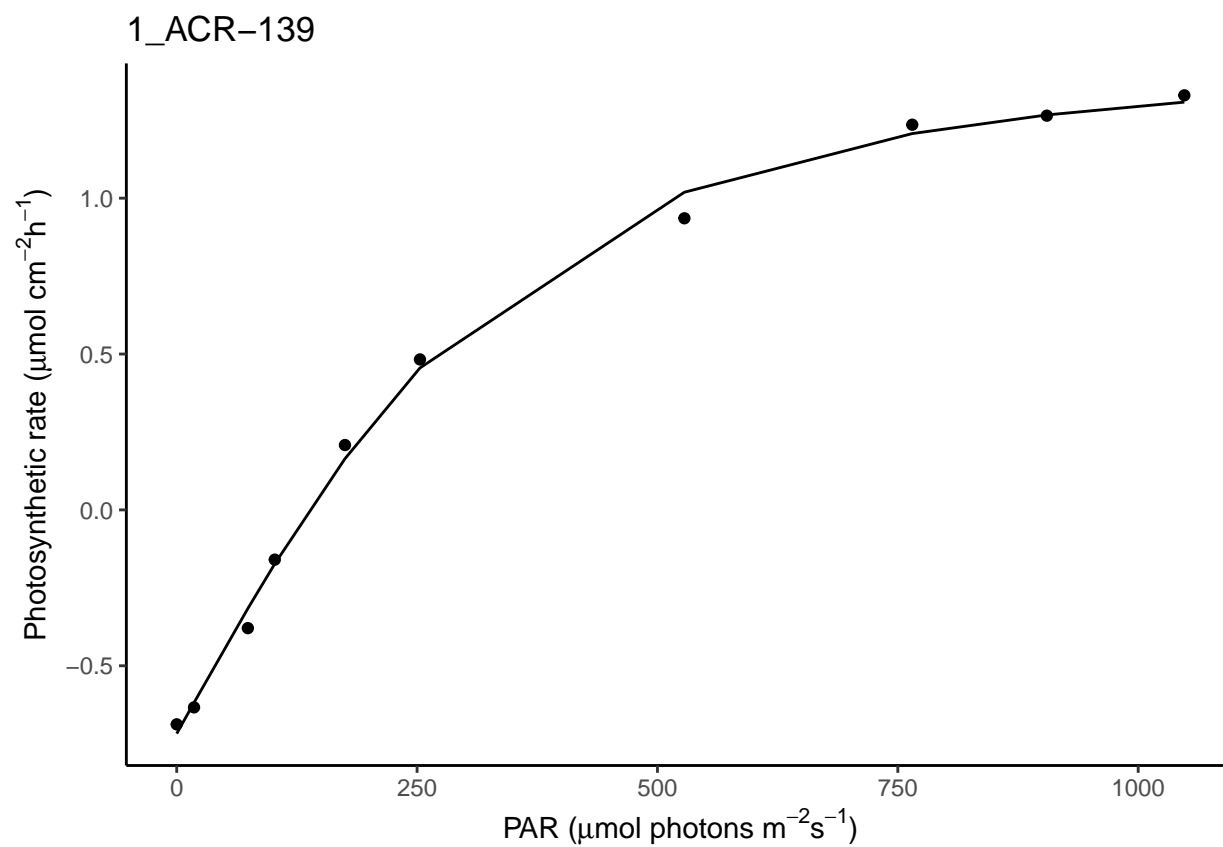
augmented\$colony_id: POR-253



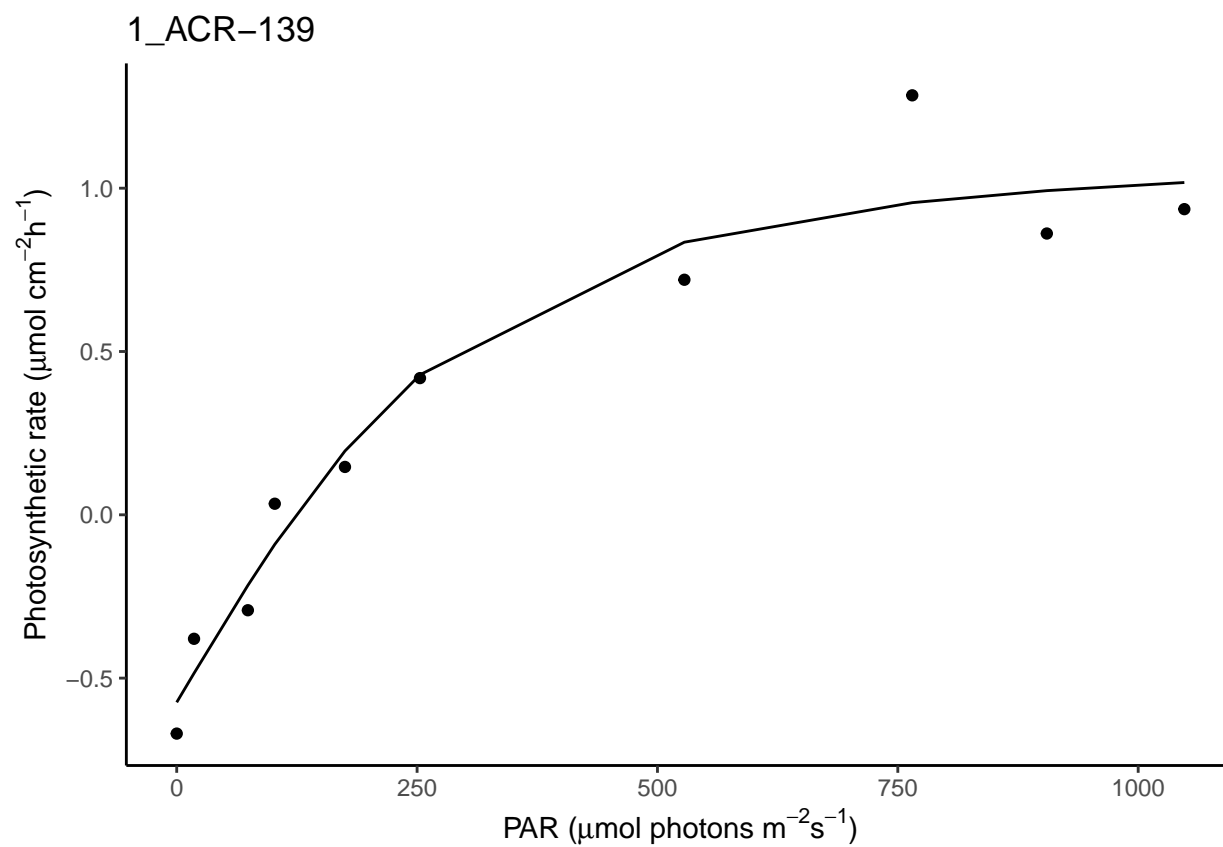
augmented\$colony_id: POR-260



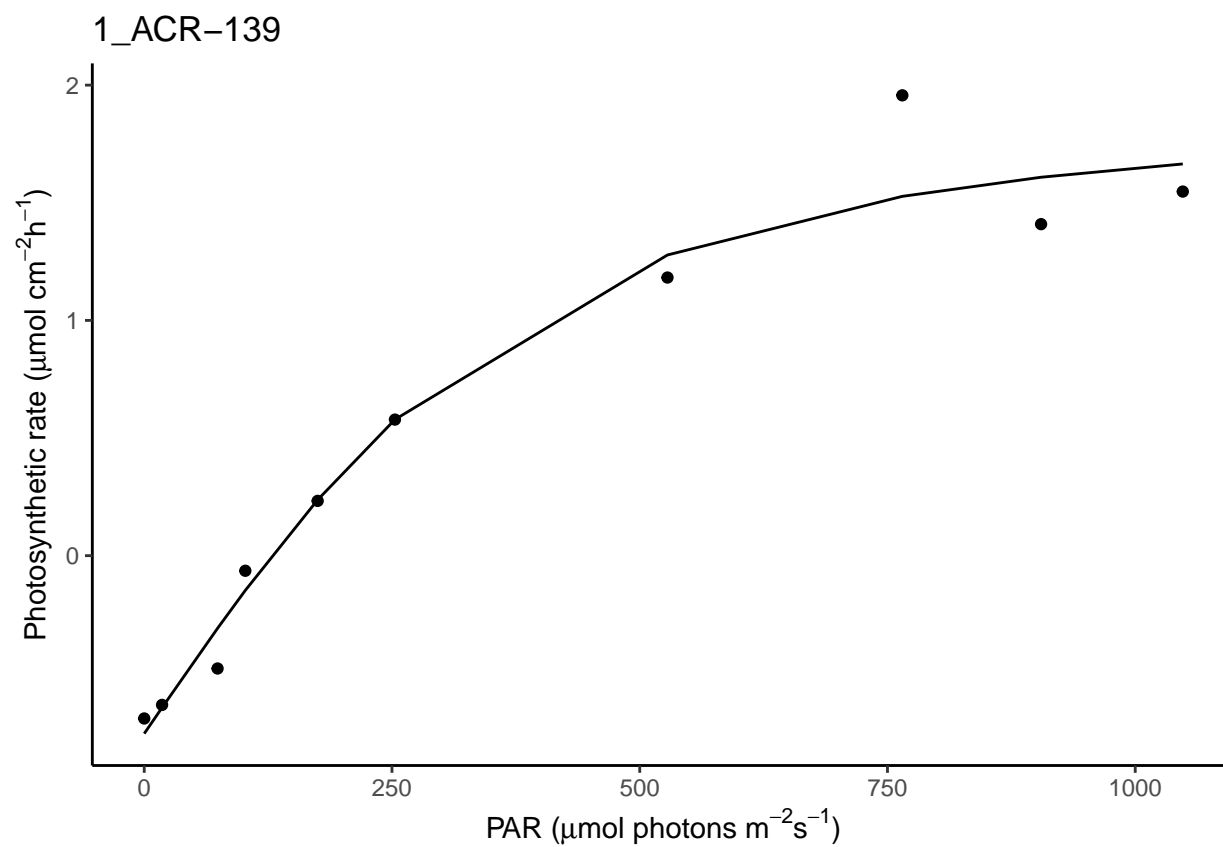
augmented\$colony_id: POR-262



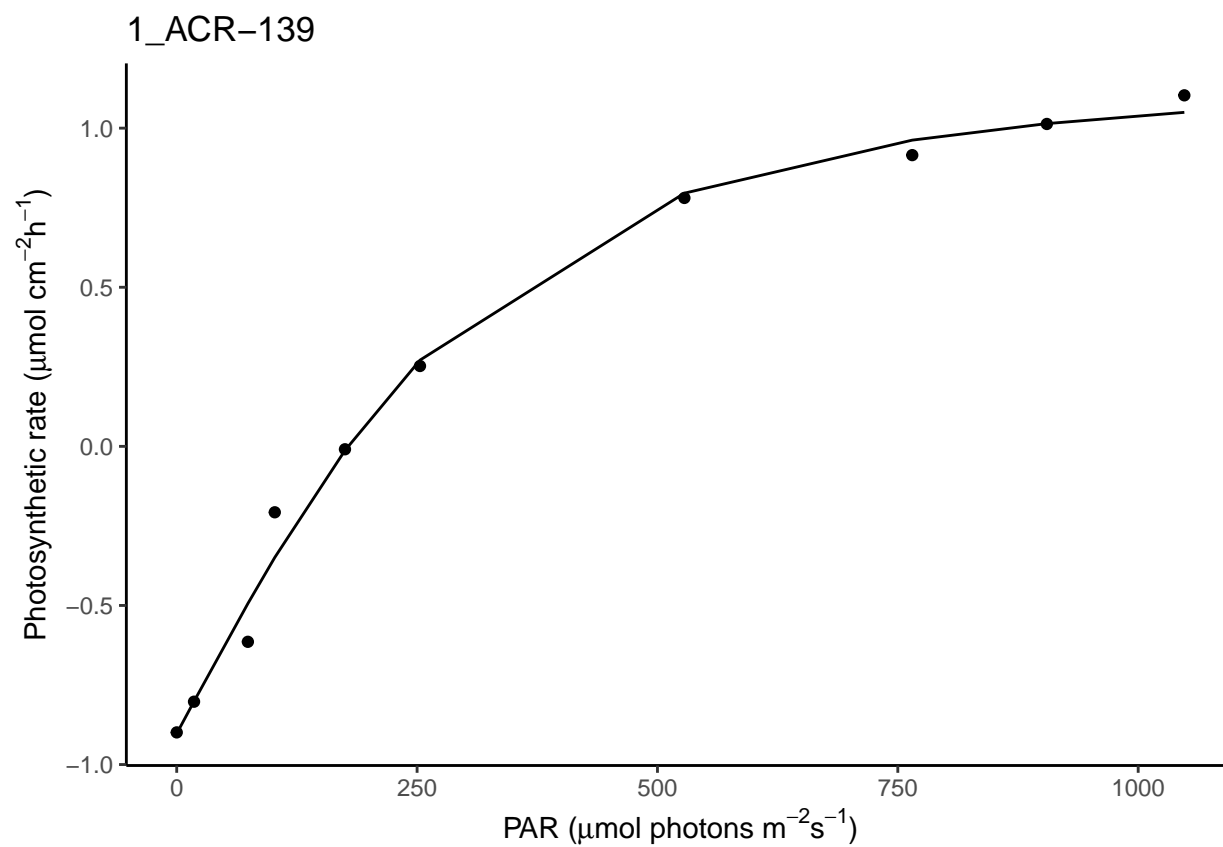
augmented\$colony_id: POR-338



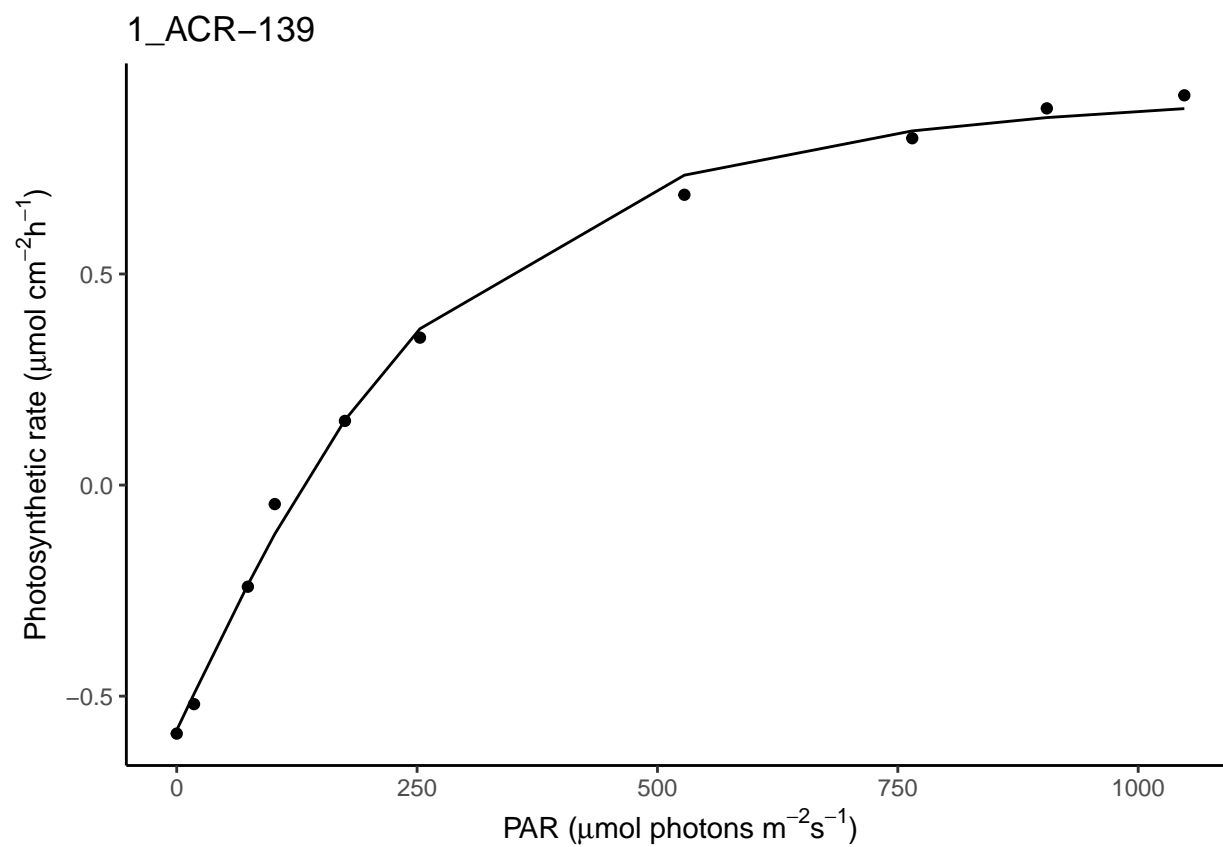
```
## -----  
## augmented$colony_id: POR-340
```



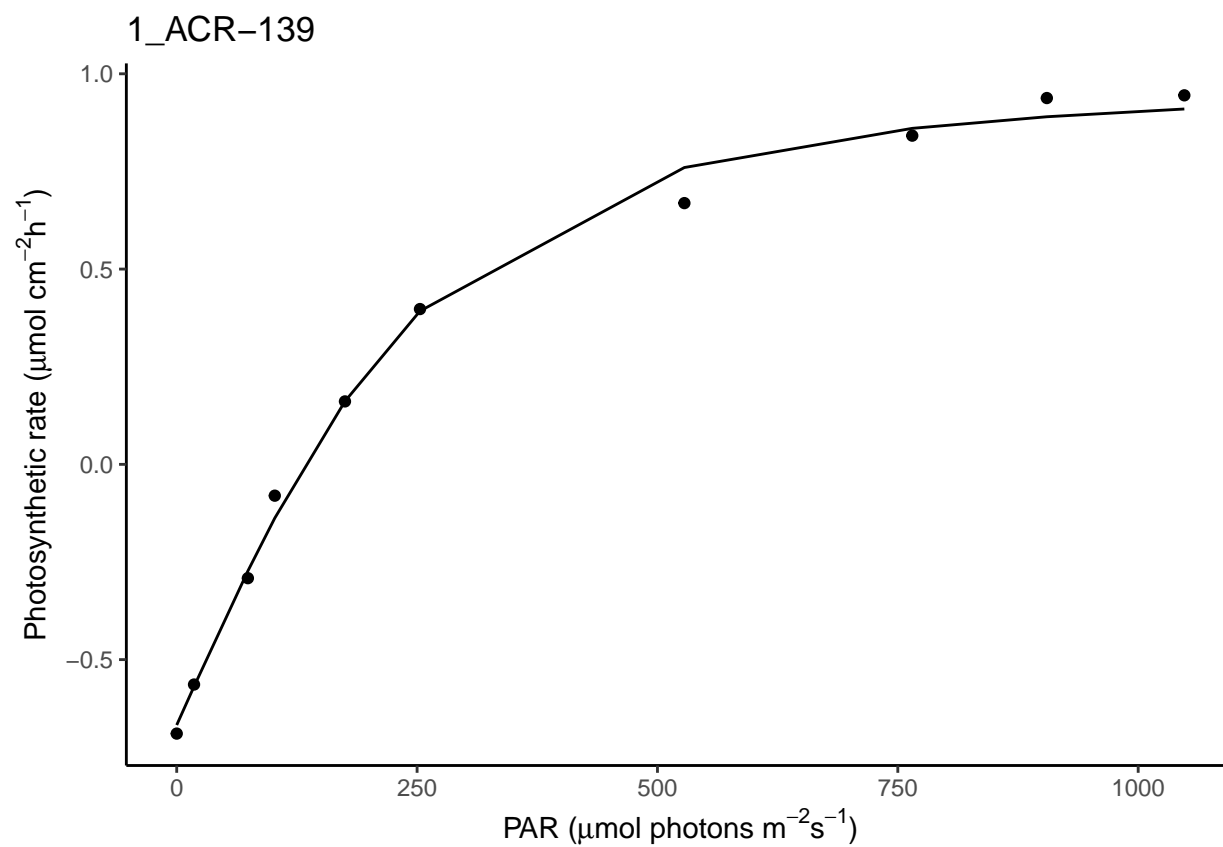
```
## -----  
## augmented$colony_id: POR-341
```



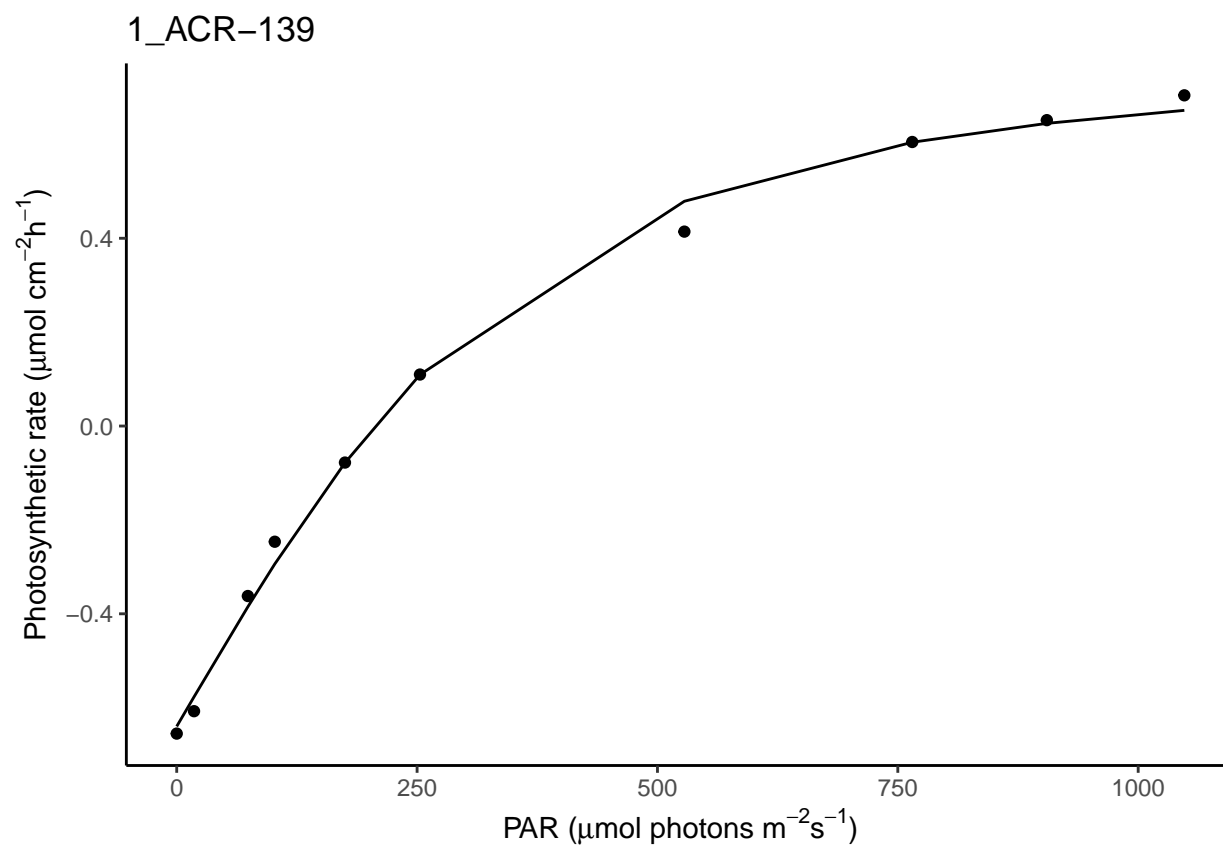
augmented\$colony_id: POR-349



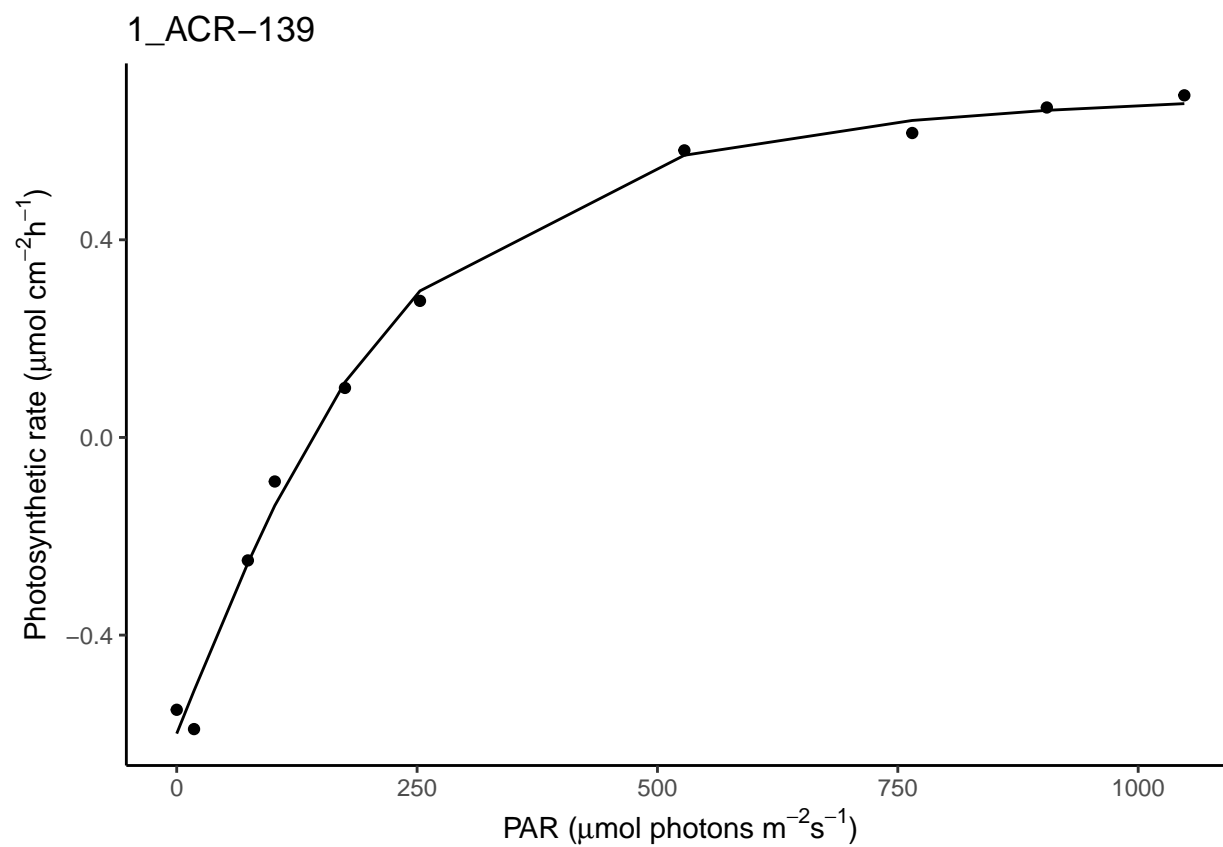
augmented\$colony_id: POR-353



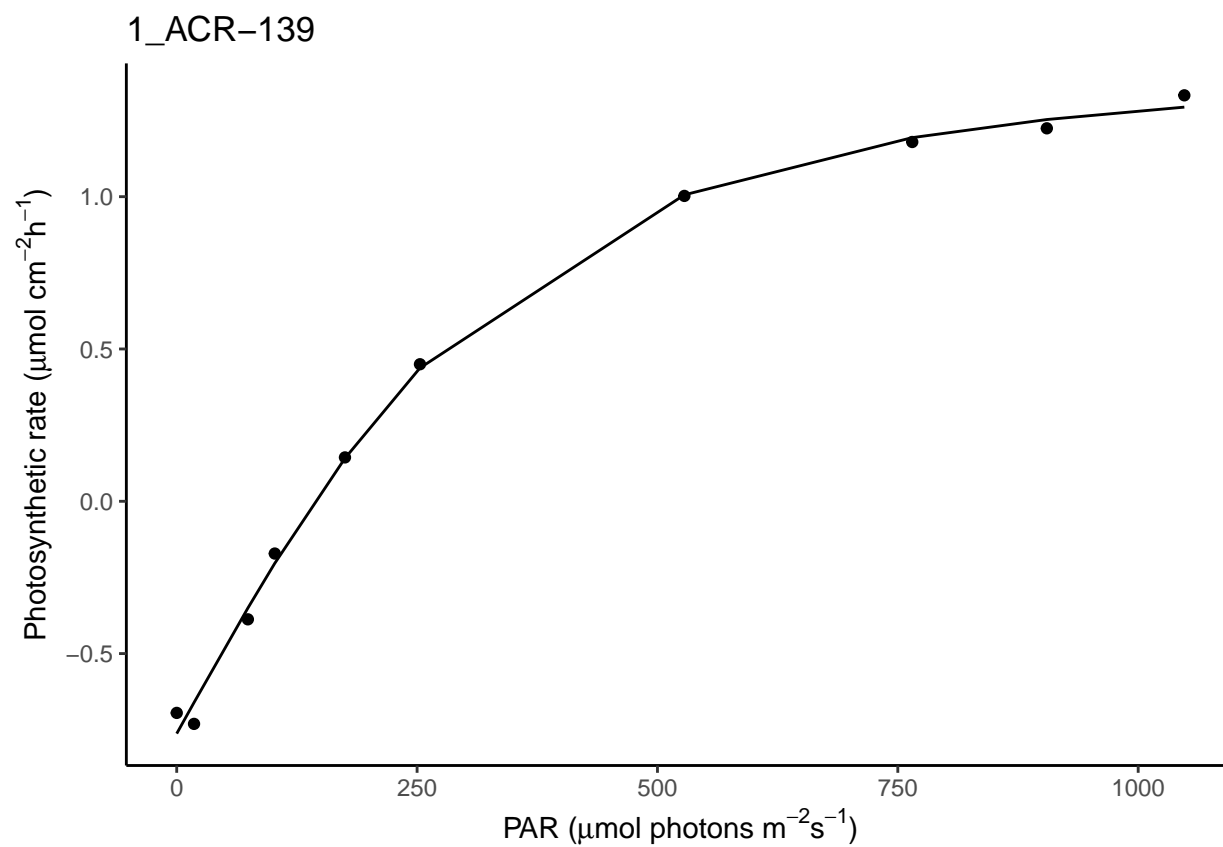
augmented\$colony_id: POR-354



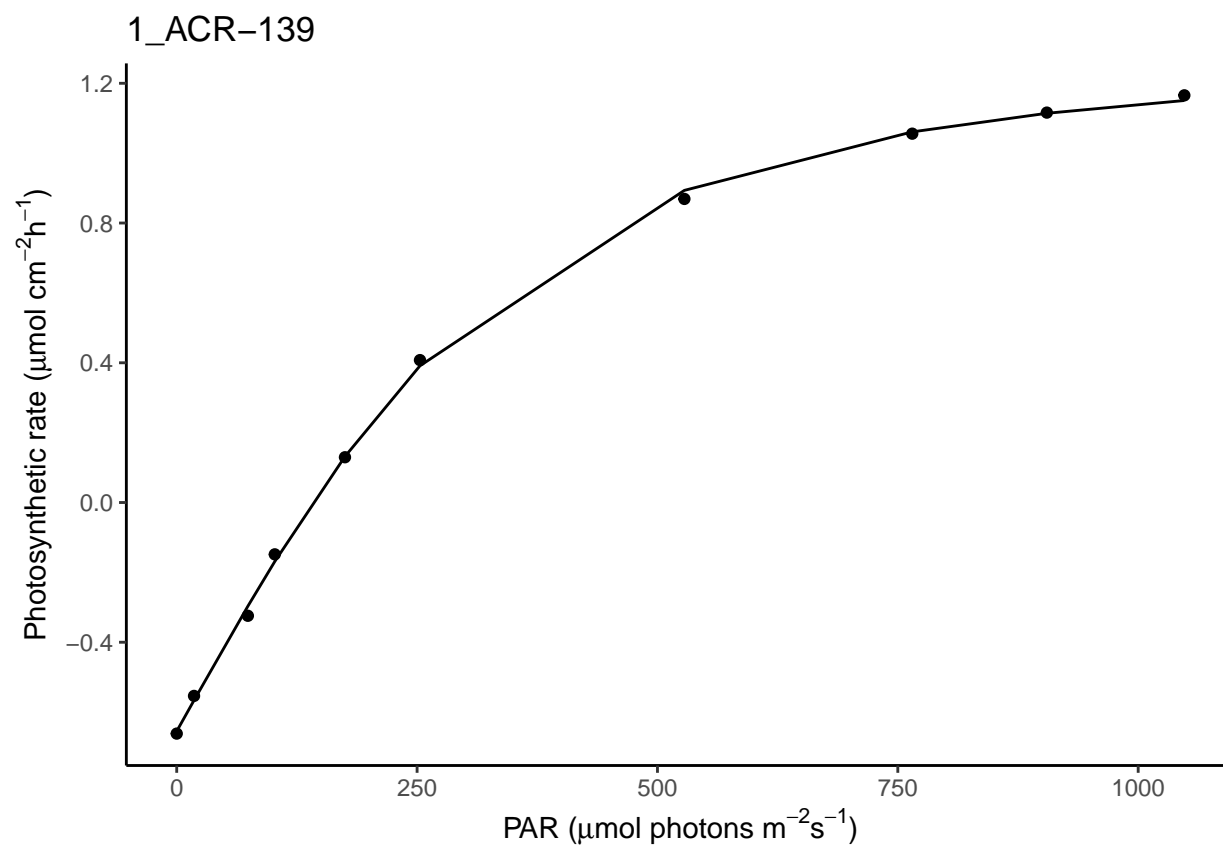
augmented\$colony_id: POR-357



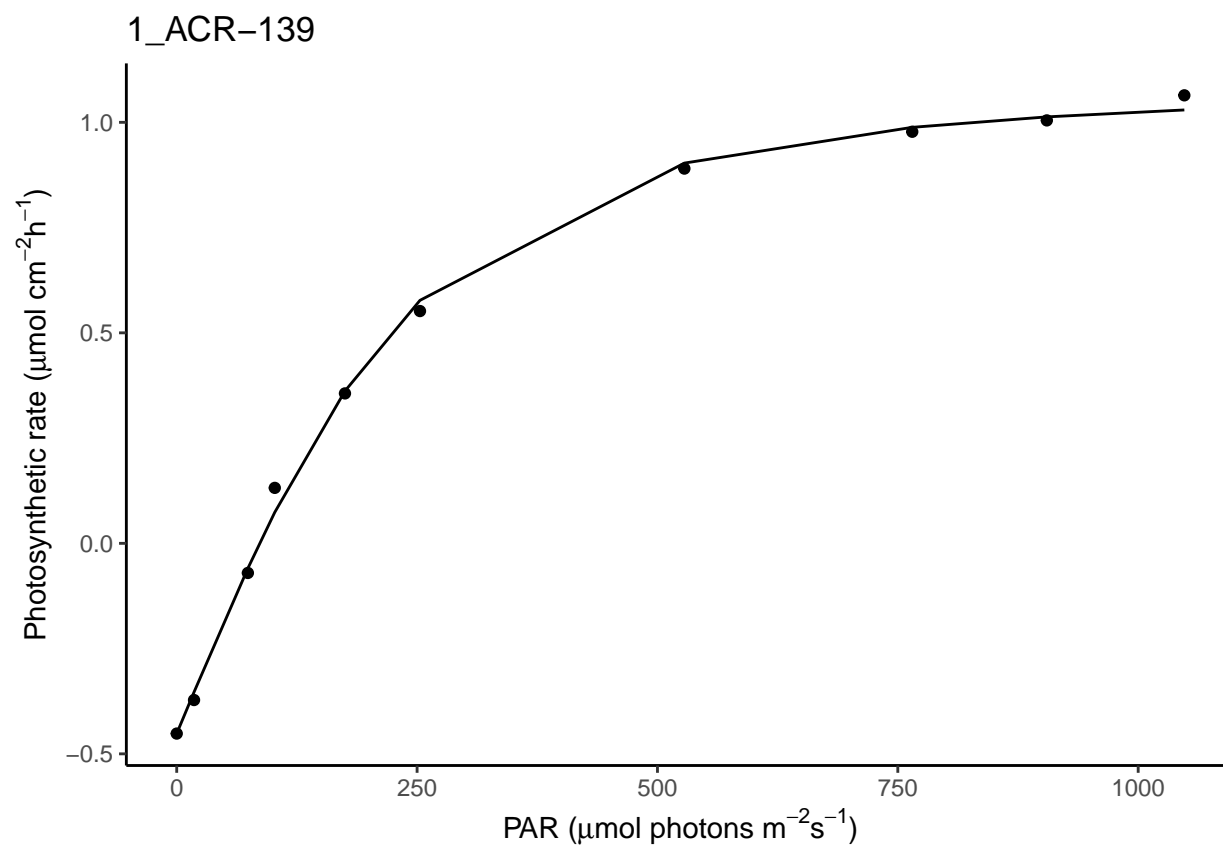
augmented\$colony_id: POR-362



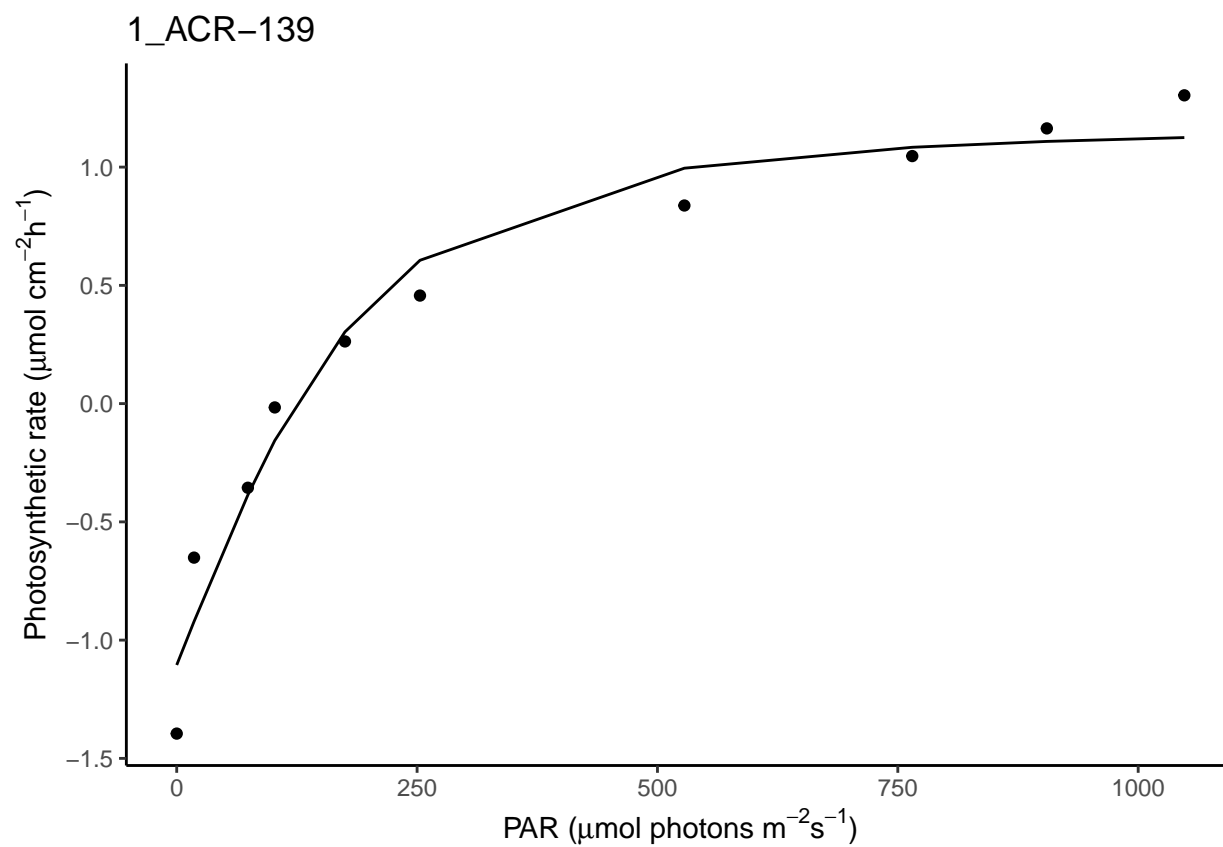
augmented\$colony_id: POR-365



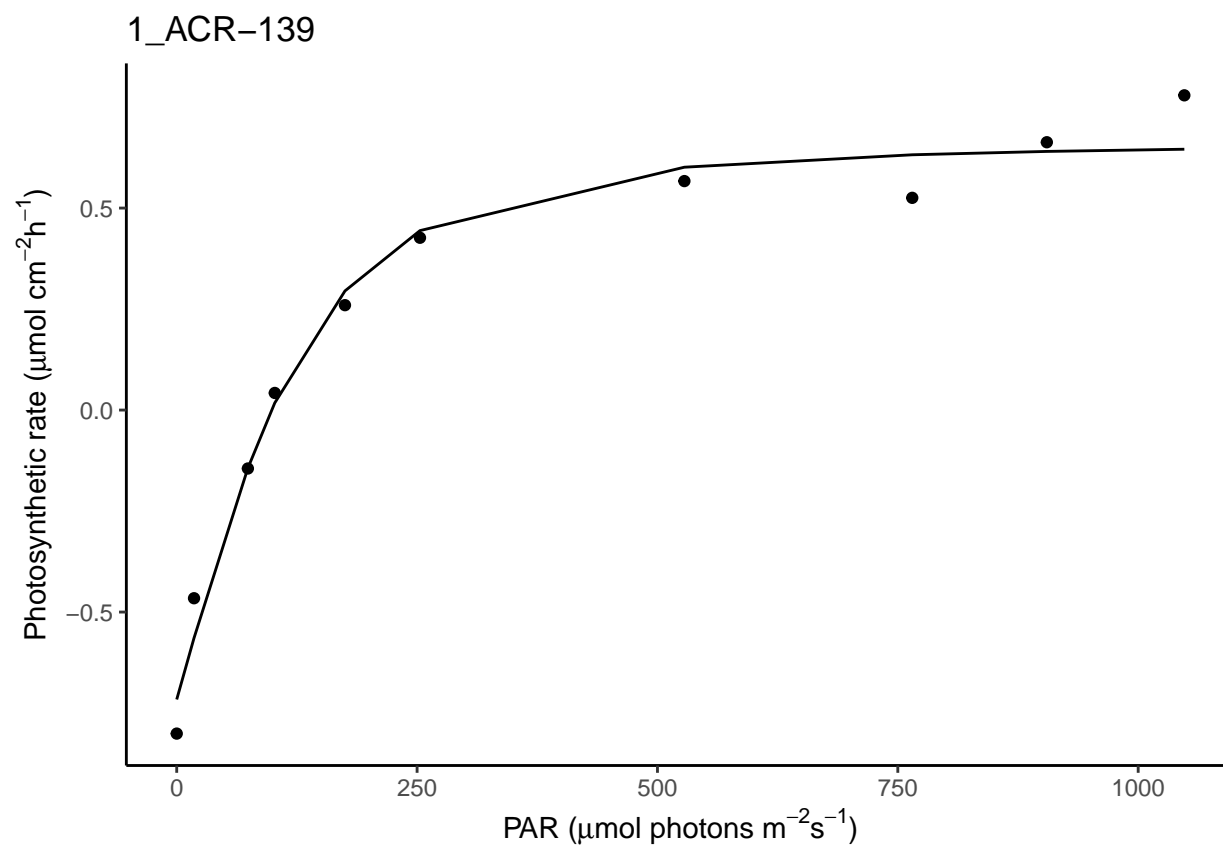
augmented\$colony_id: POR-367



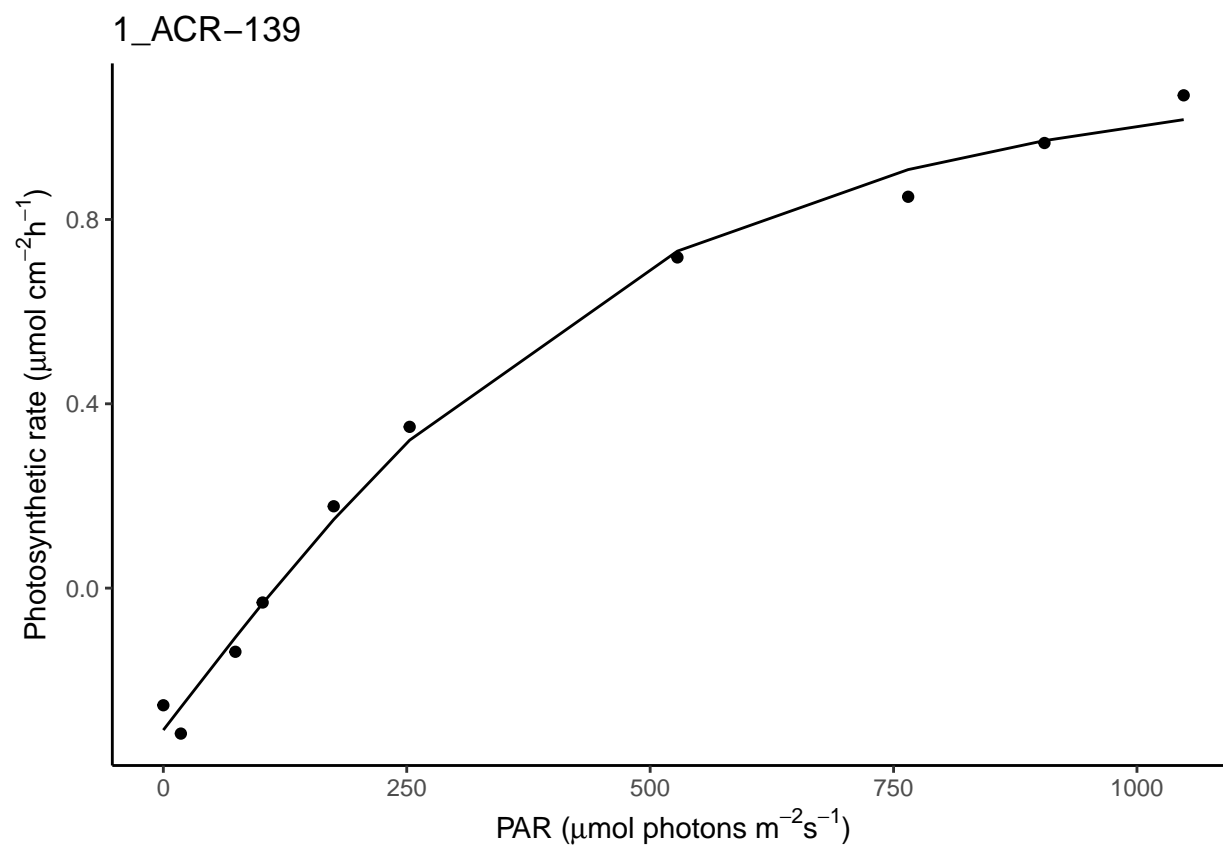
augmented\$colony_id: POR-381



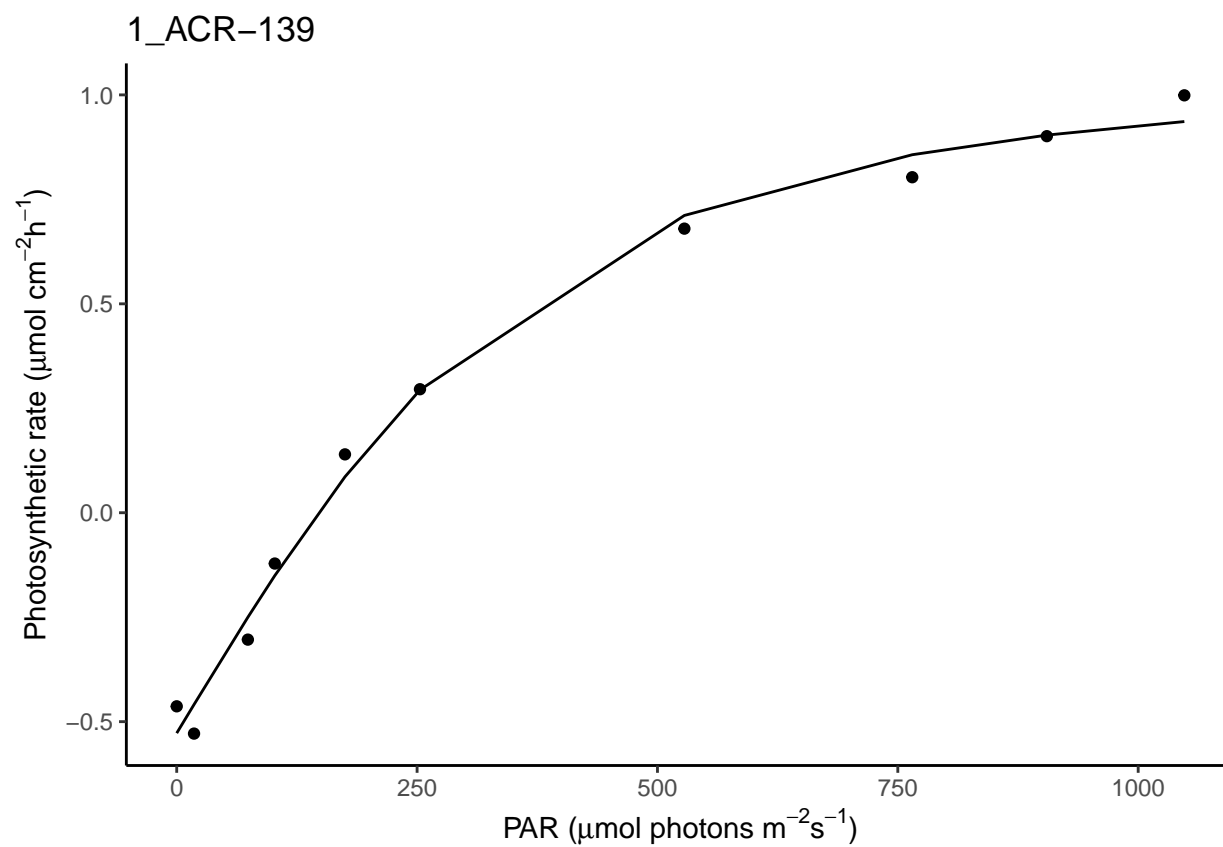
augmented\$colony_id: POR-383



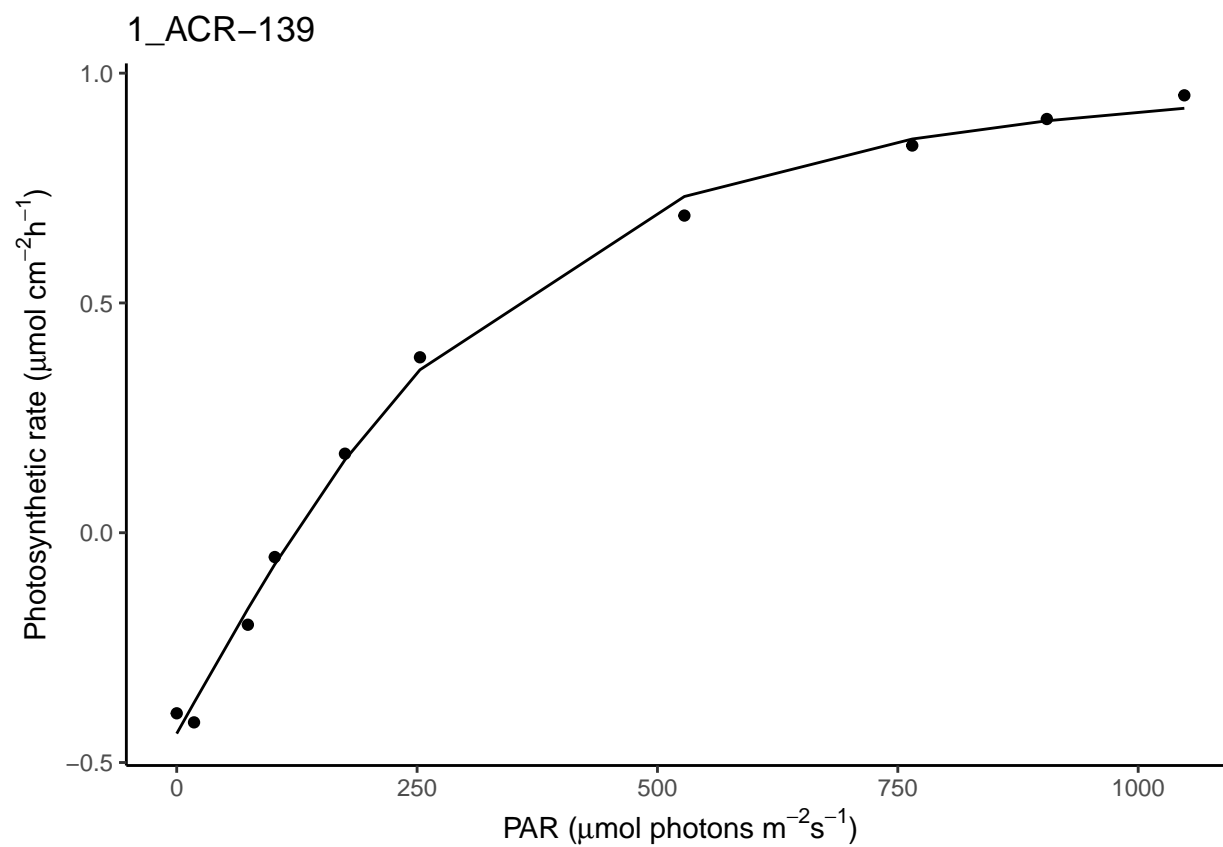
augmented\$colony_id: POR-384



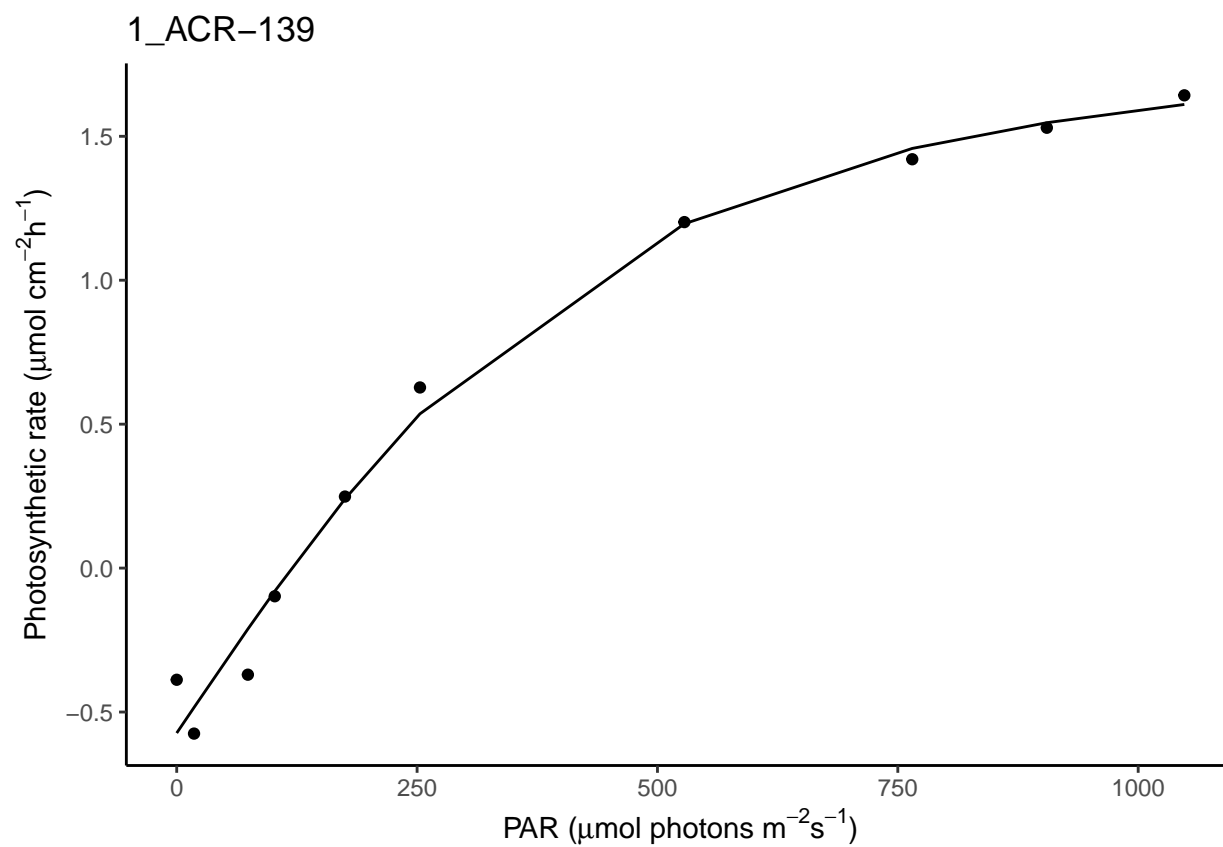
```
## -----  
## augmented$colony_id: POR-385
```



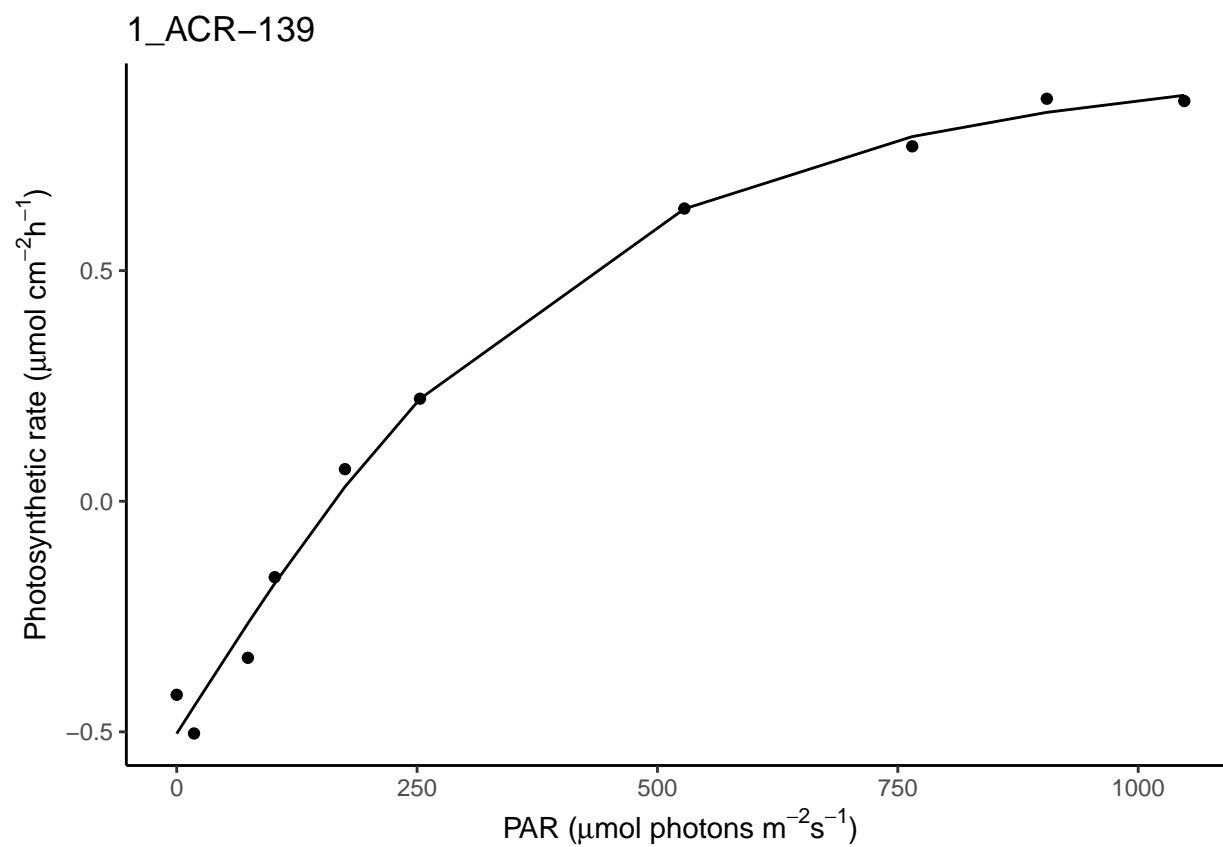
```
## -----  
## augmented$colony_id: POR-69
```



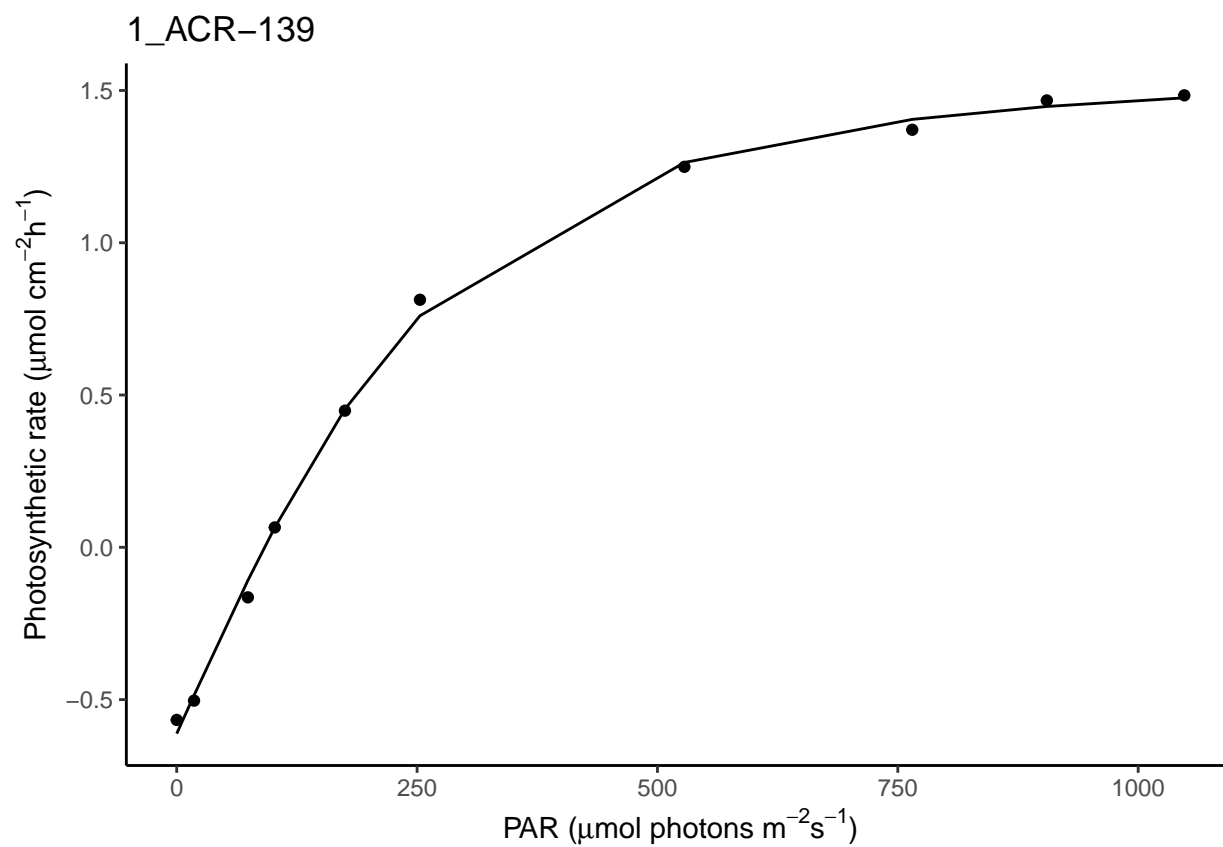
augmented\$colony_id: POR-70



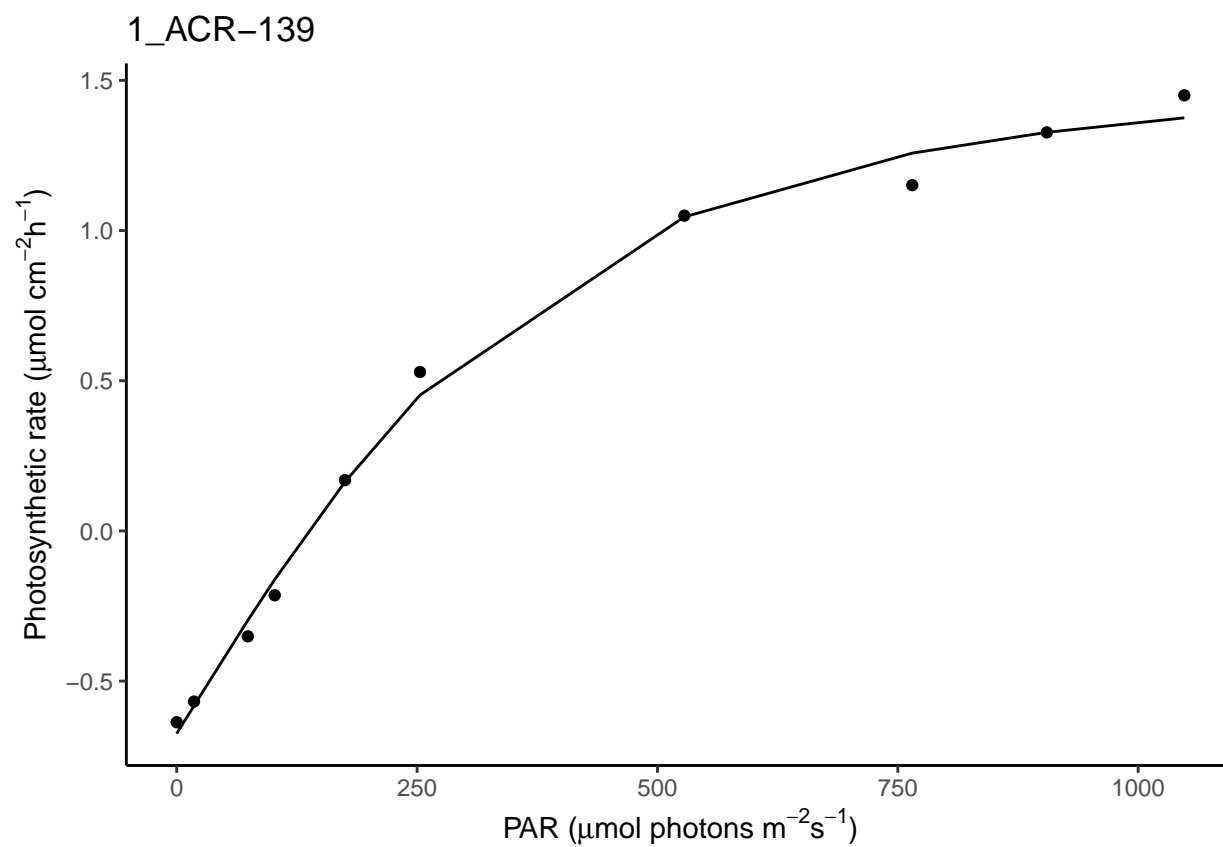
```
## -----  
## augmented$colony_id: POR-71
```



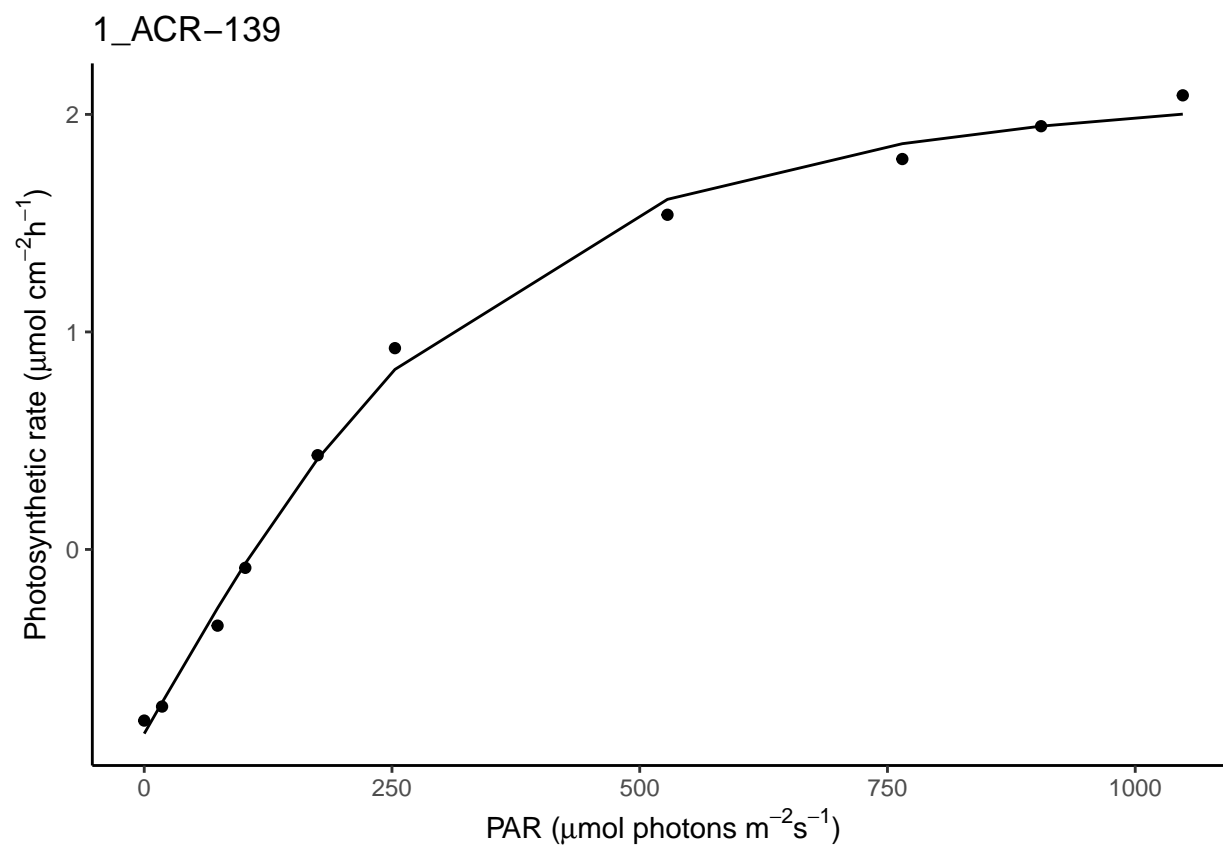
```
## -----  
## augmented$colony_id: POR-72
```



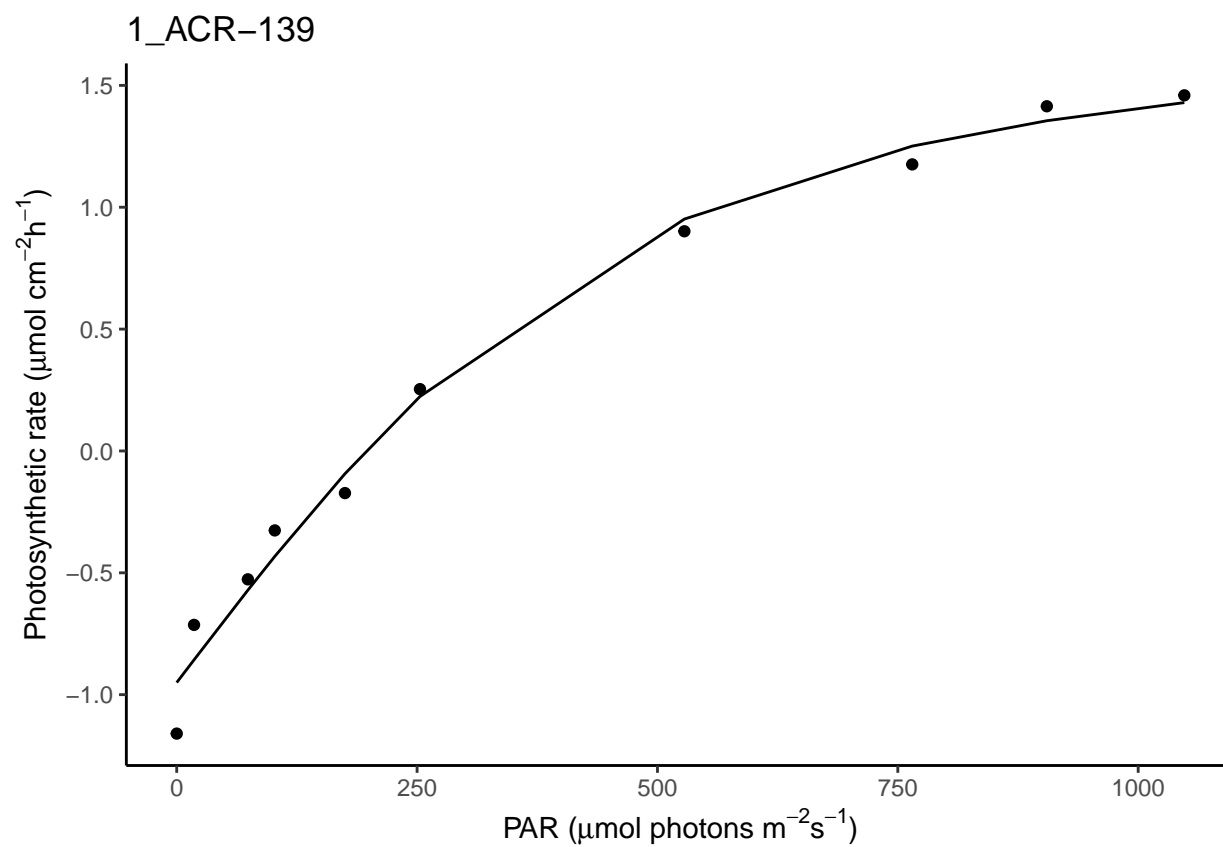
```
## -----  
## augmented$colony_id: POR-73
```



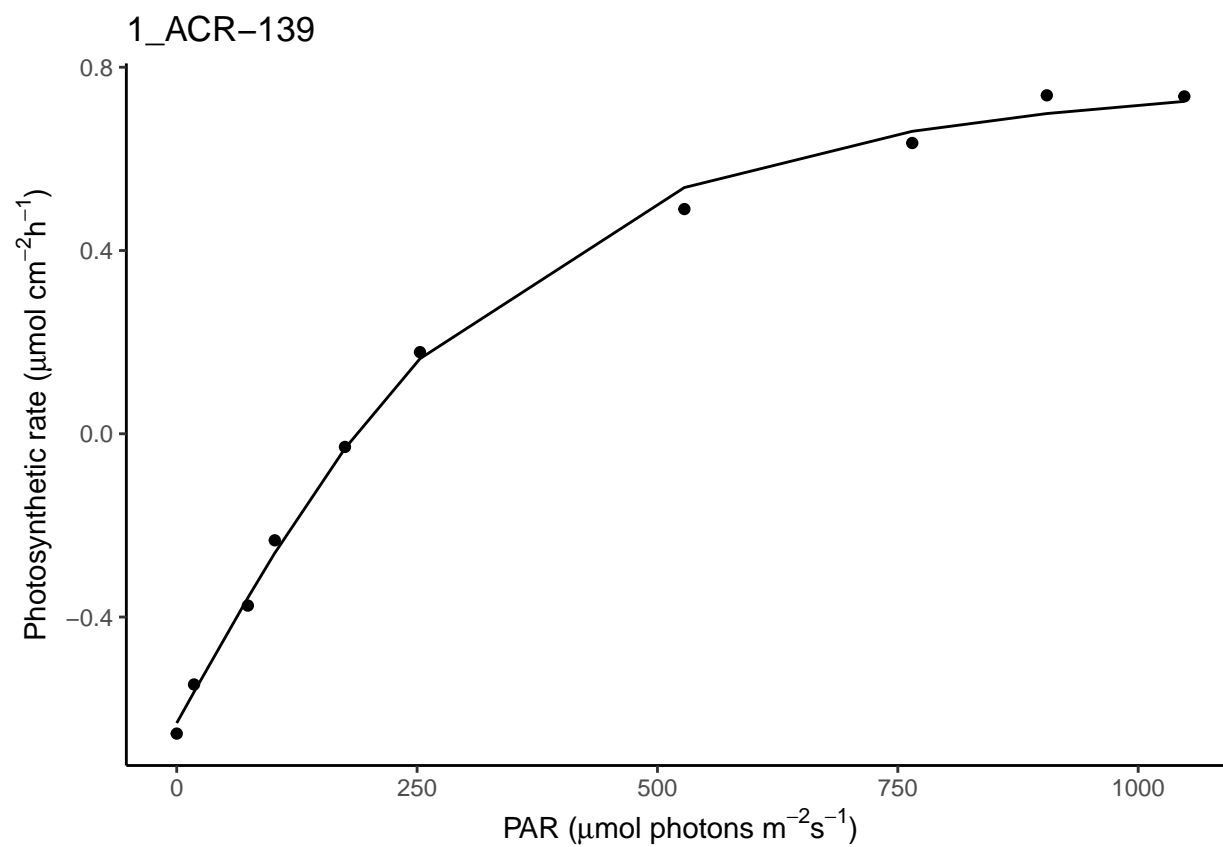
augmented\$colony_id: POR-74



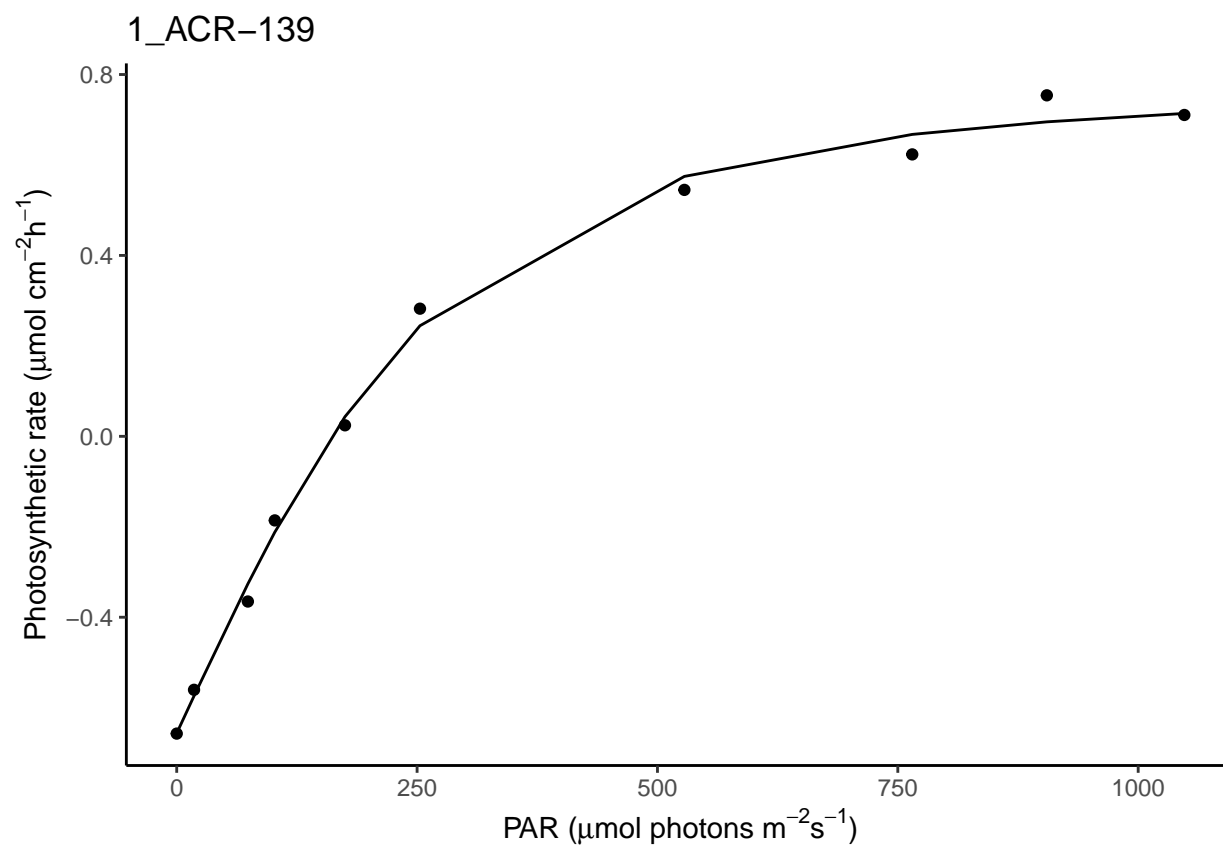
augmented\$colony_id: POR-75



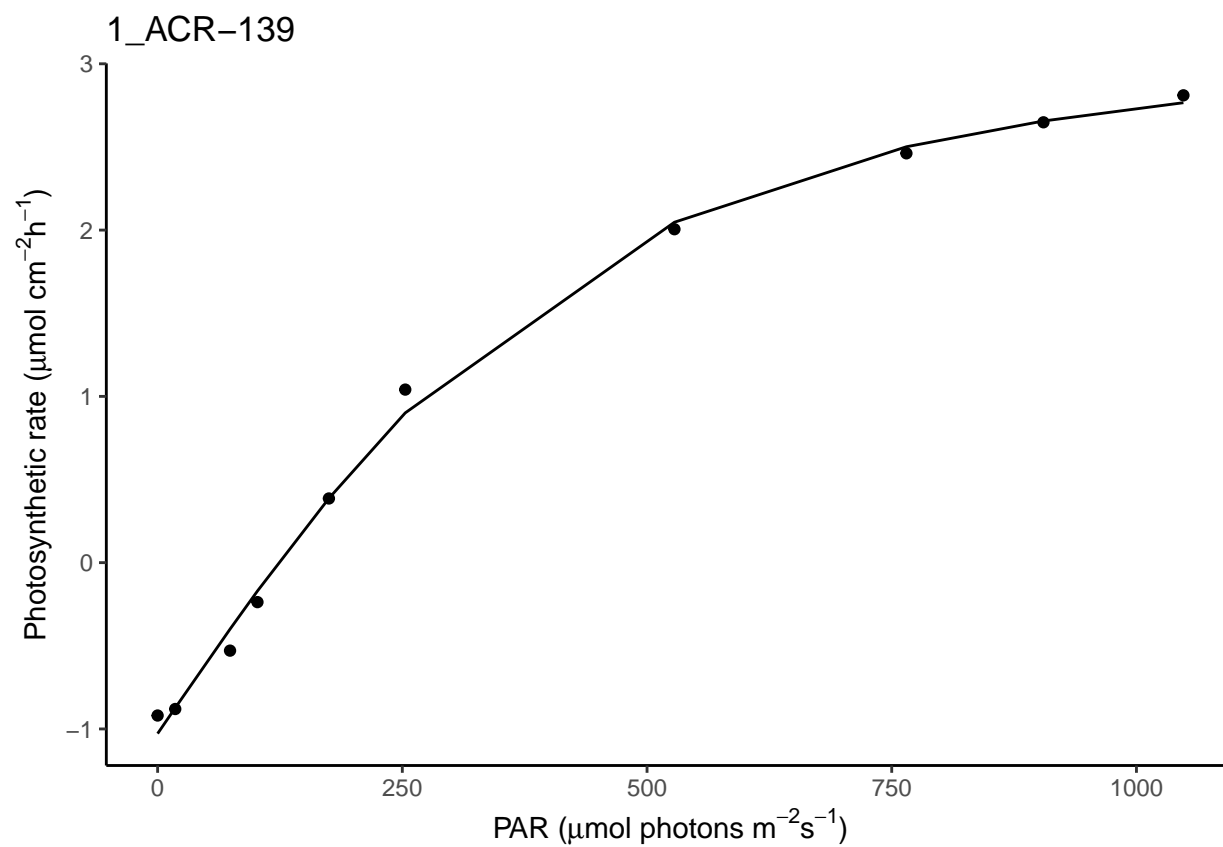
augmented\$colony_id: POR-76



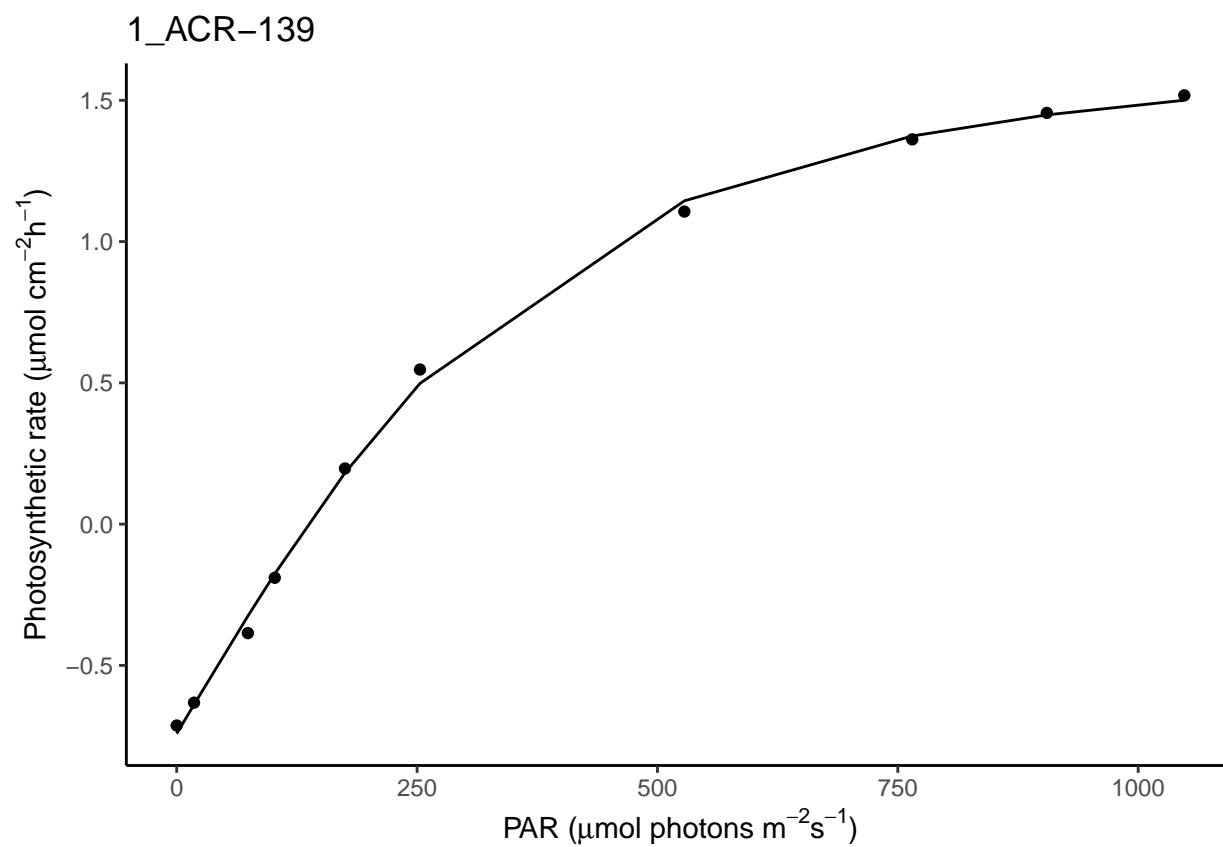
augmented\$colony_id: POR-79



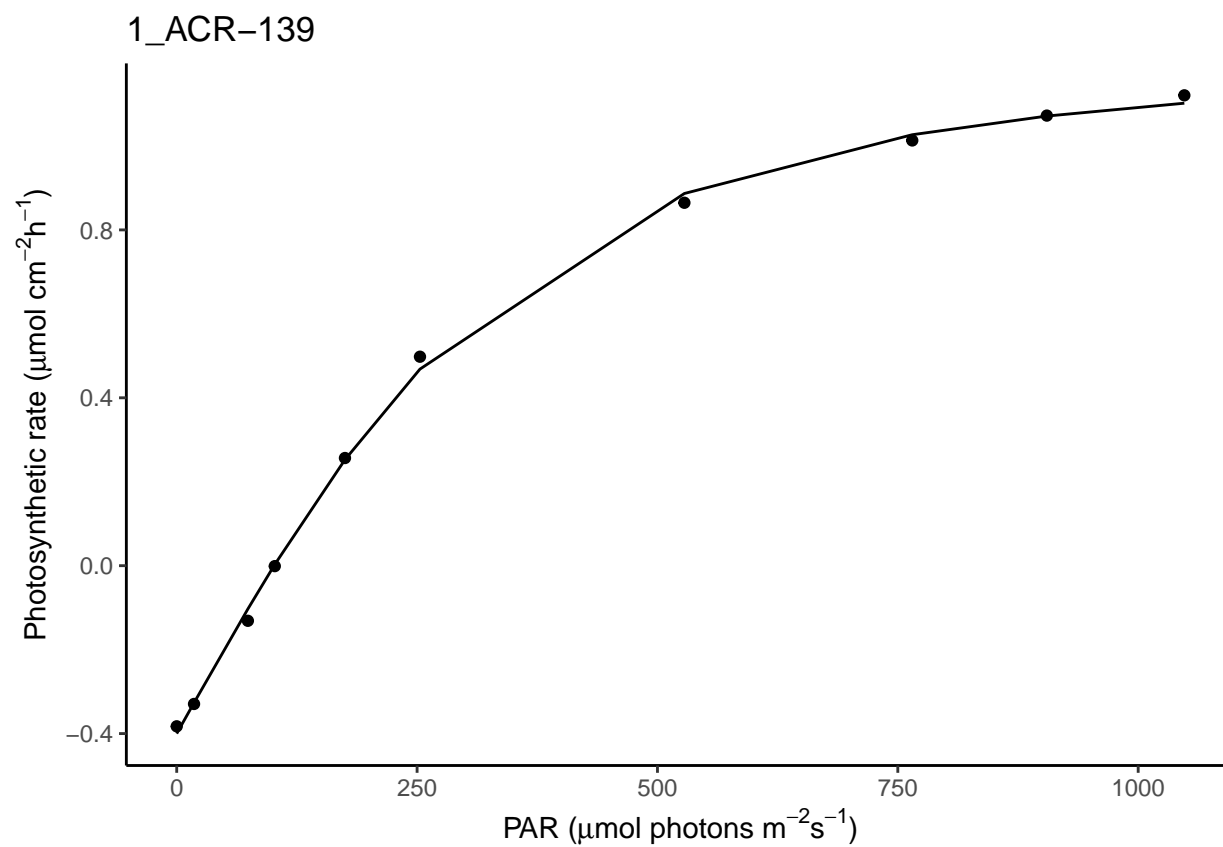
augmented\$colony_id: POR-81



augmented\$colony_id: POR-82



augmented\$colony_id: POR-83



#NEED TO FIND A WAY TO SAVE INDIVIDUALS