

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/2_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>-2)
```

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 (not used, kept for reference):

```
#nls_data <- Data %>%
  #filter(Pc>-2)%>% #remove low outliers
  #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="timepoint2")%>%
  #write_csv(., "output/2_pi_curve_pars_NLS.csv")
```

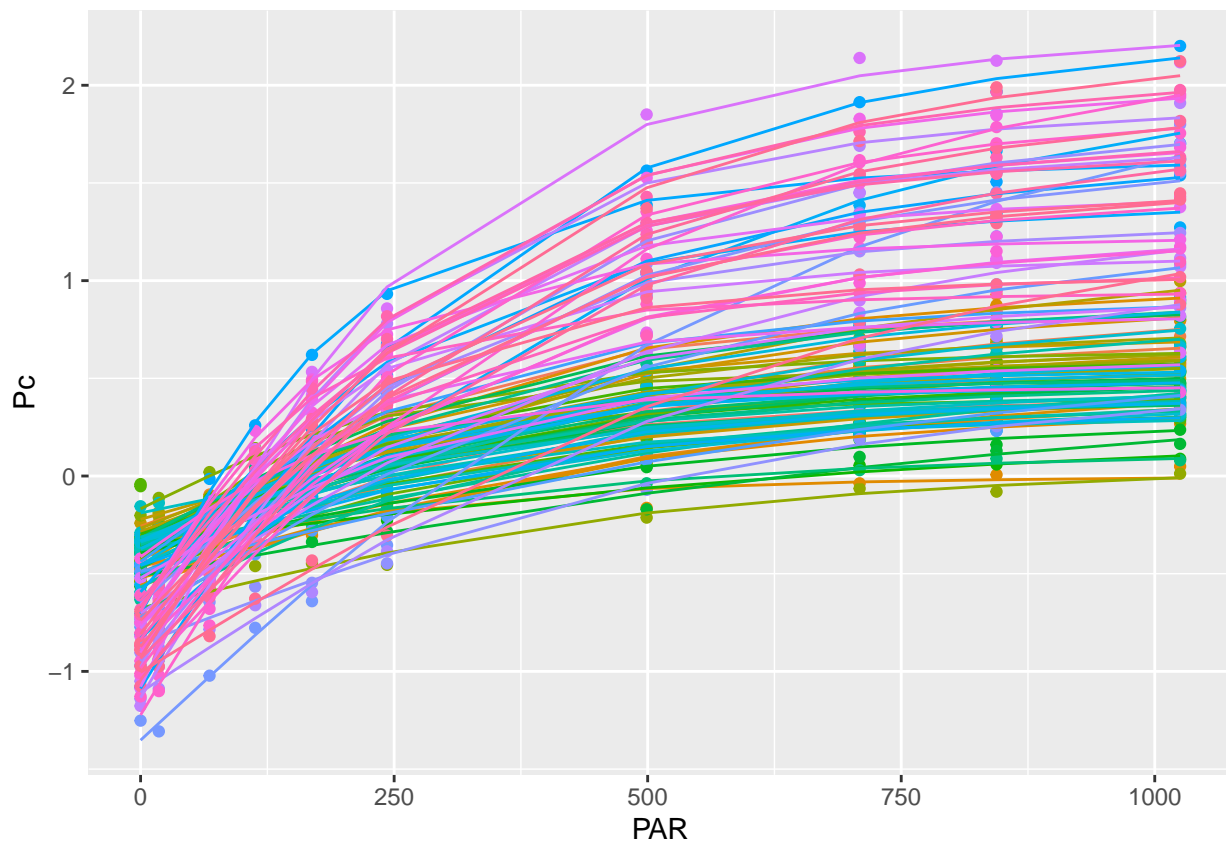
Using flexible initial values based on input data:

```
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=
    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="timepoint2")%>%
  write_csv(., "output/2_pi_curve_pars_NLS.csv")
```

Plot curve over data points.

```
augmented <- Data %>%
  filter(Pc>-2)%>%
  nest(-colony_id) %>%
  mutate(
    fit = map(data, ~ nls(Pc ~ (Am*((AQY*PAR)/(sqrt(Am^2 + (AQY*PAR)^2)))-Rd), data=., start=list(Am=0.1, Rd=0.1)),
    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")
```

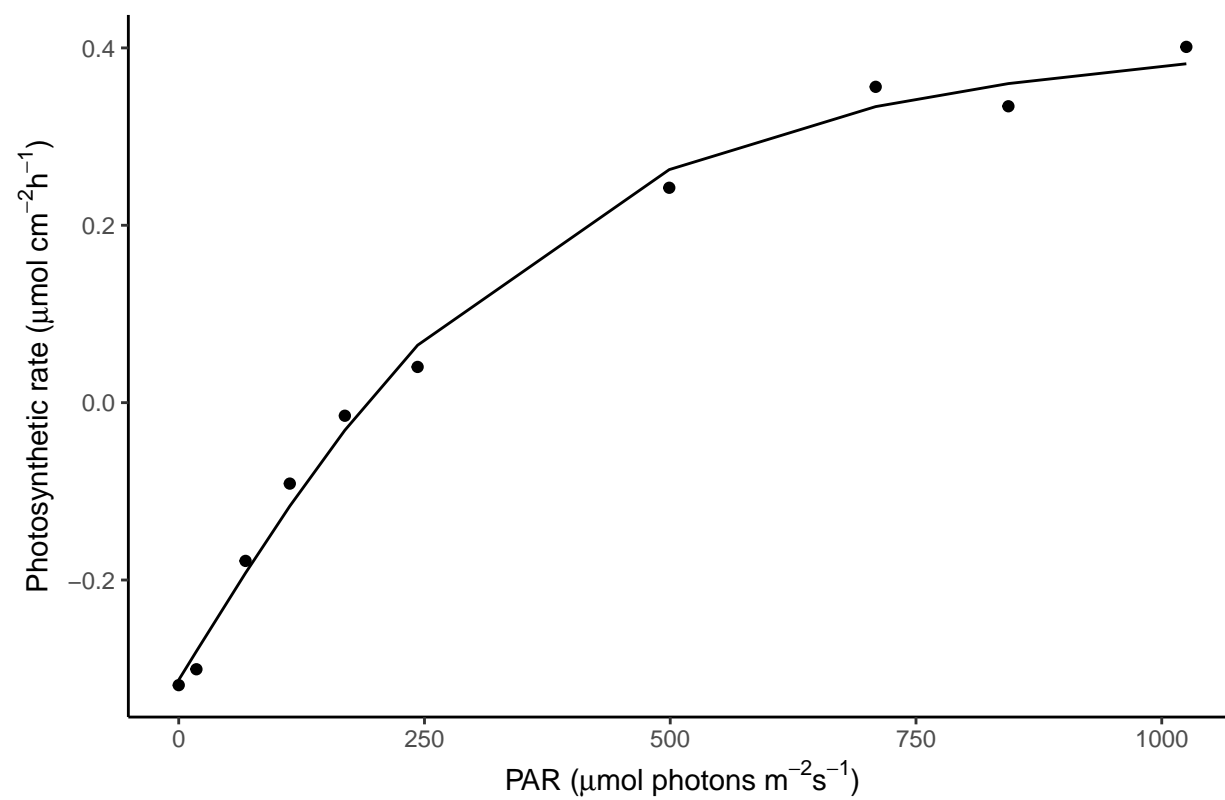


```
#view individual plots
by(augmented,augmented$colony_id, function(i) {
  ggplot(i) +
    geom_point(aes(PAR, Pc, group=colony_id)) +
    geom_line(aes(y=.fitted, x=PAR)) +
    theme_classic()+
    labs(x = expression(paste('PAR (', mu, "mol photons m"^-2, 's'^-1,")')),
         y = expression(paste('Photosynthetic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

```
} )
```

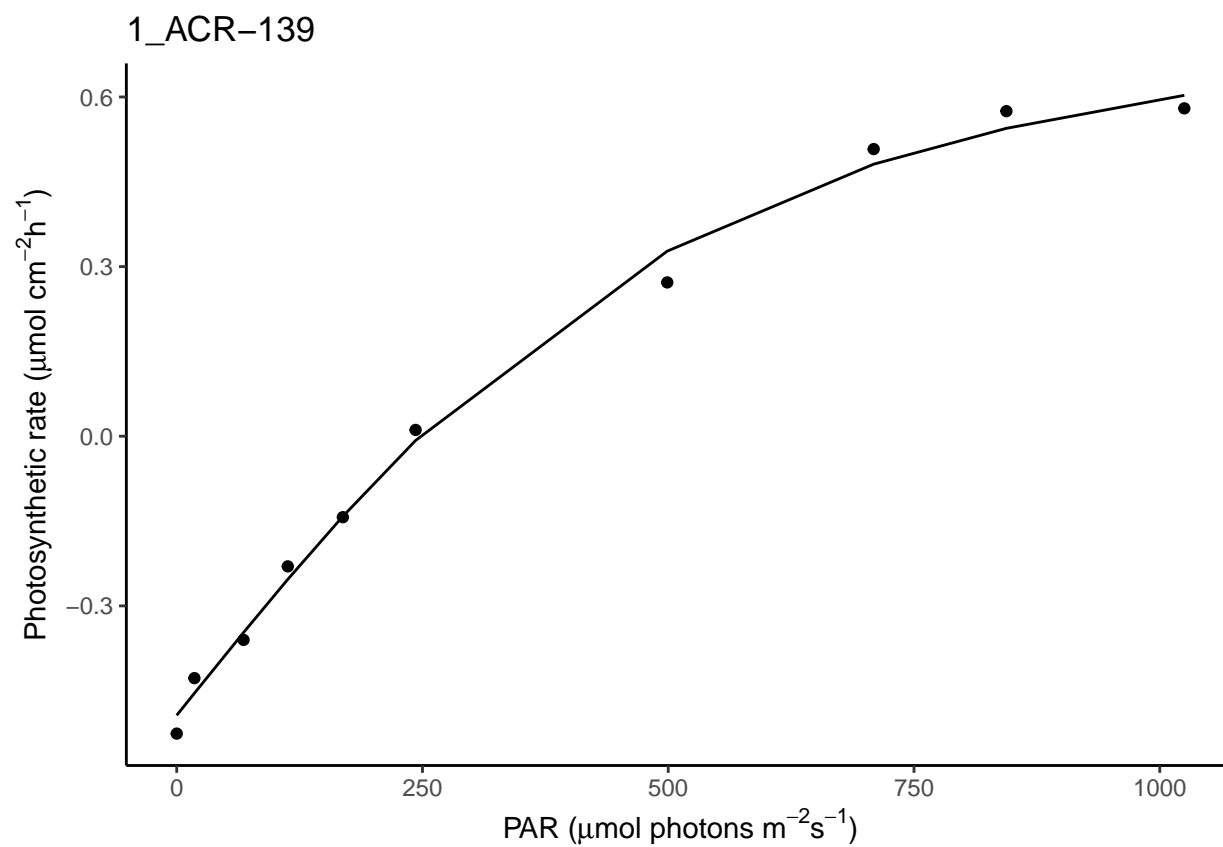
```
## augmented$colony_id: ACR-139
```

1_ACR-139

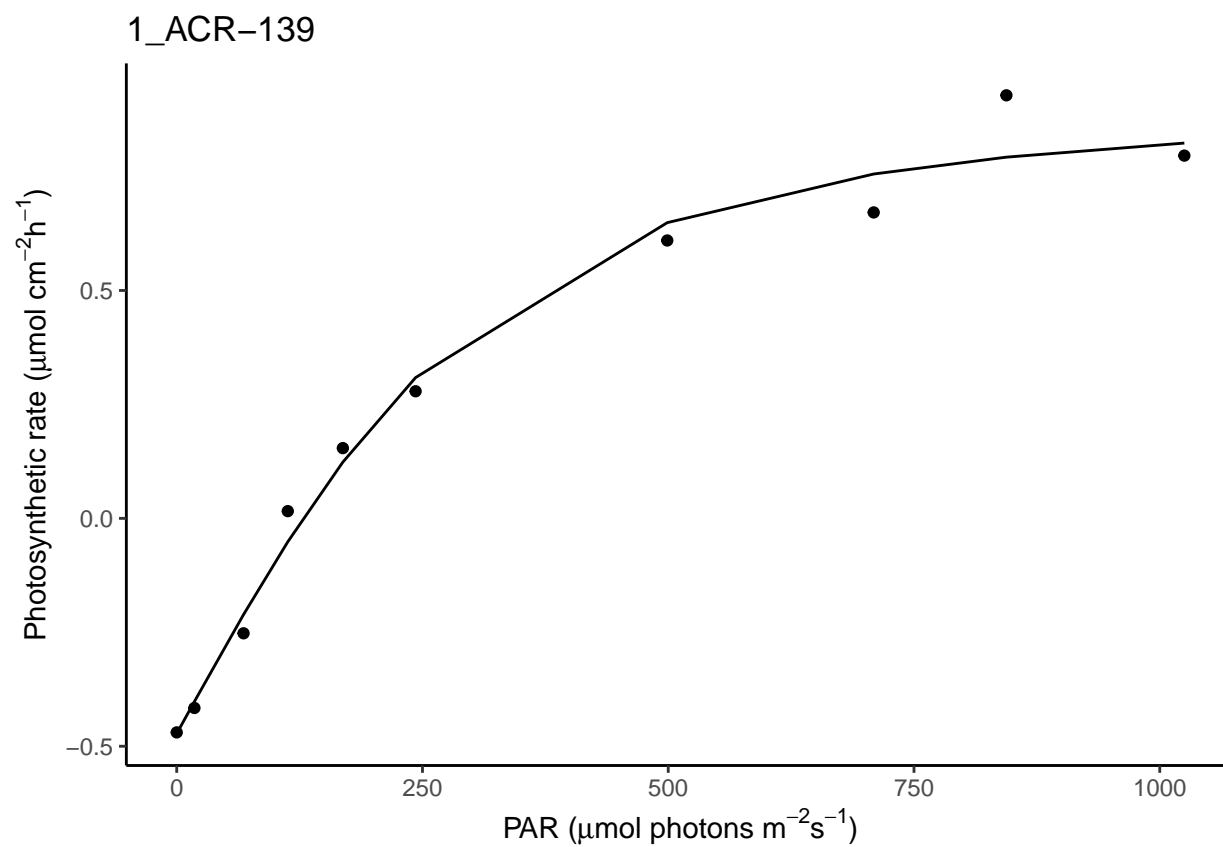


```
## -----
```

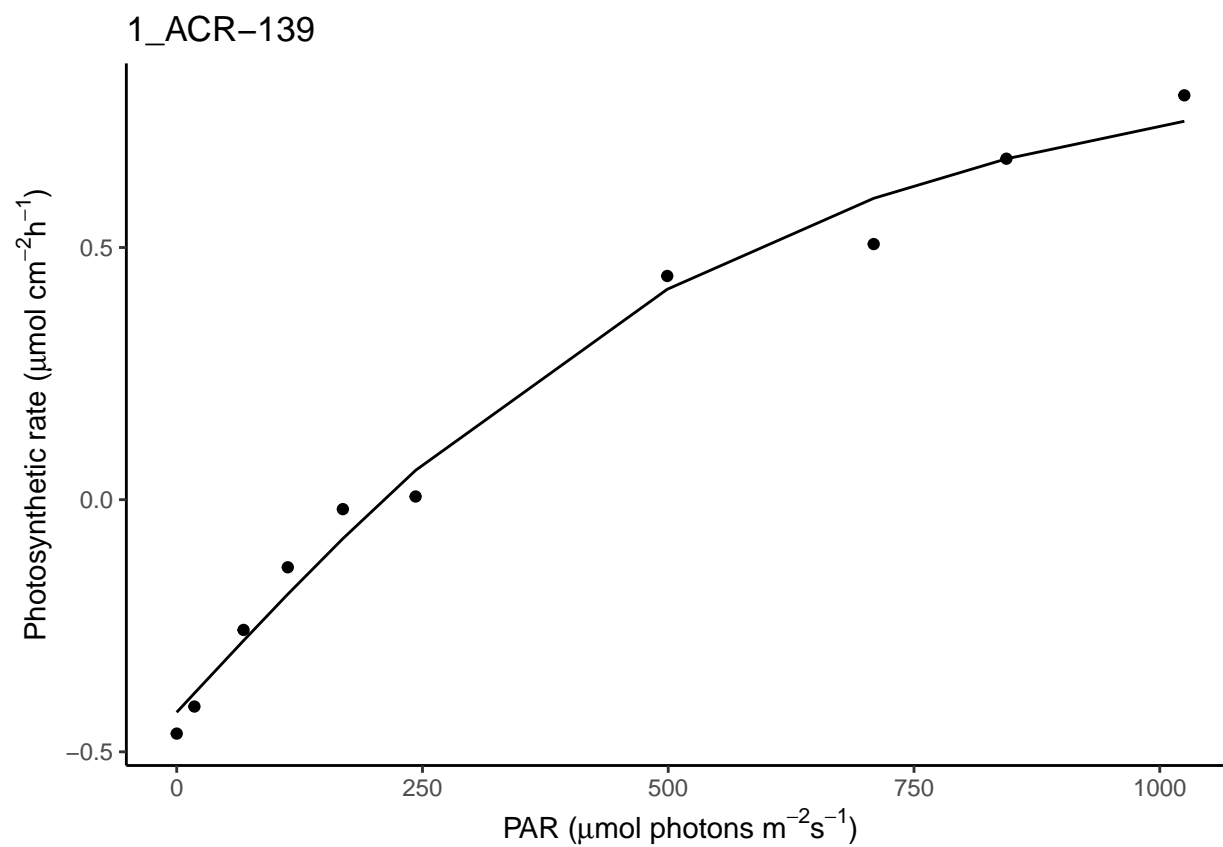
```
## augmented$colony_id: ACR-140
```



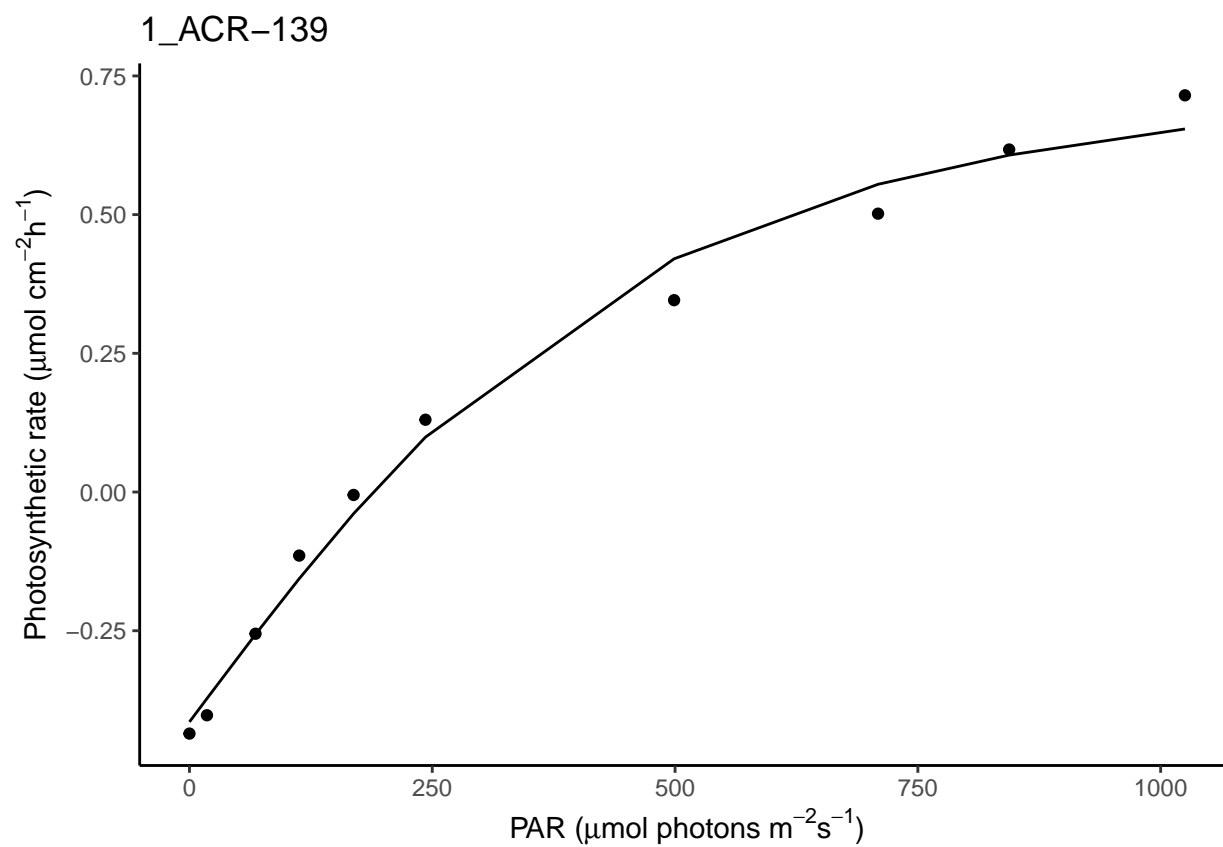
augmented\$colony_id: ACR-145



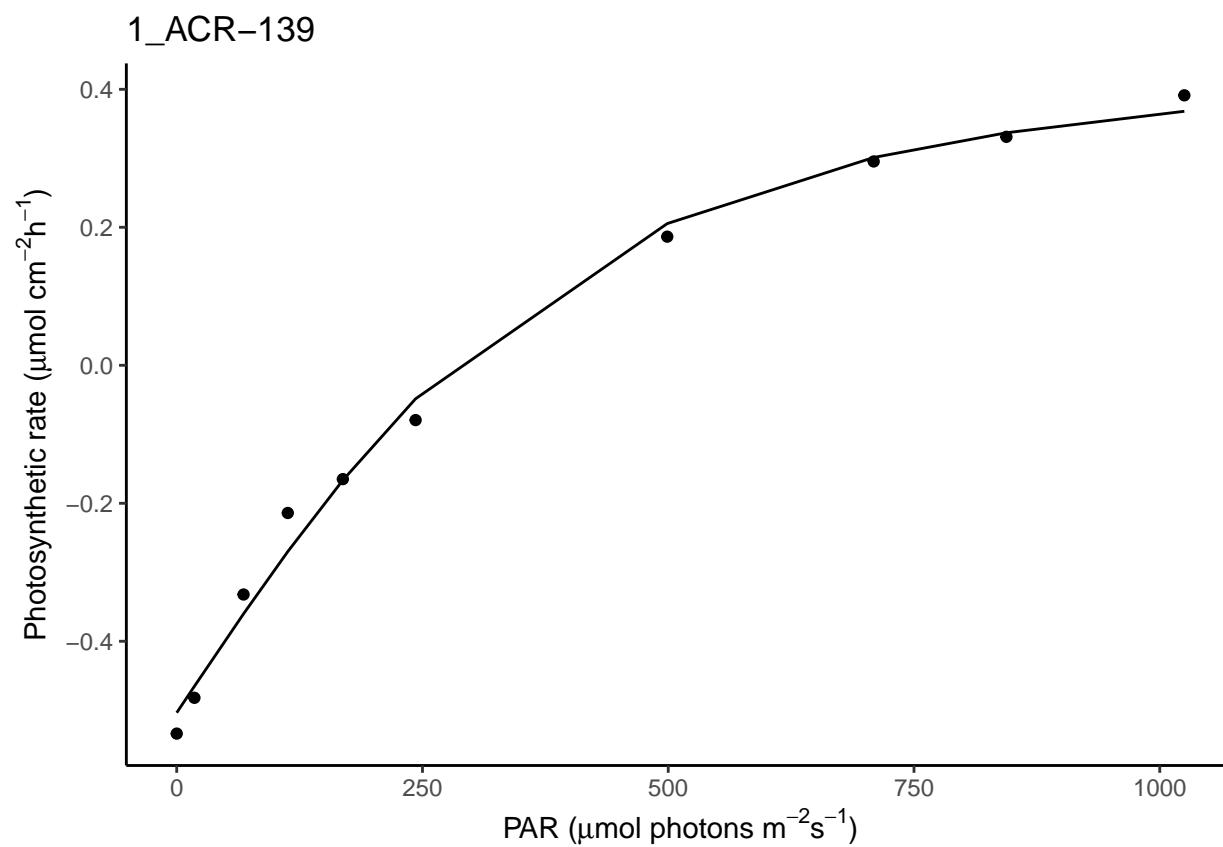
```
## -----  
## augmented$colony_id: ACR-150
```



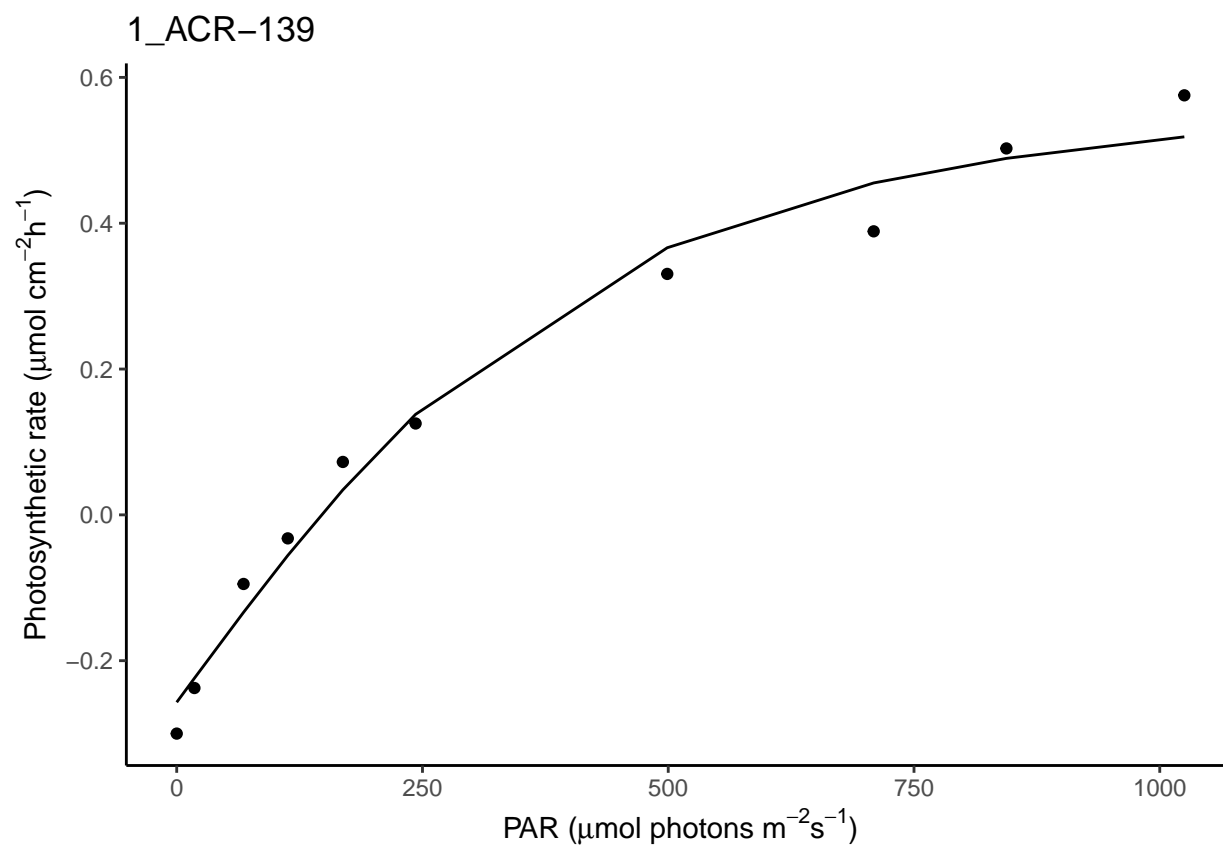
augmented\$colony_id: ACR-173



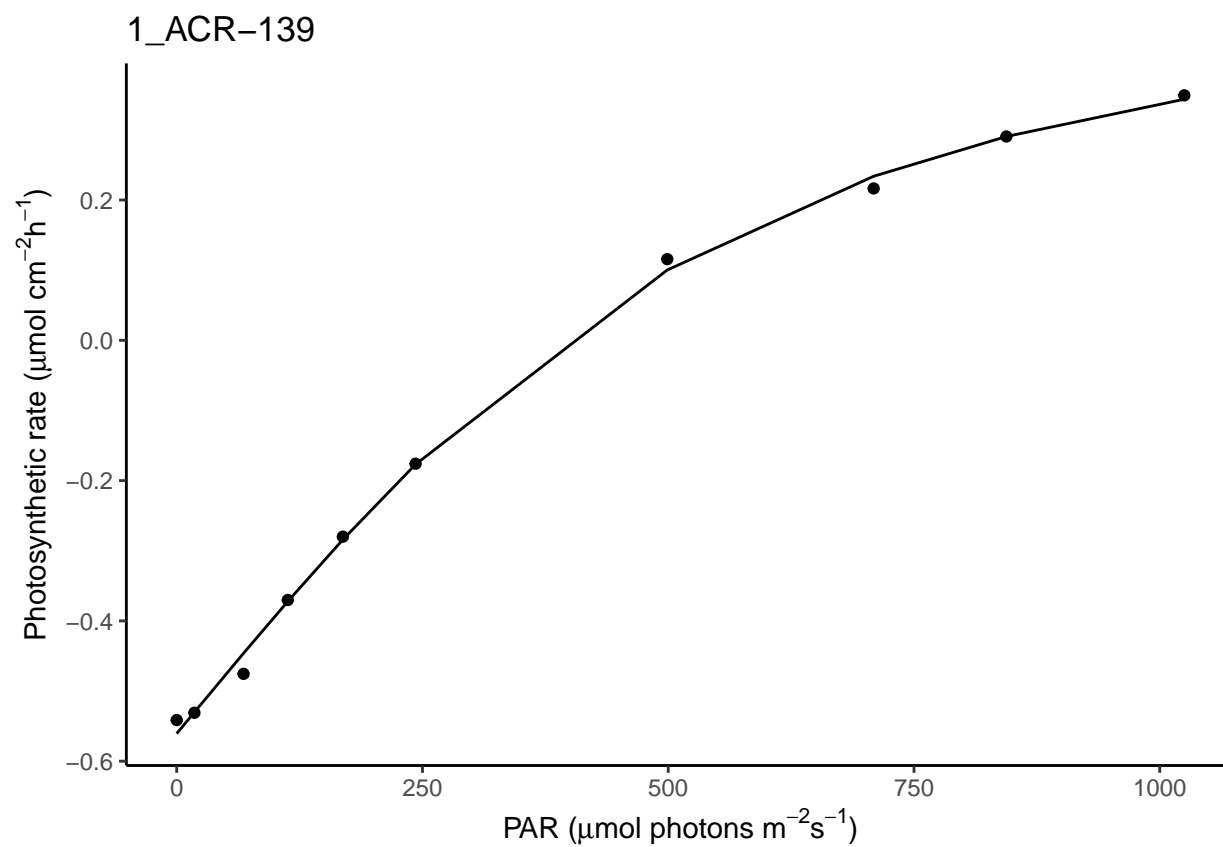
```
## -----  
## augmented$colony_id: ACR-178
```

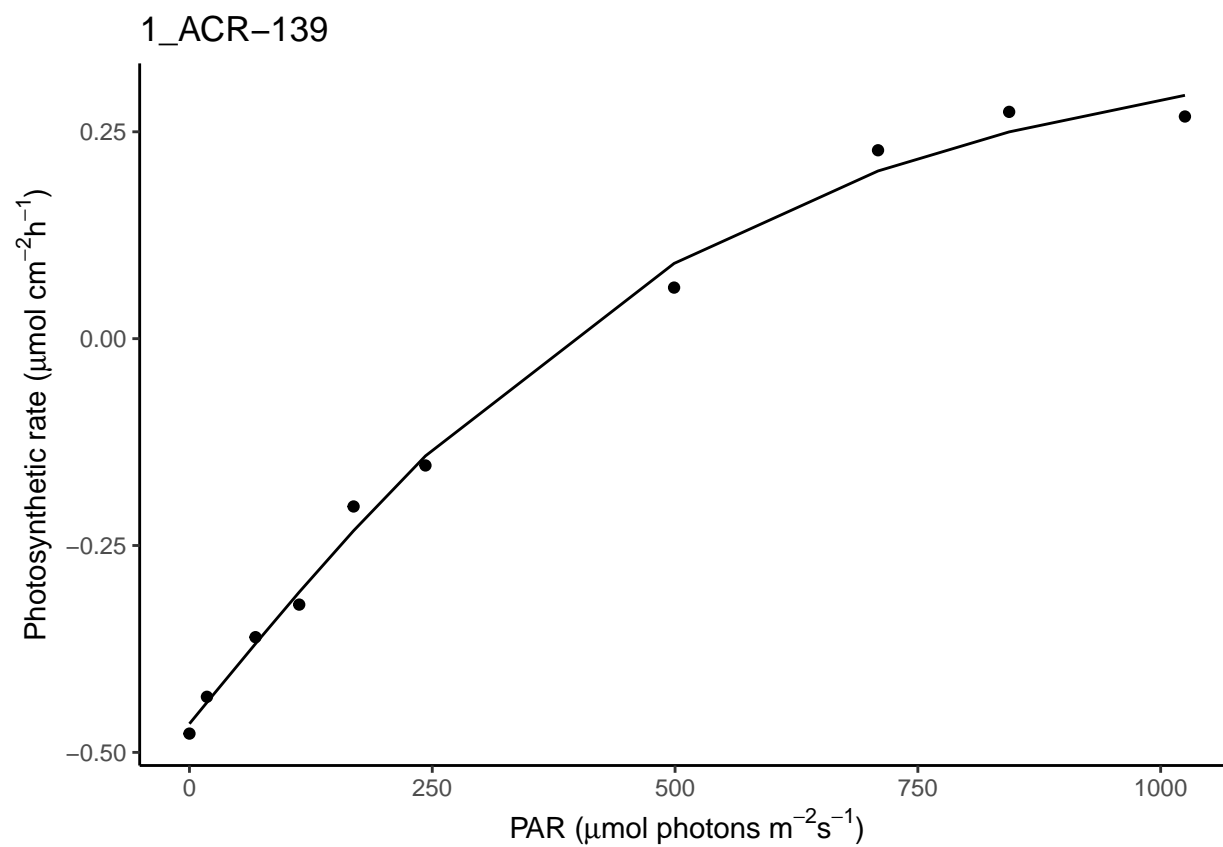
augmented\$colony_id: ACR-186



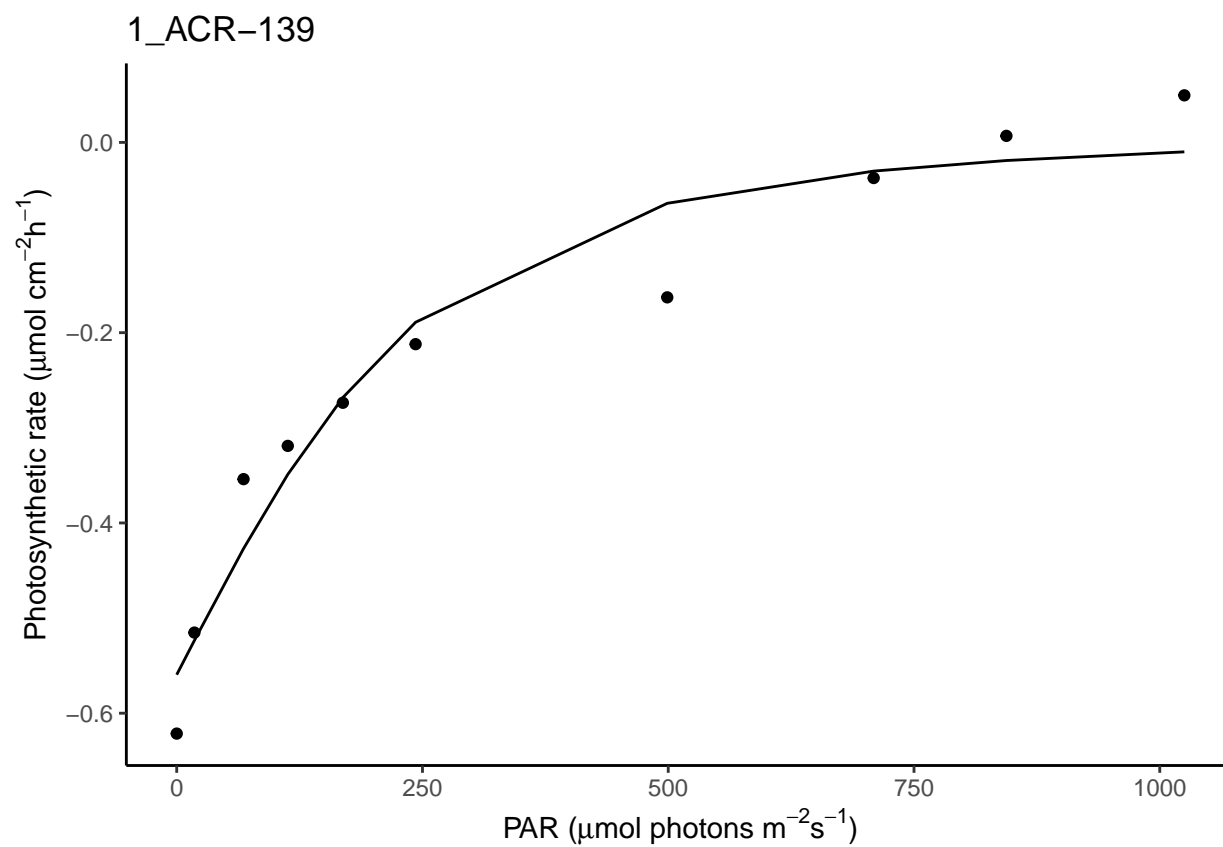
```
## -----  
## augmented$colony_id: ACR-190
```



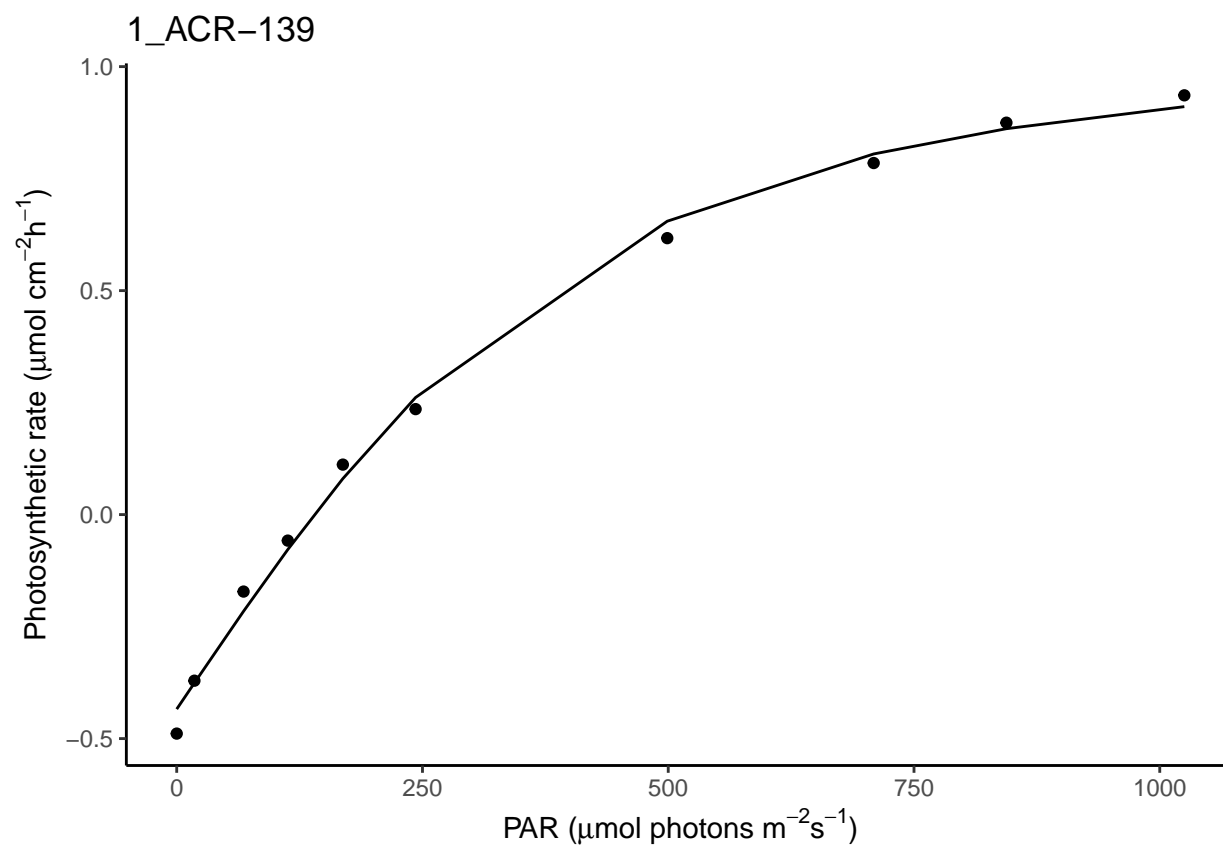
augmented\$colony_id: ACR-225



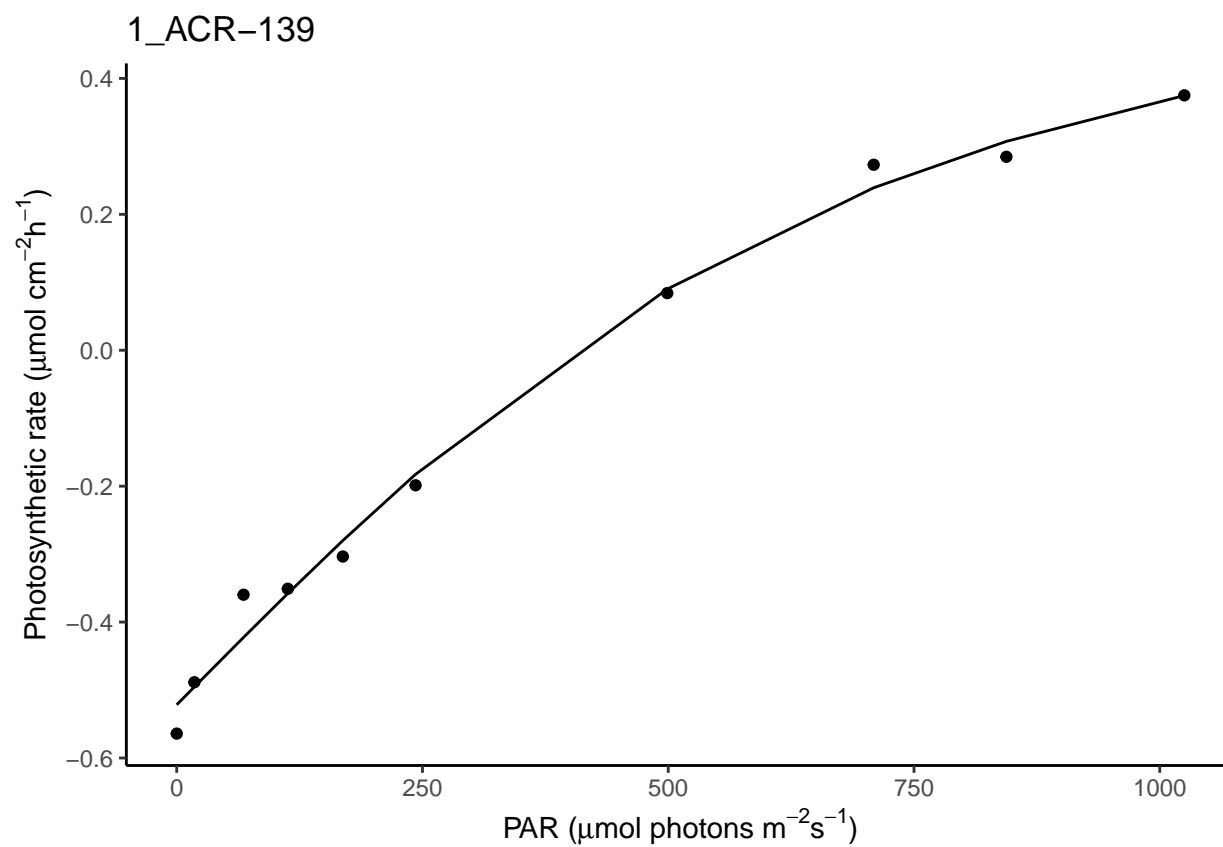
augmented\$colony_id: ACR-229



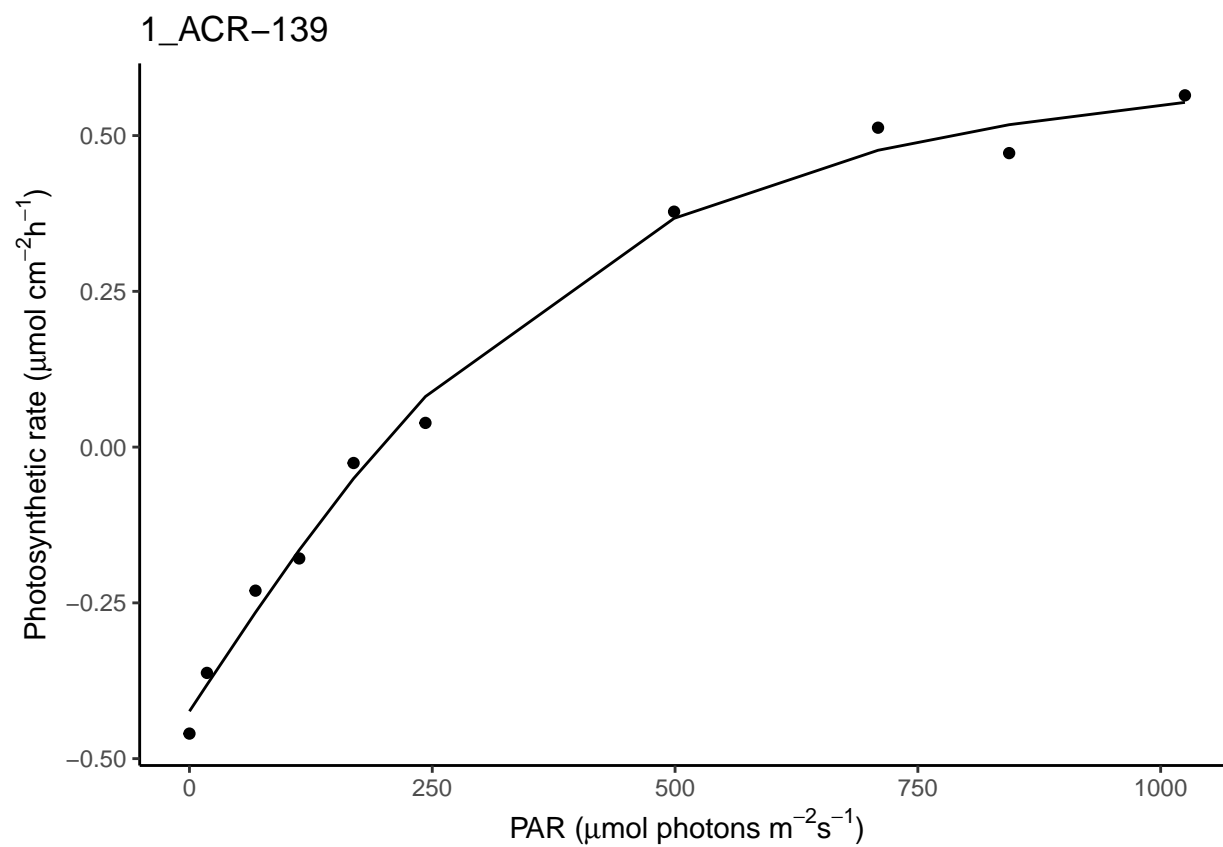
```
## -----  
## augmented$colony_id: ACR-237
```



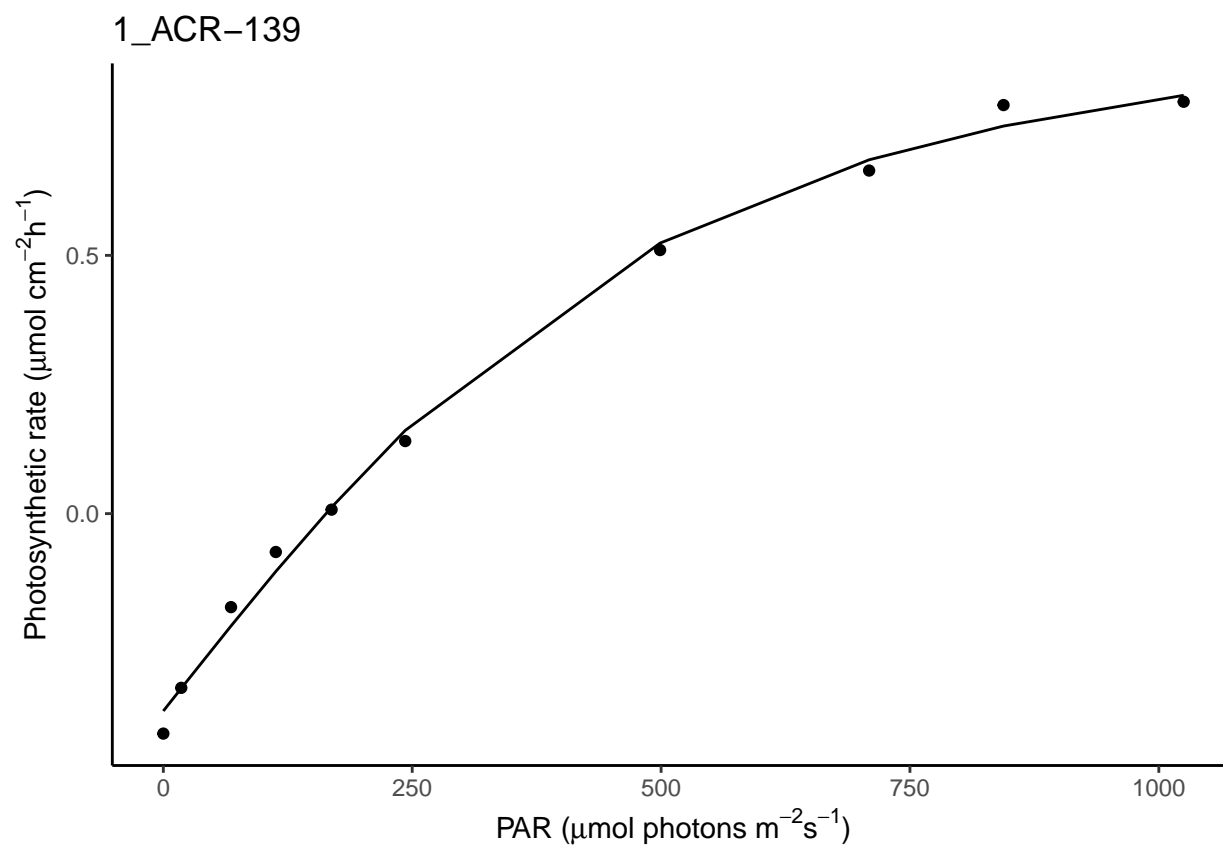
augmented\$colony_id: ACR-244



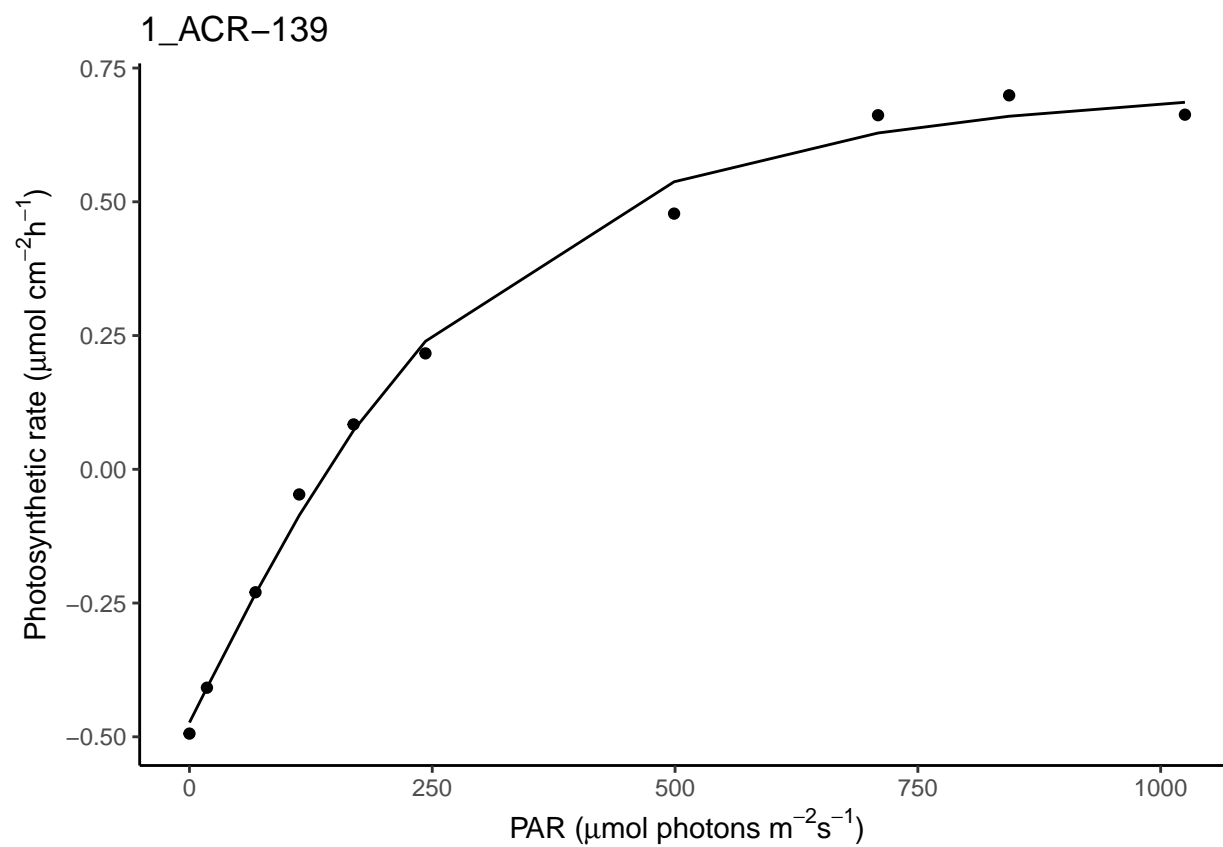
augmented\$colony_id: ACR-258



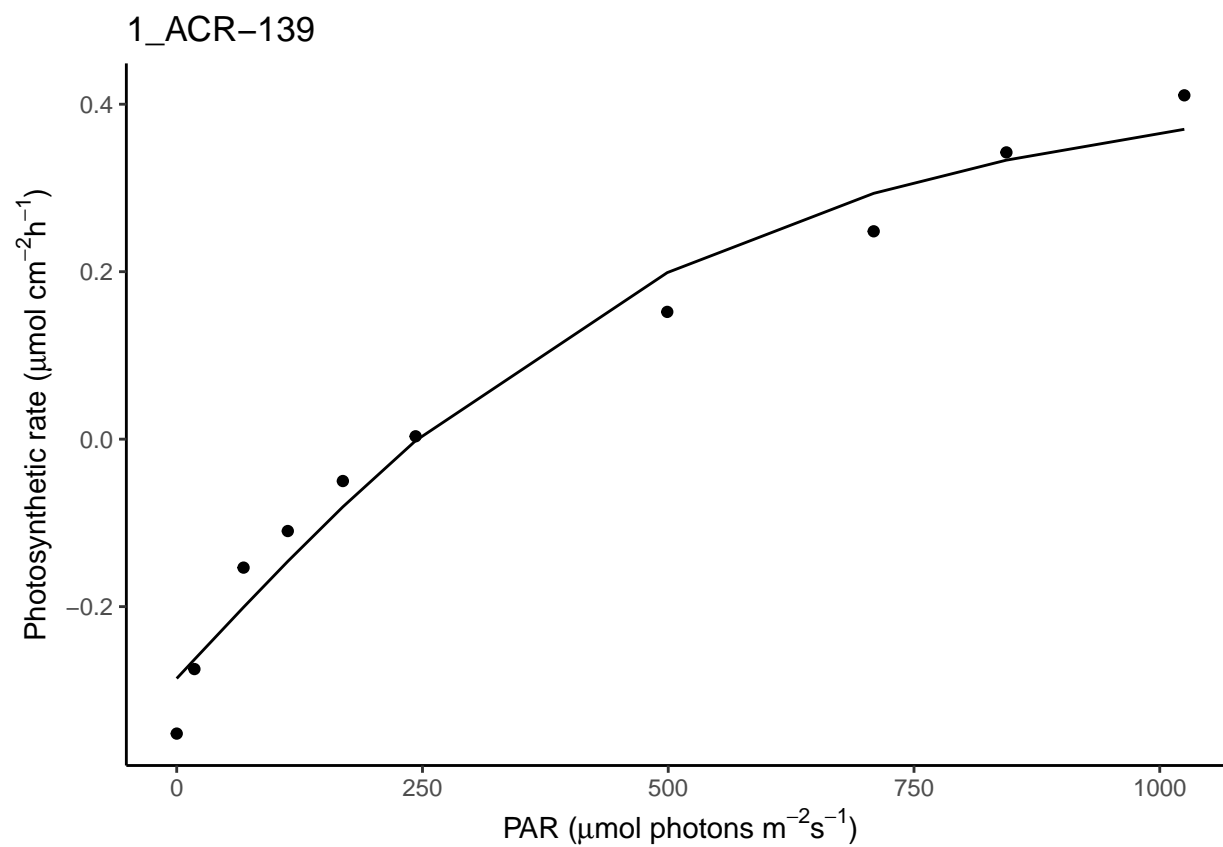
```
## -----  
## augmented$colony_id: ACR-265
```

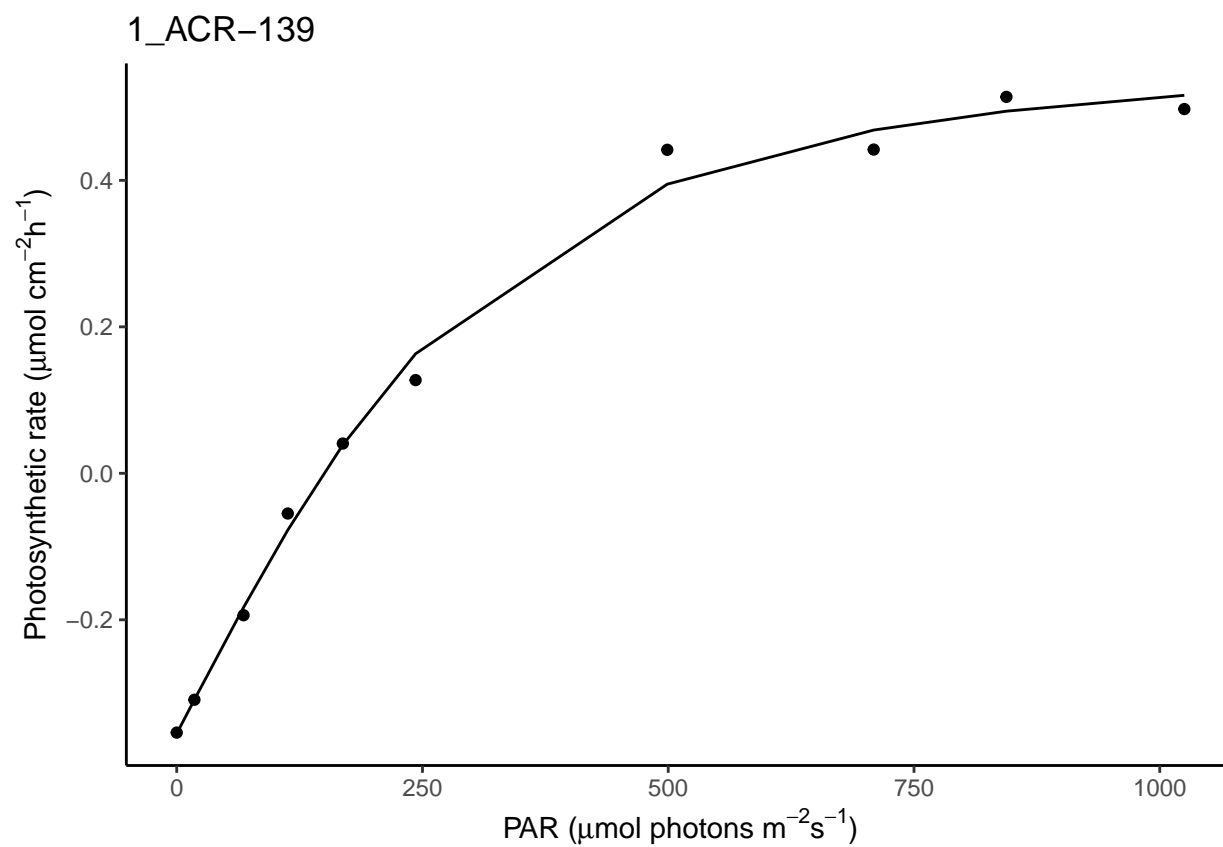
```
## -----  
## augmented$colony_id: ACR-343
```



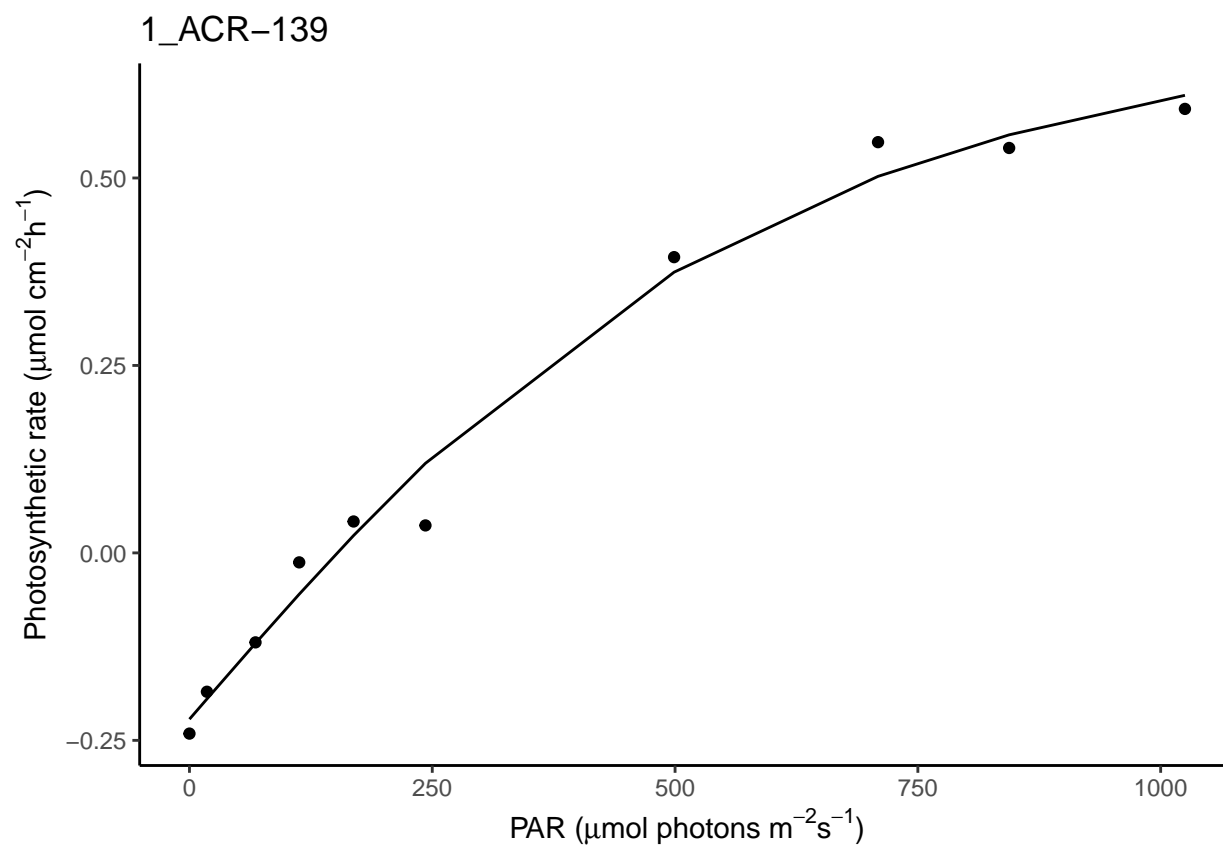
augmented\$colony_id: ACR-347



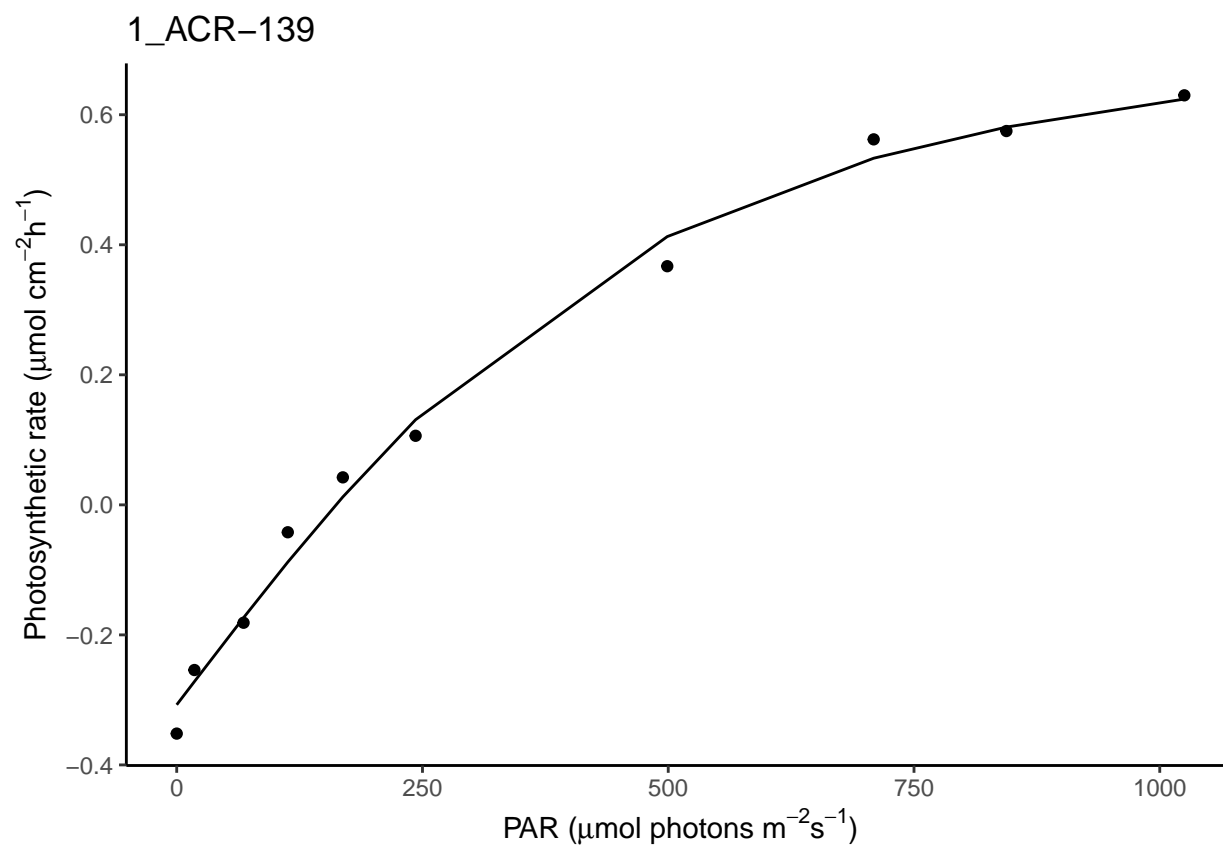
```
## -----  
## augmented$colony_id: ACR-350
```



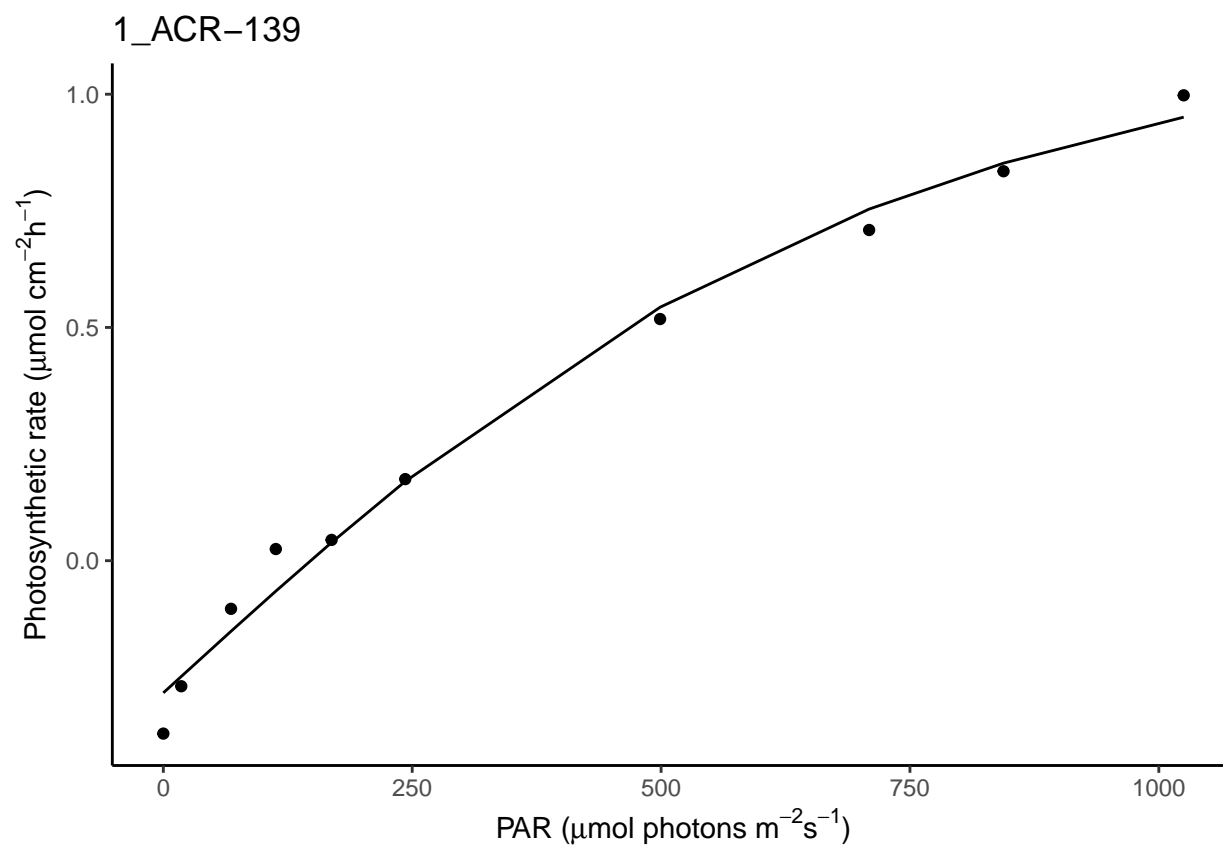
```
## -----  
## augmented$colony_id: ACR-351
```



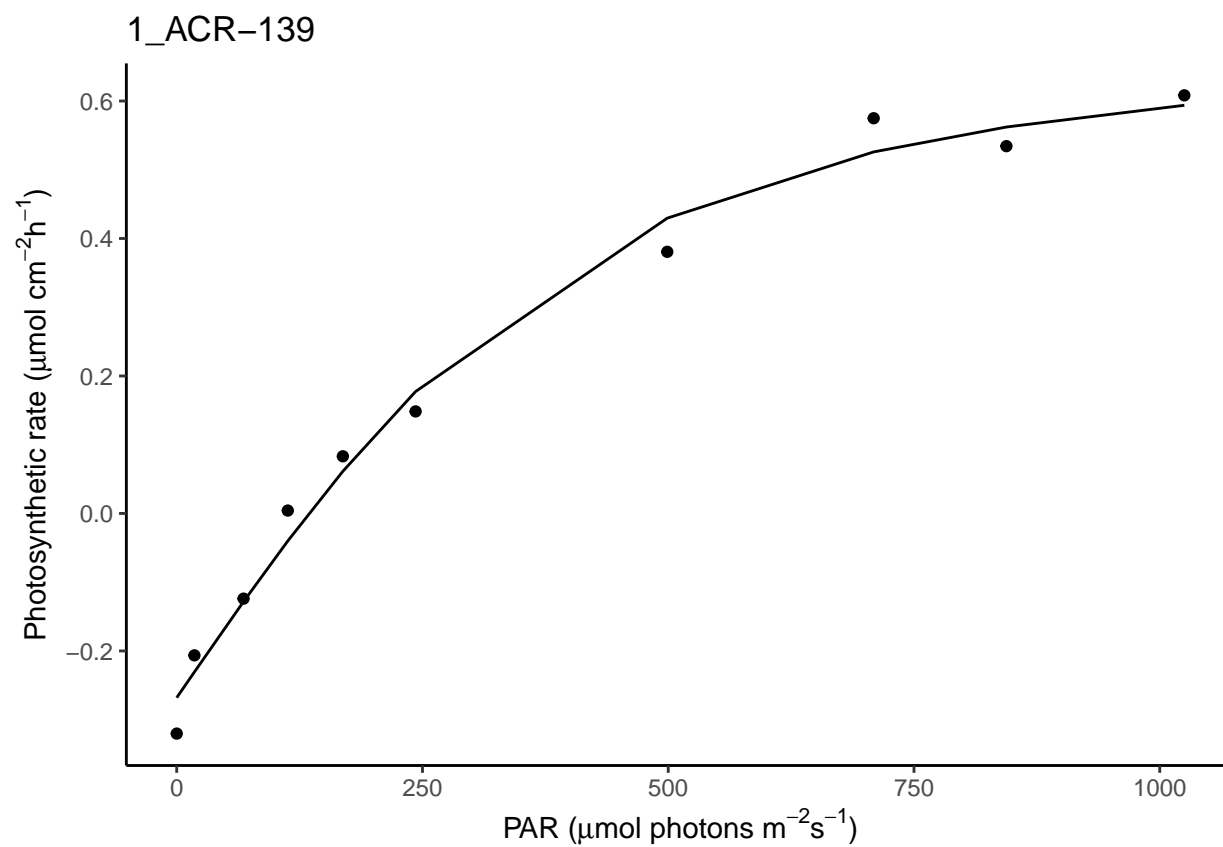
augmented\$colony_id: ACR-360



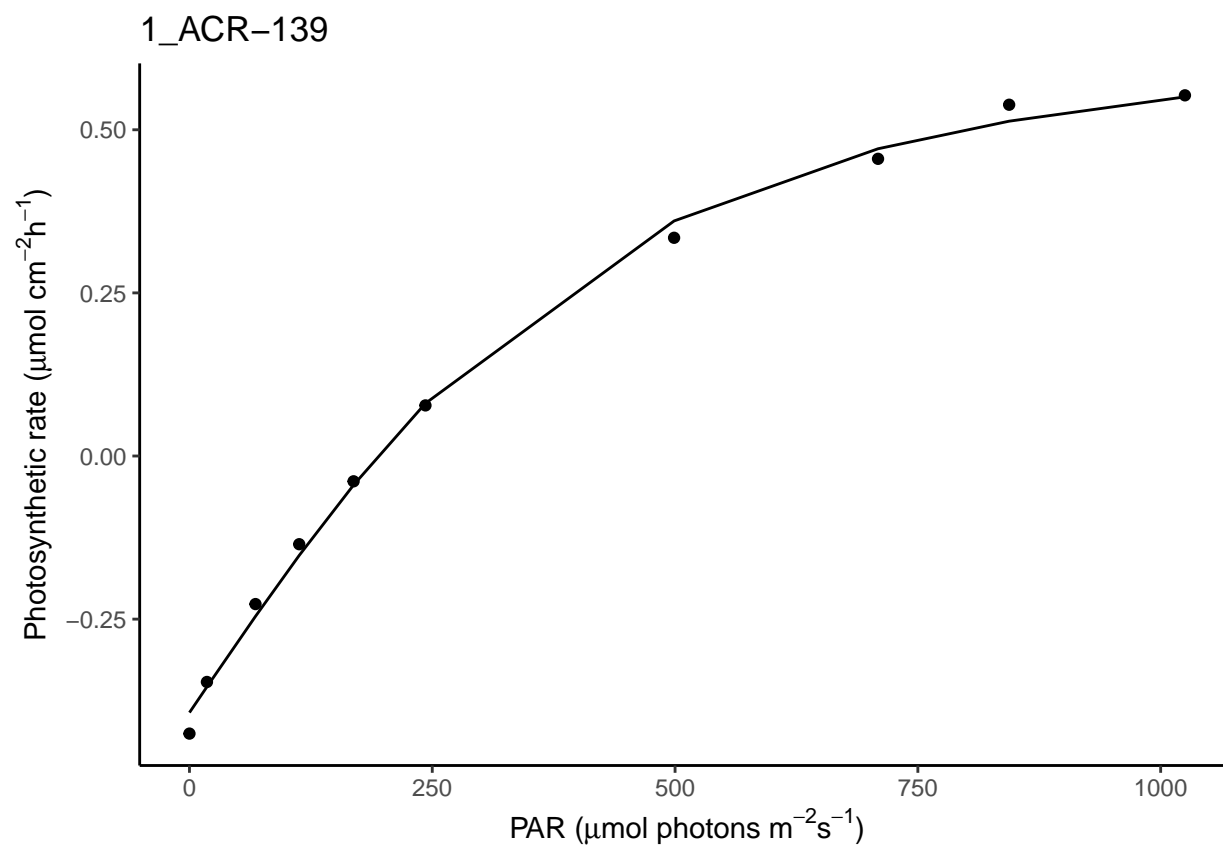
augmented\$colony_id: ACR-364



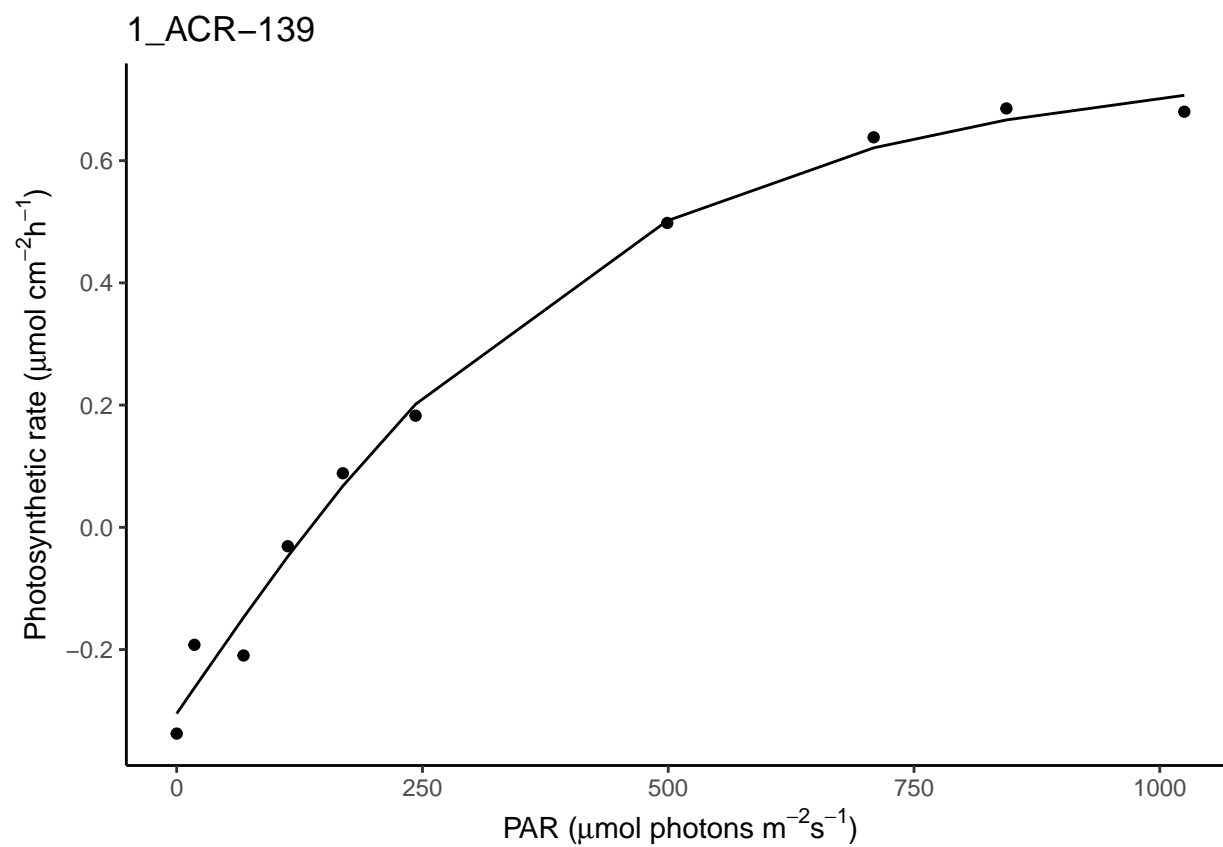
```
## -----  
## augmented$colony_id: ACR-368
```



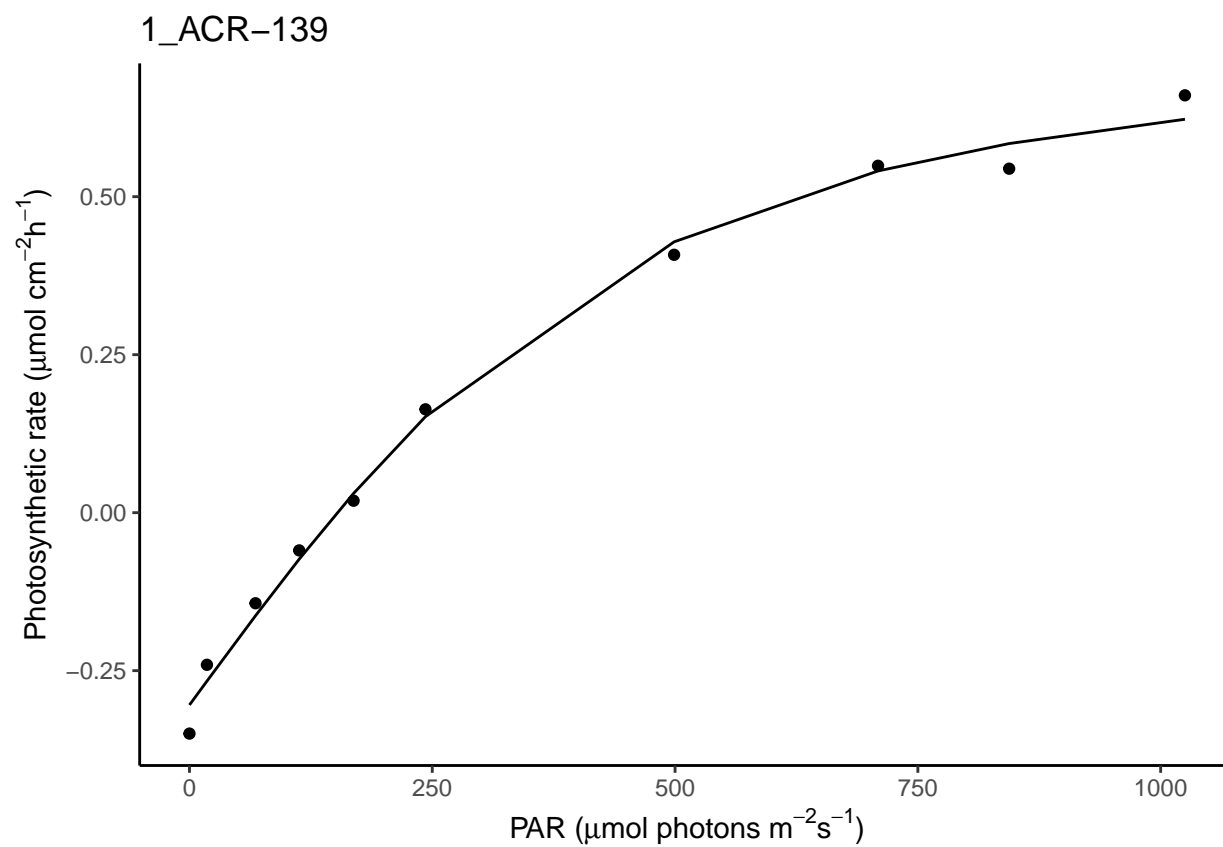
```
## -----  
## augmented$colony_id: ACR-393
```

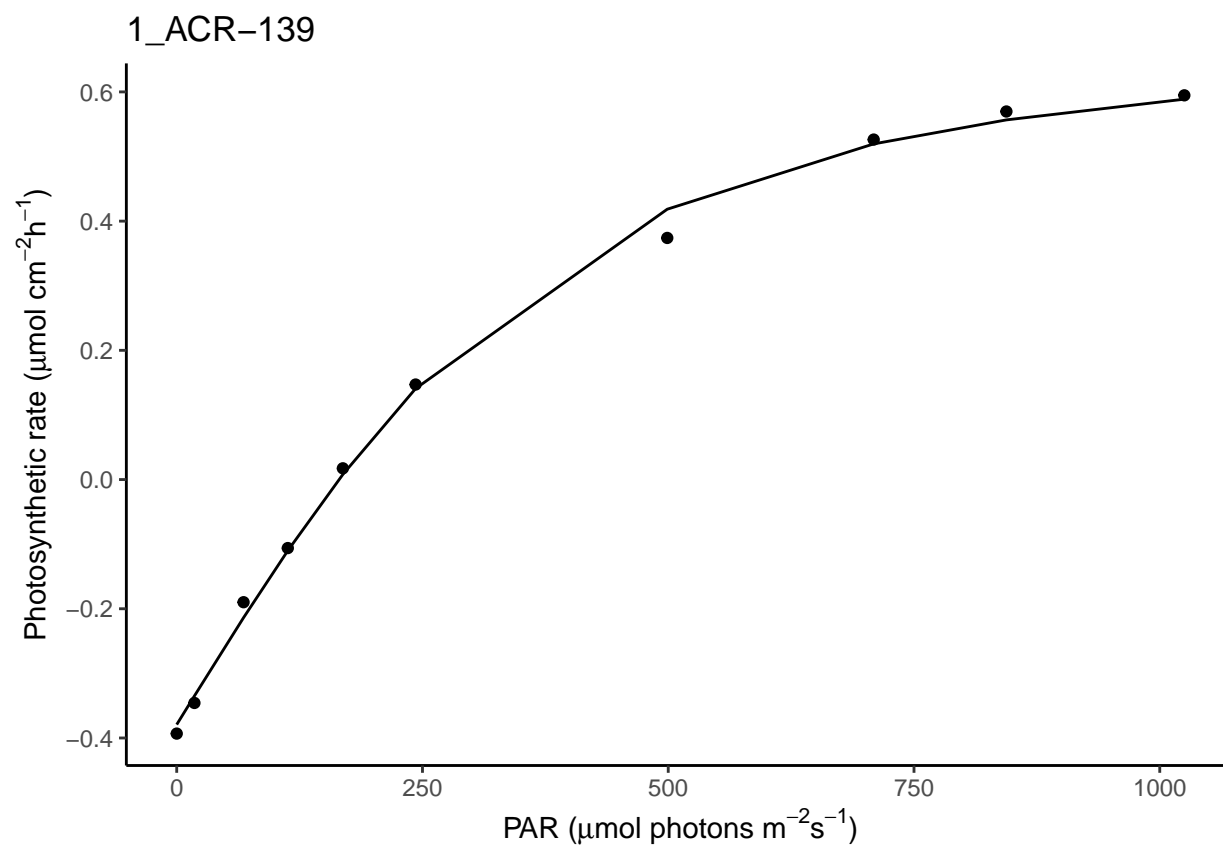
```
## -----  
## augmented$colony_id: ACR-396
```



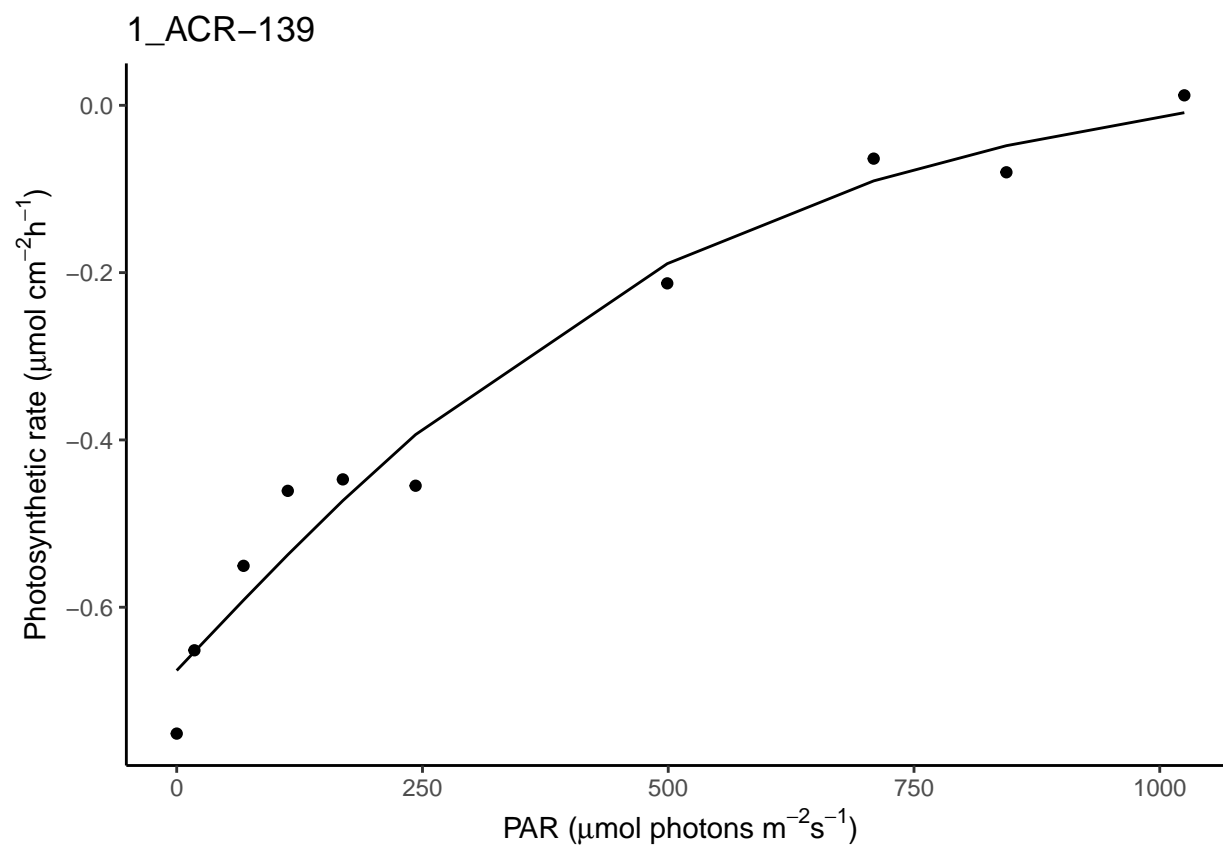
augmented\$colony_id: ACR-51



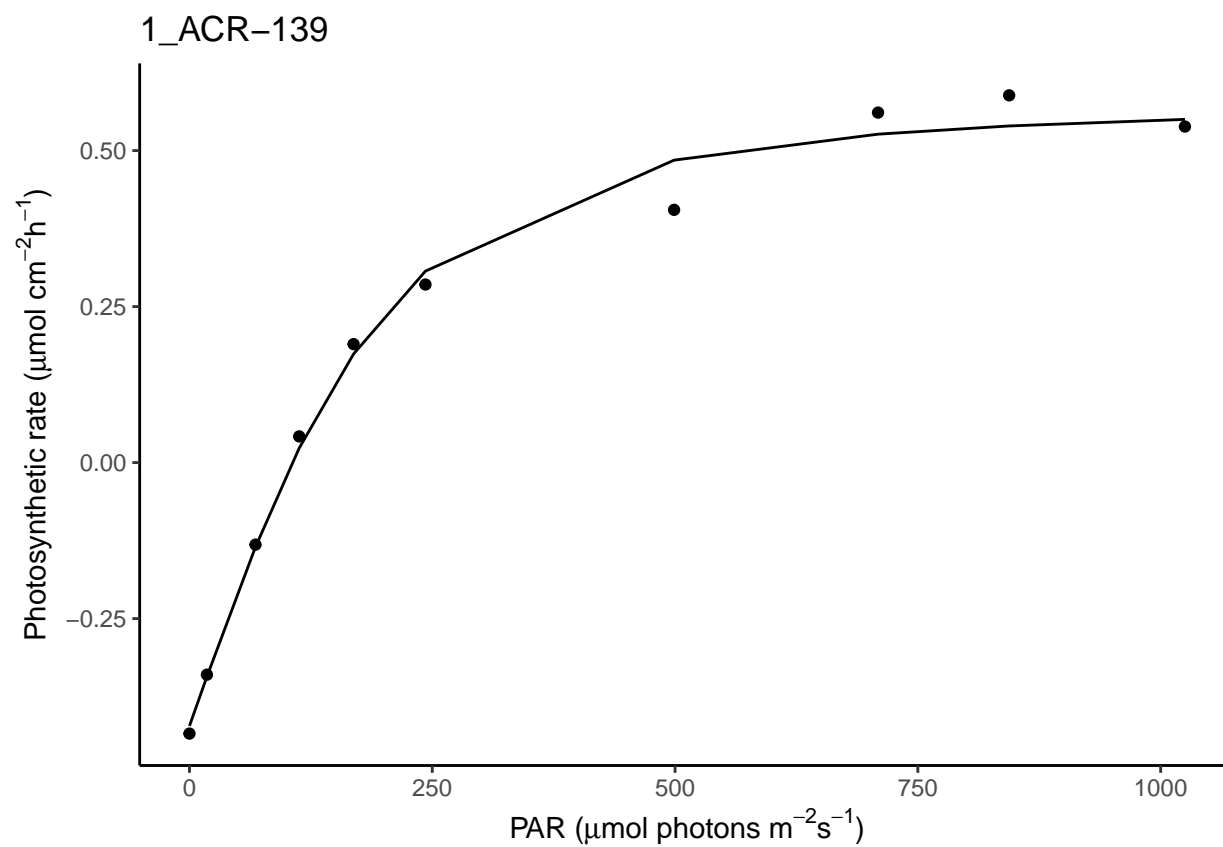
augmented\$colony_id: POC-200



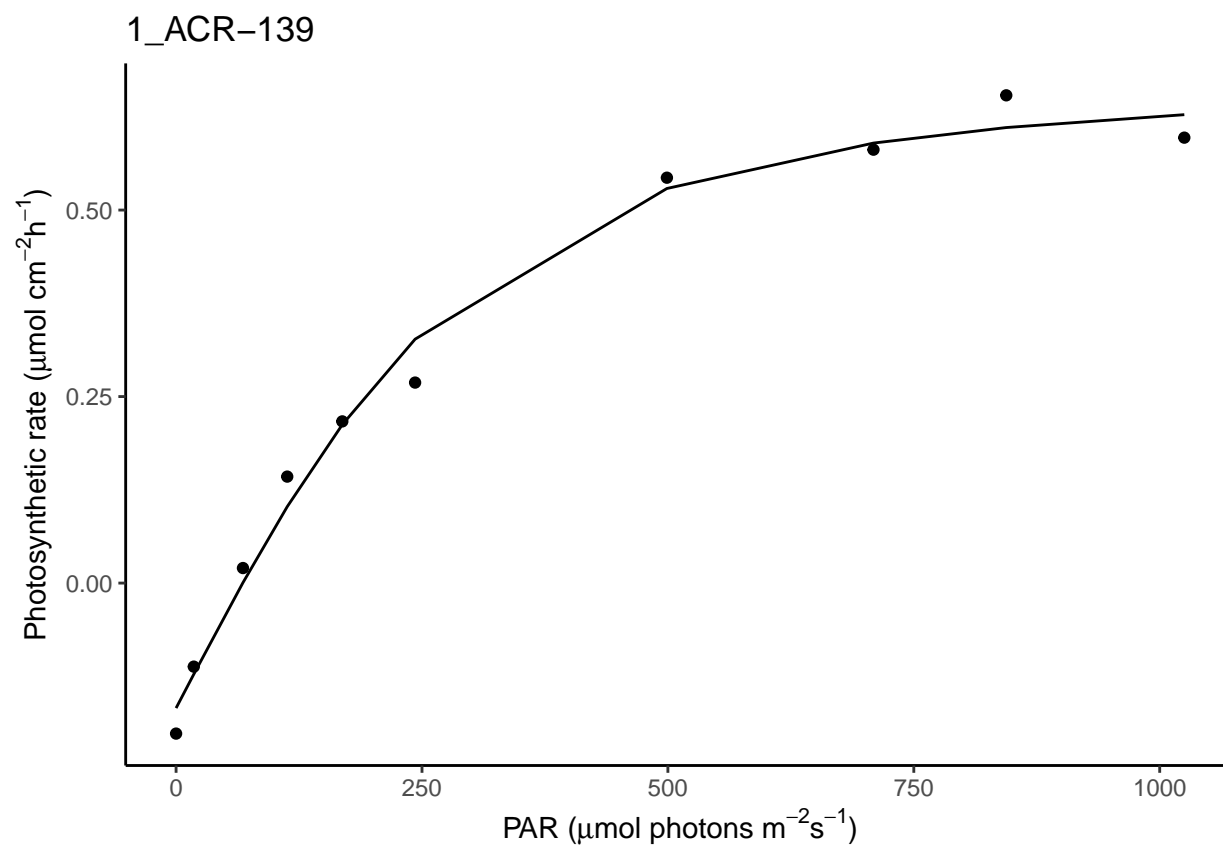
augmented\$colony_id: POC-201



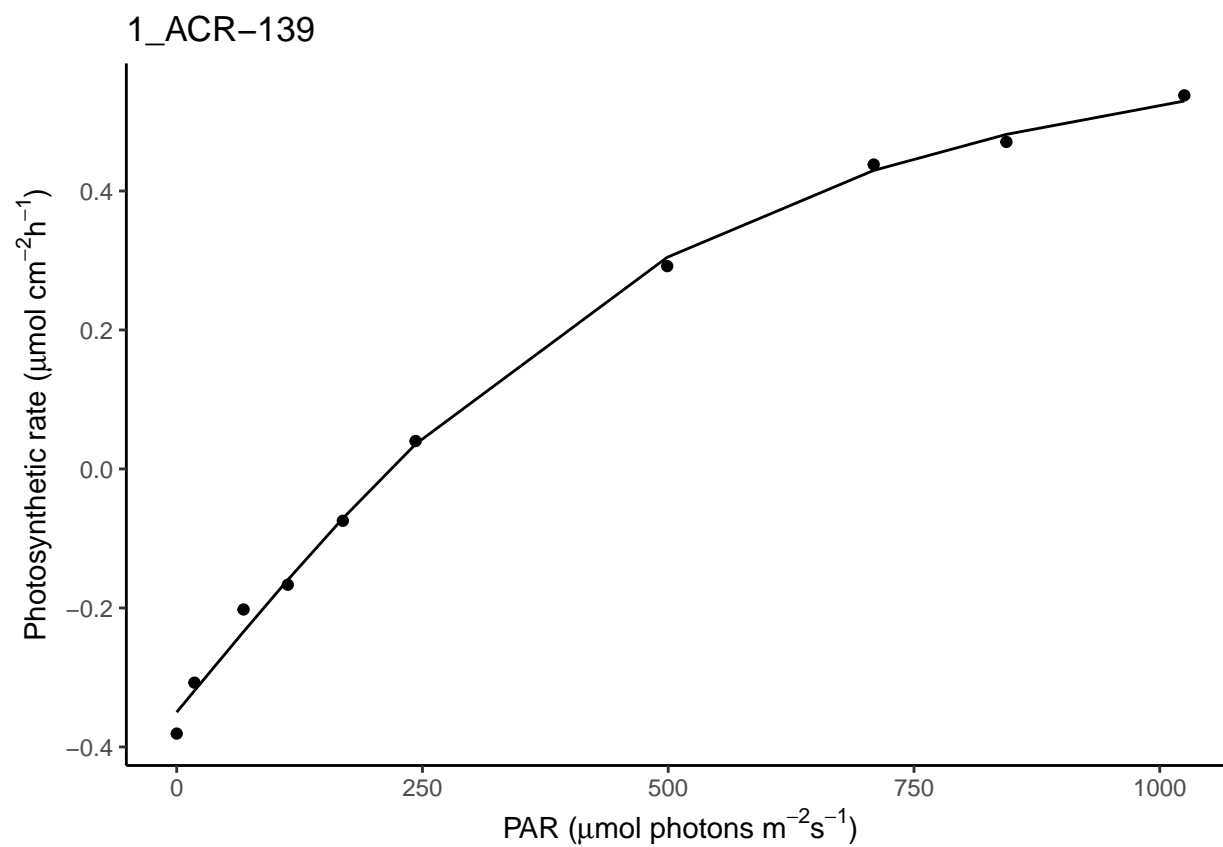
```
## -----  
## augmented$colony_id: POC-205
```



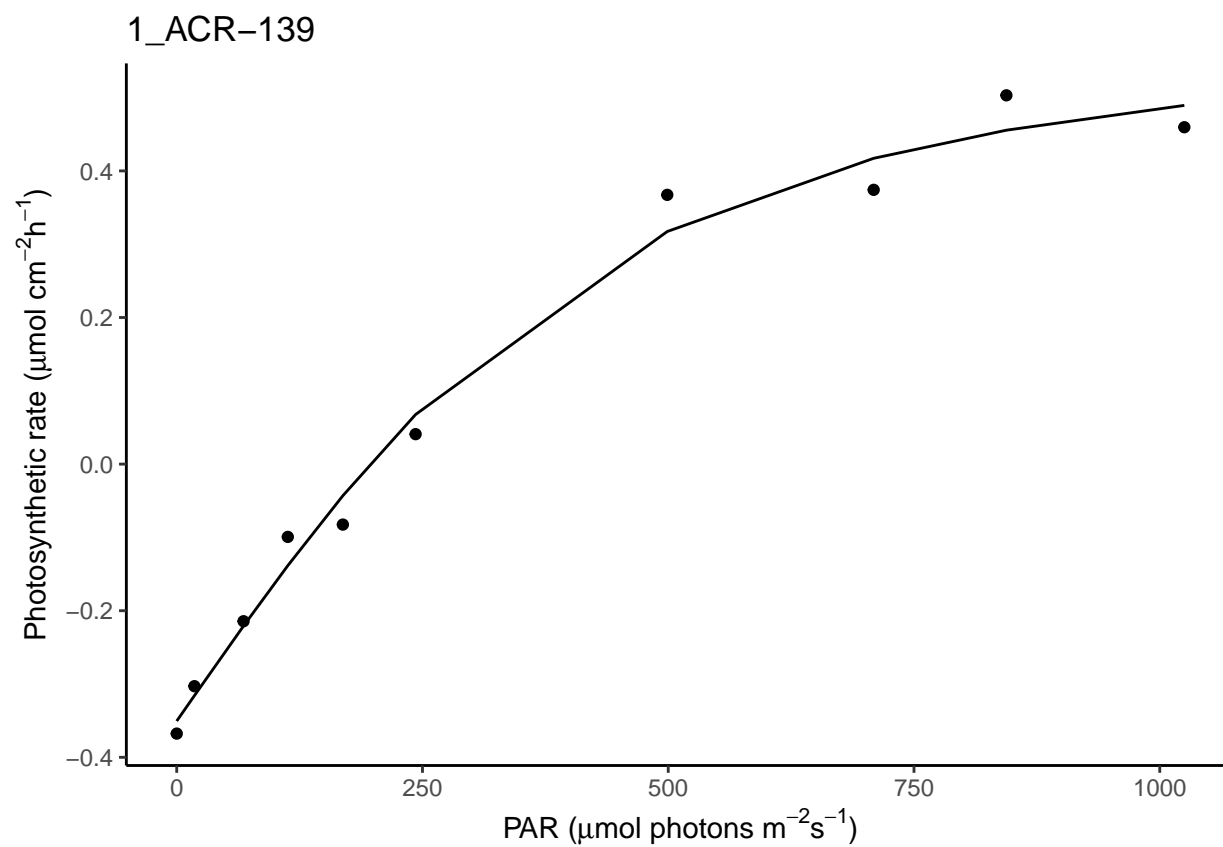
augmented\$colony_id: POC-207



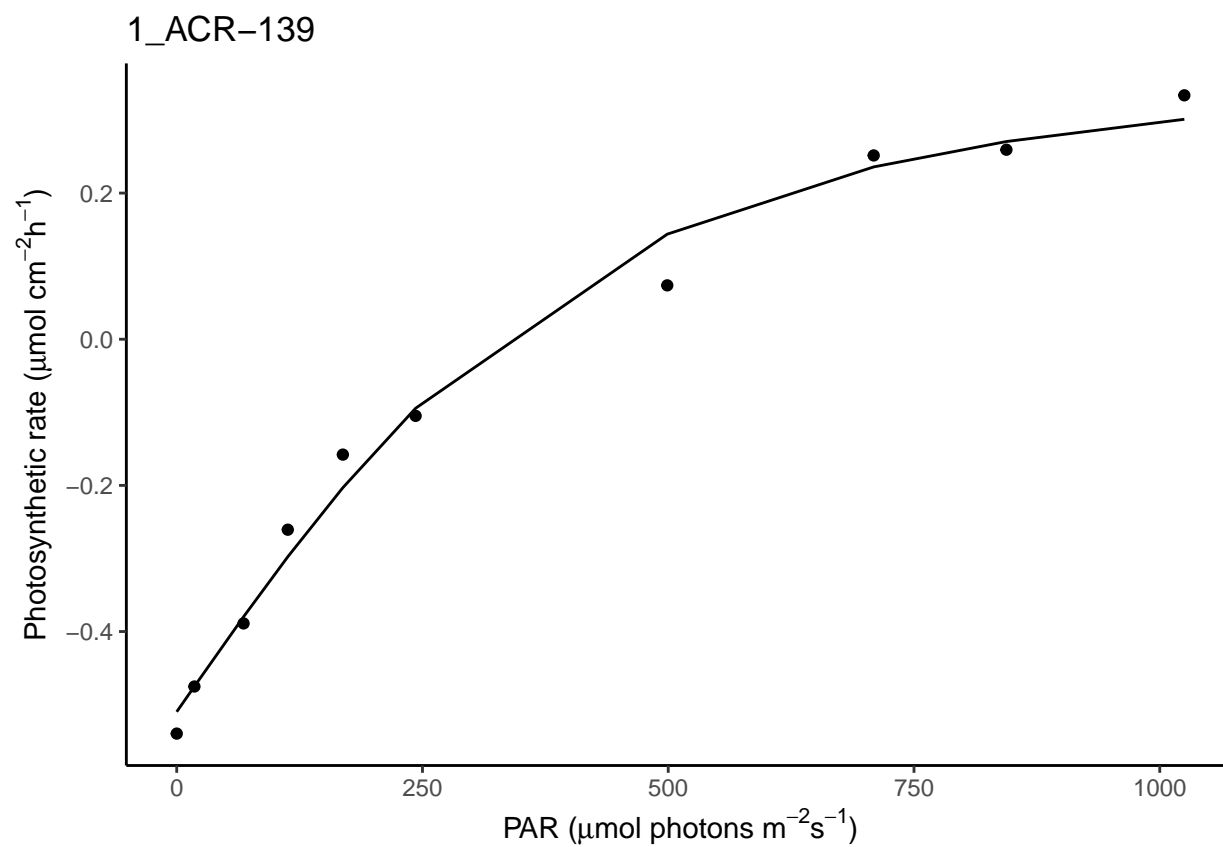
augmented\$colony_id: POC-215



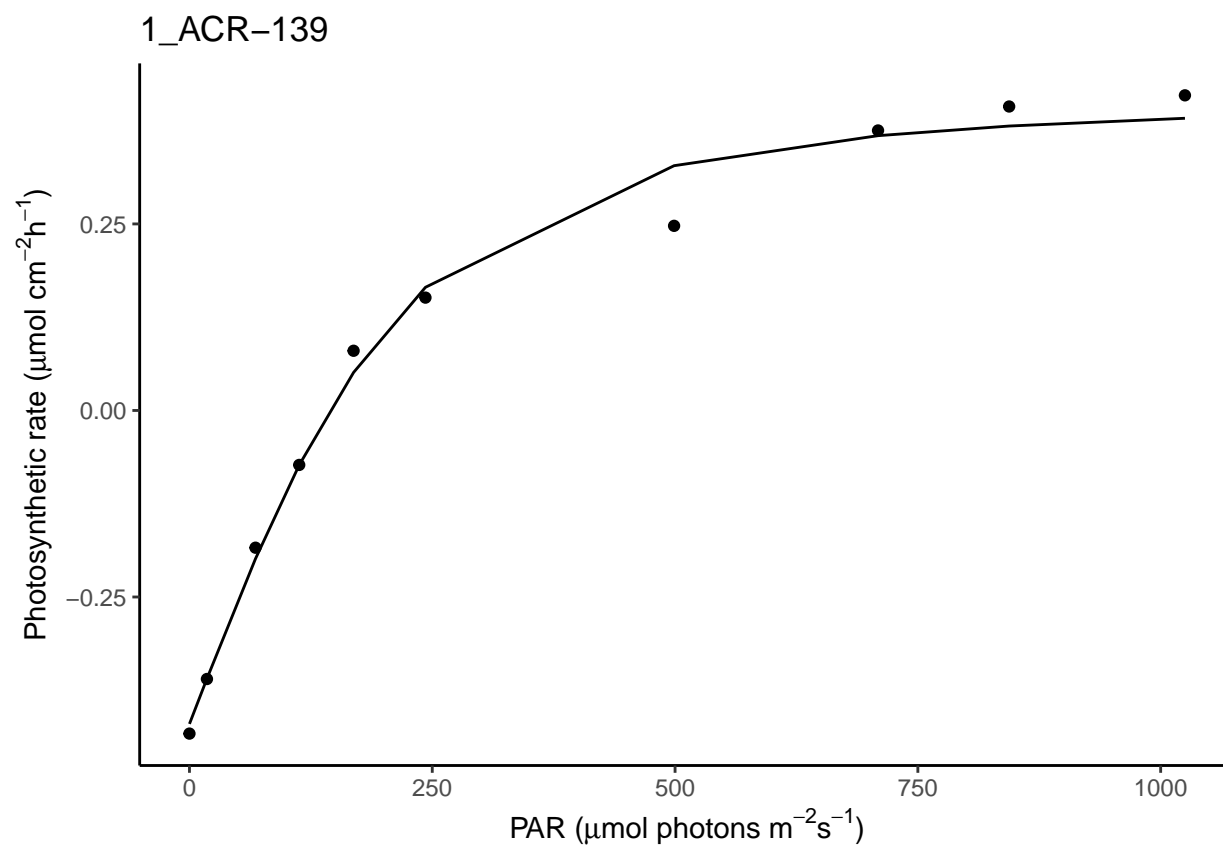
augmented\$colony_id: P0C-217



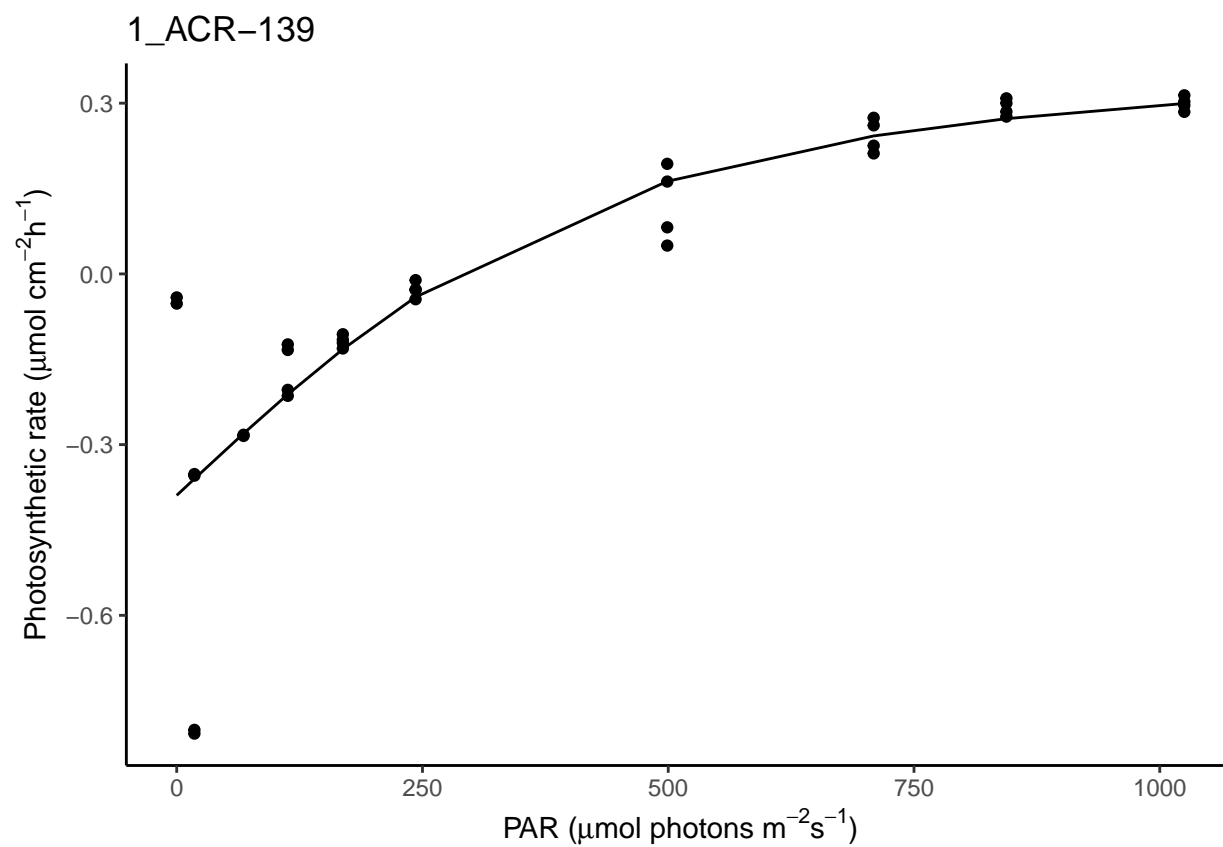
augmented\$colony_id: P0C-219



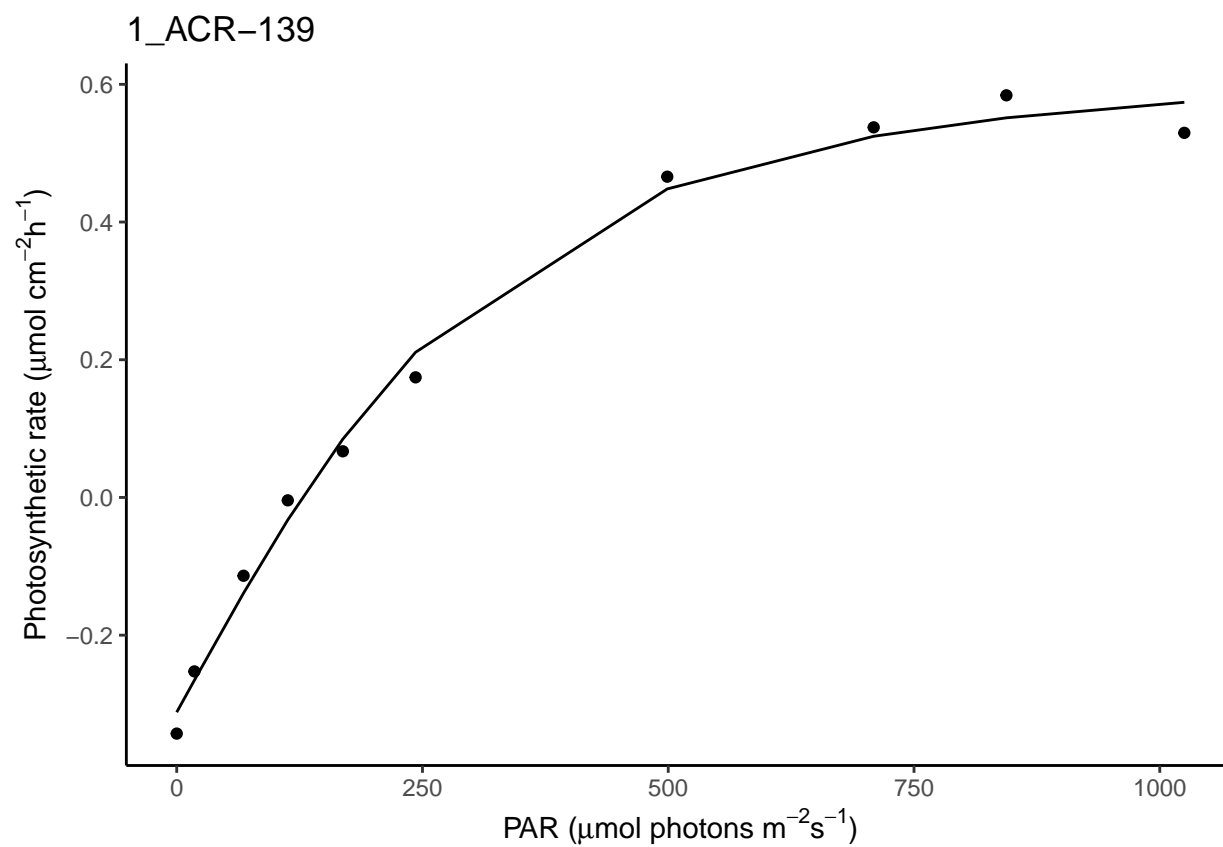
augmented\$colony_id: POC-222



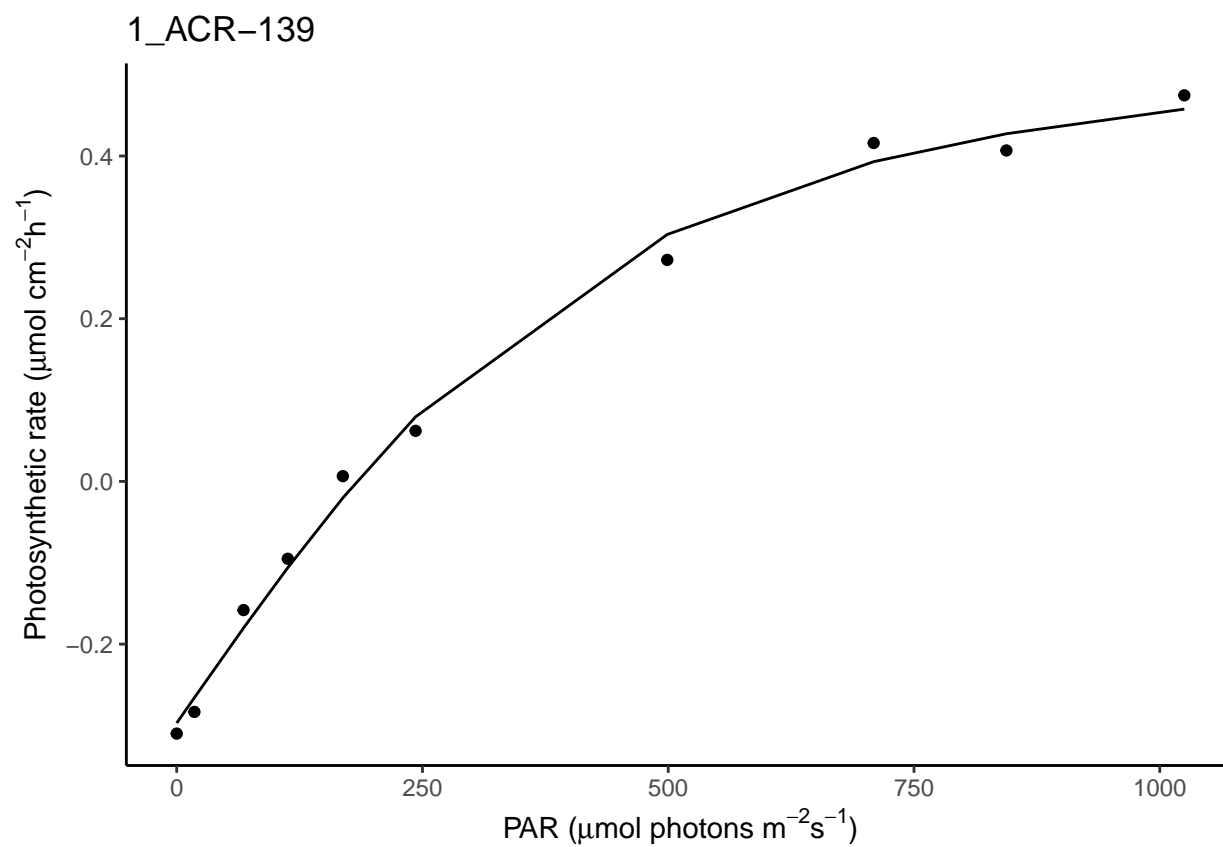
augmented\$colony_id: POC-238



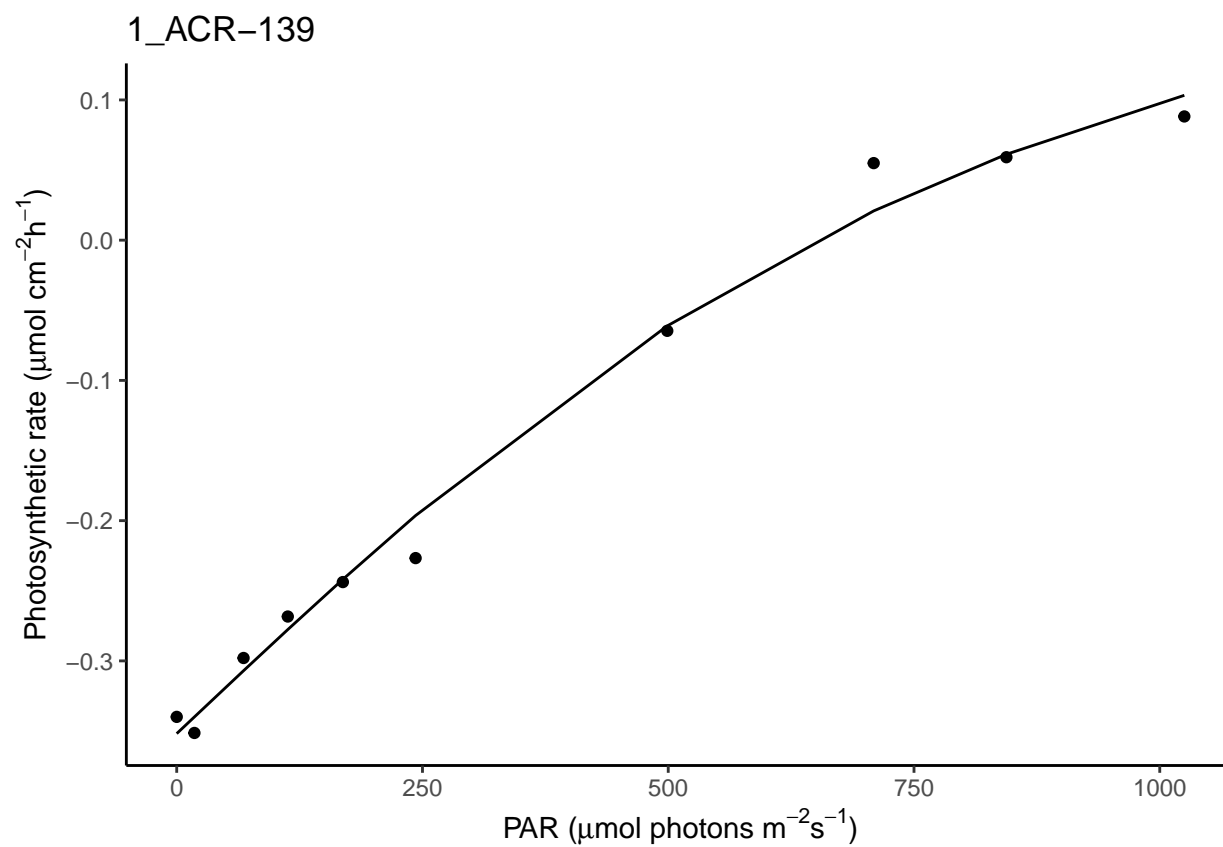
augmented\$colony_id: POC-239



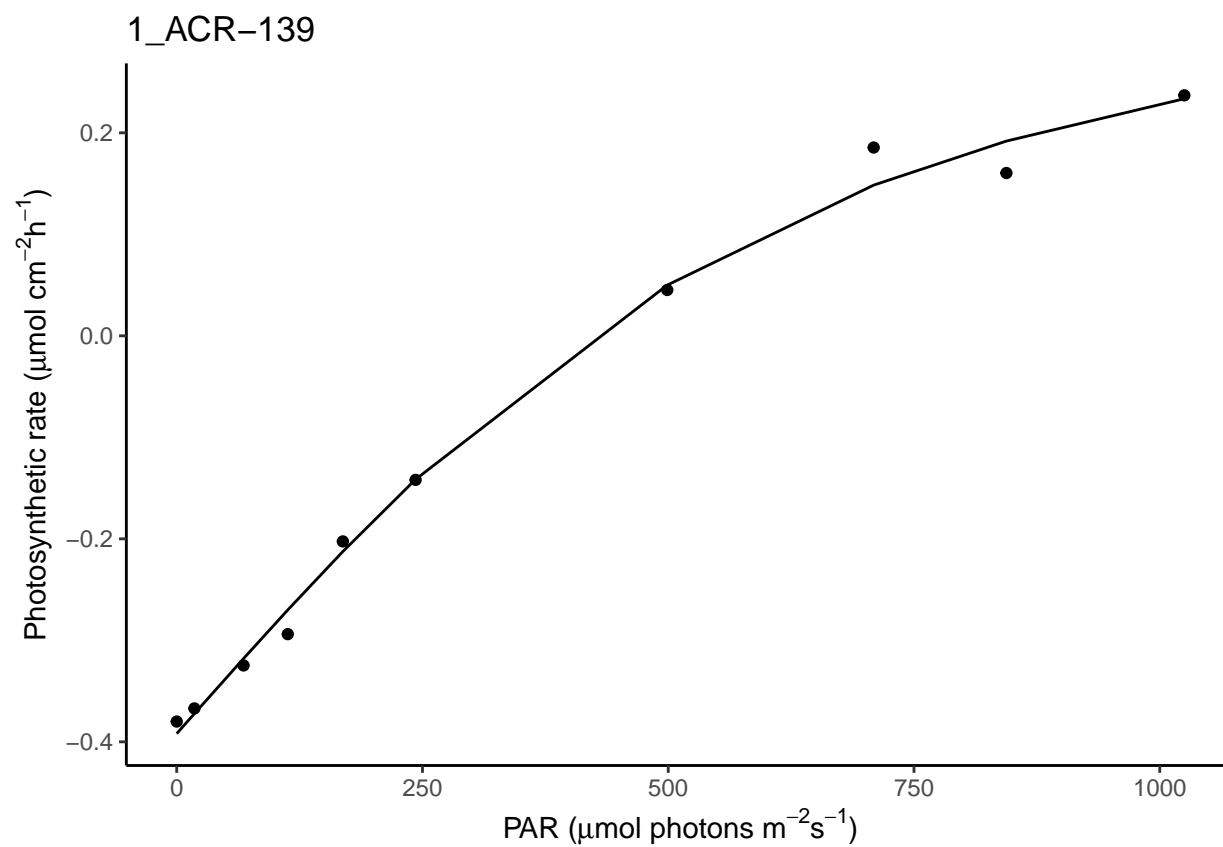
augmented\$colony_id: POC-248



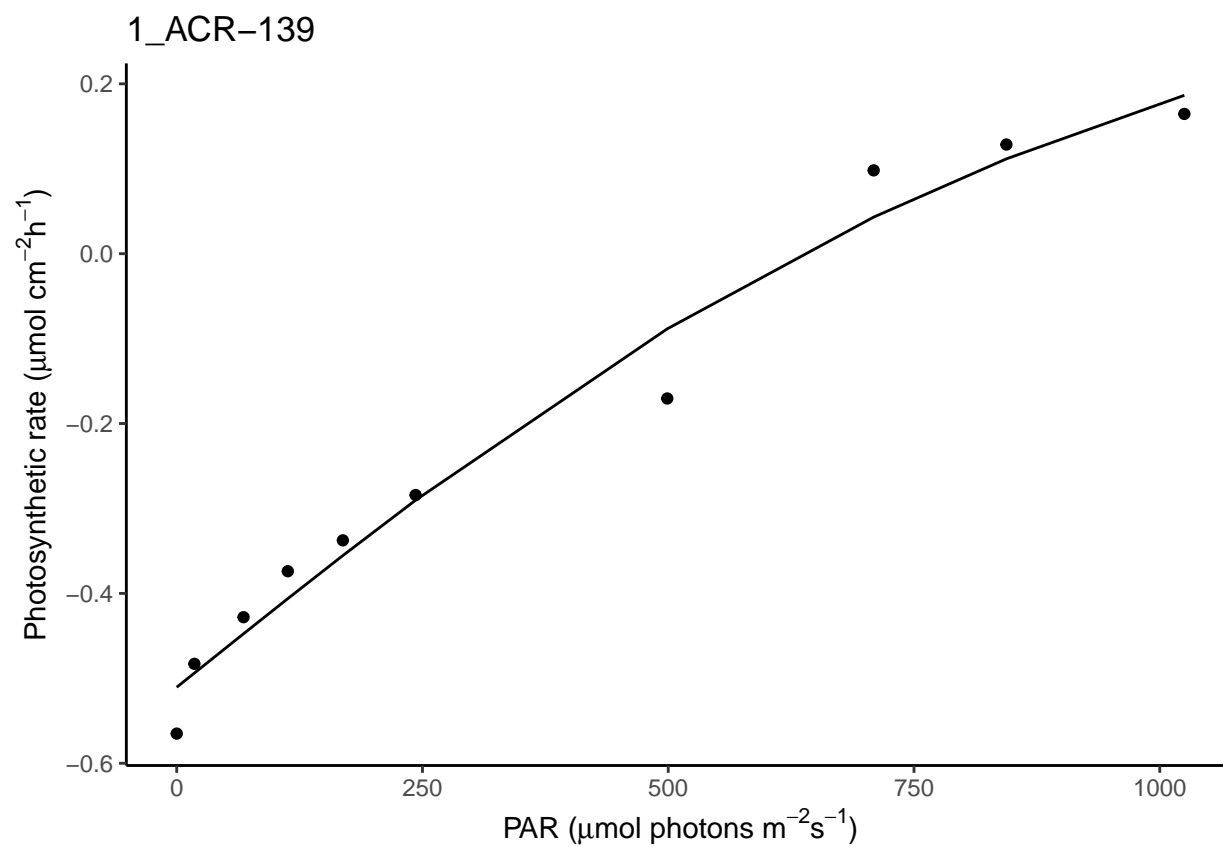
augmented\$colony_id: POC-254



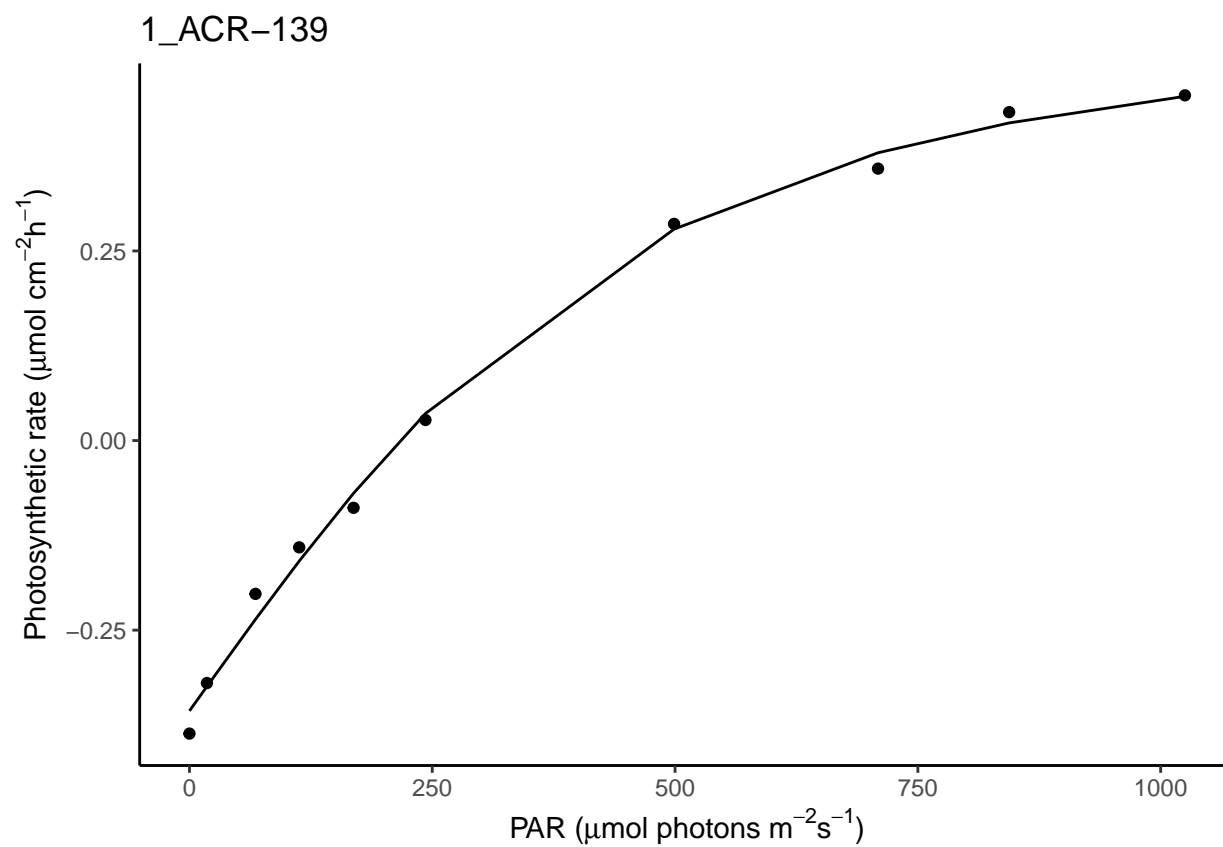
```
## -----  
## augmented$colony_id: POC-255
```



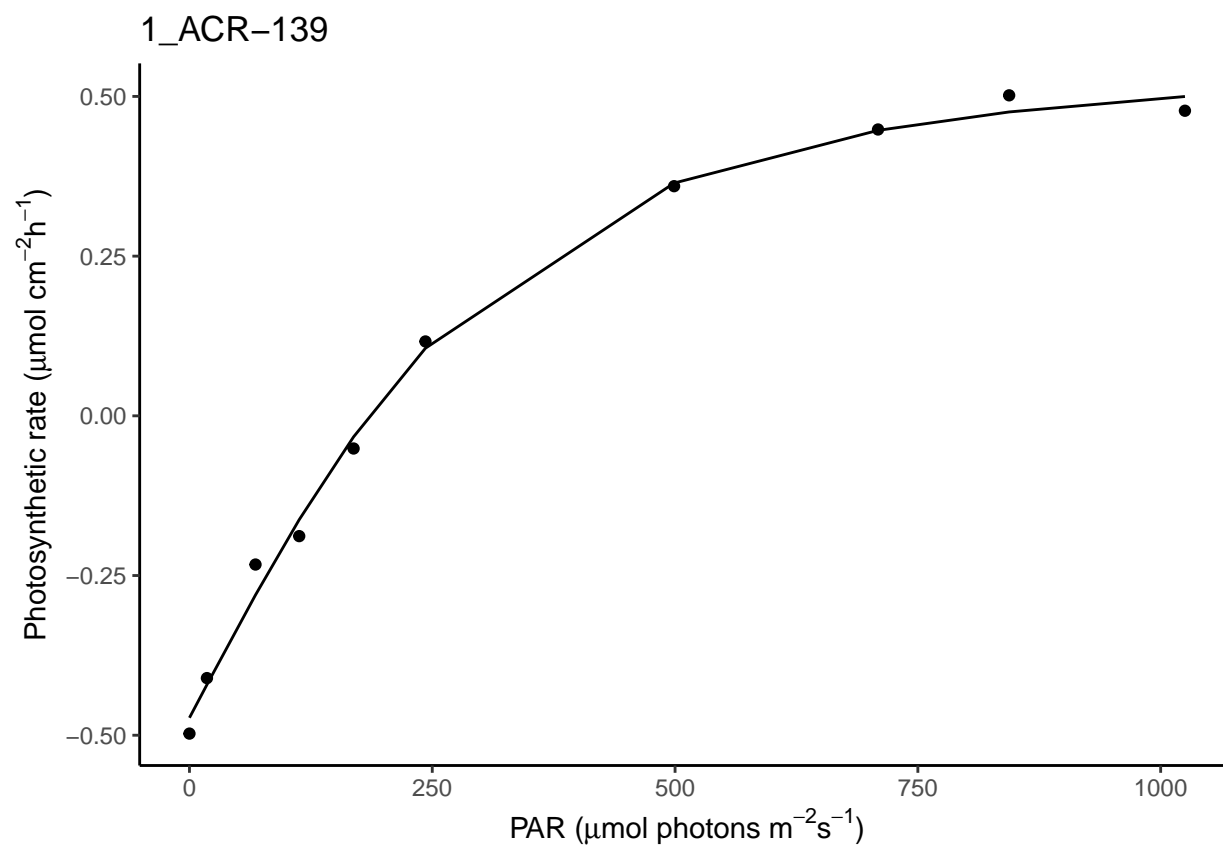
```
## -----  
## augmented$colony_id: POC-257
```

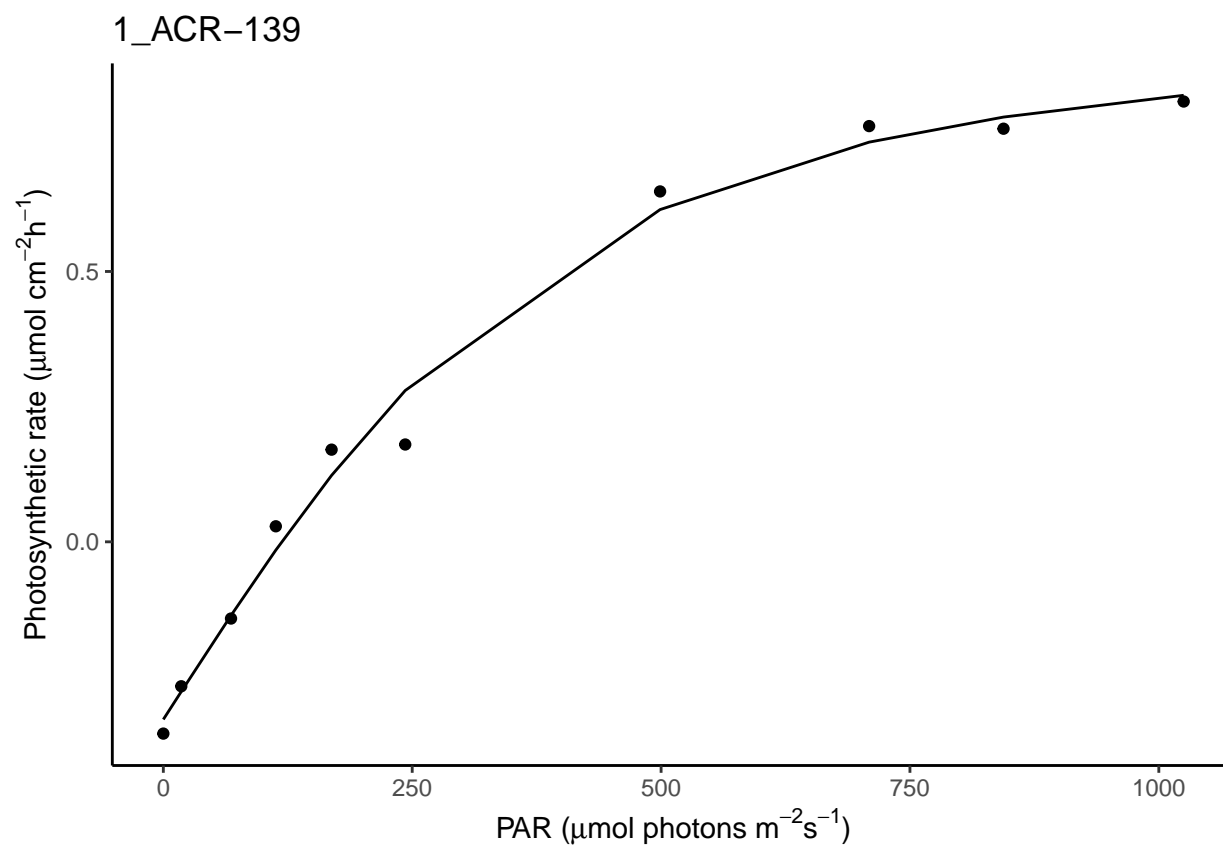
augmented\$colony_id: POC-259



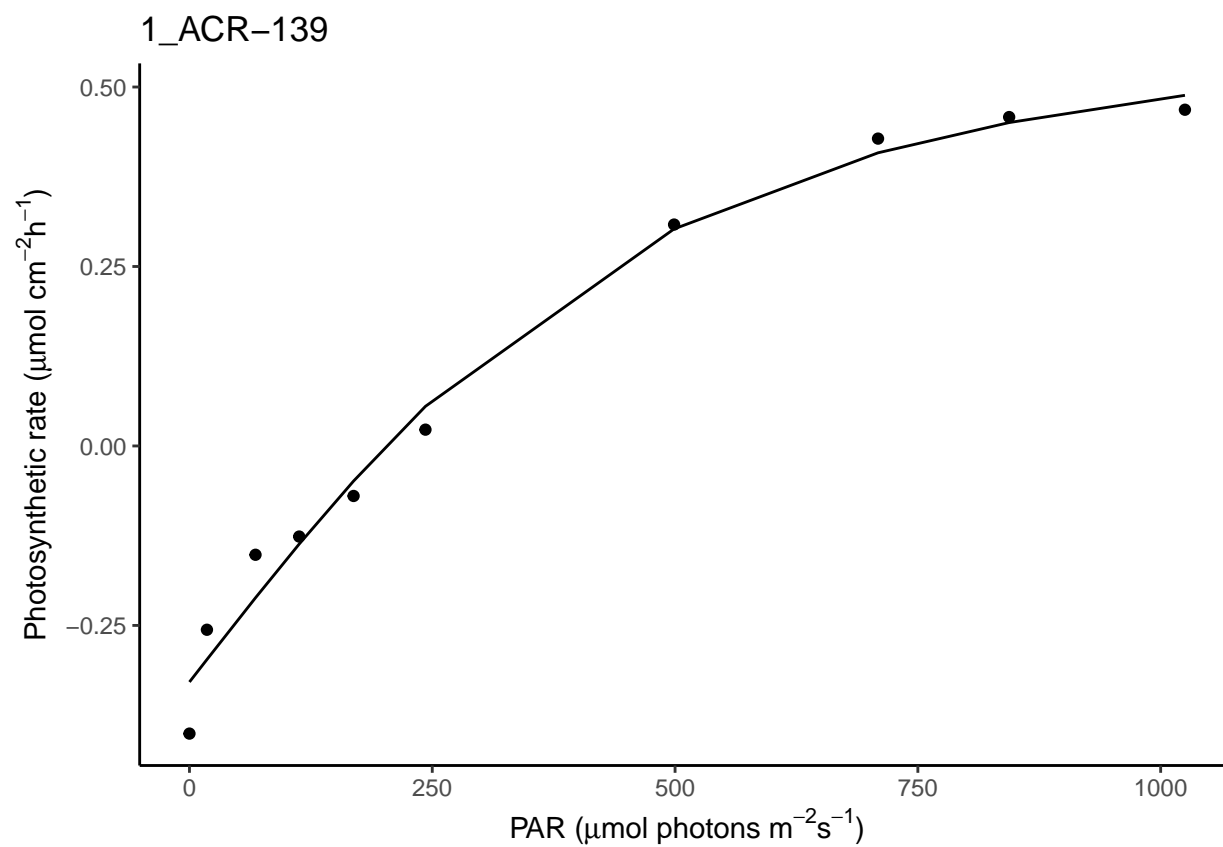
augmented\$colony_id: POC-346



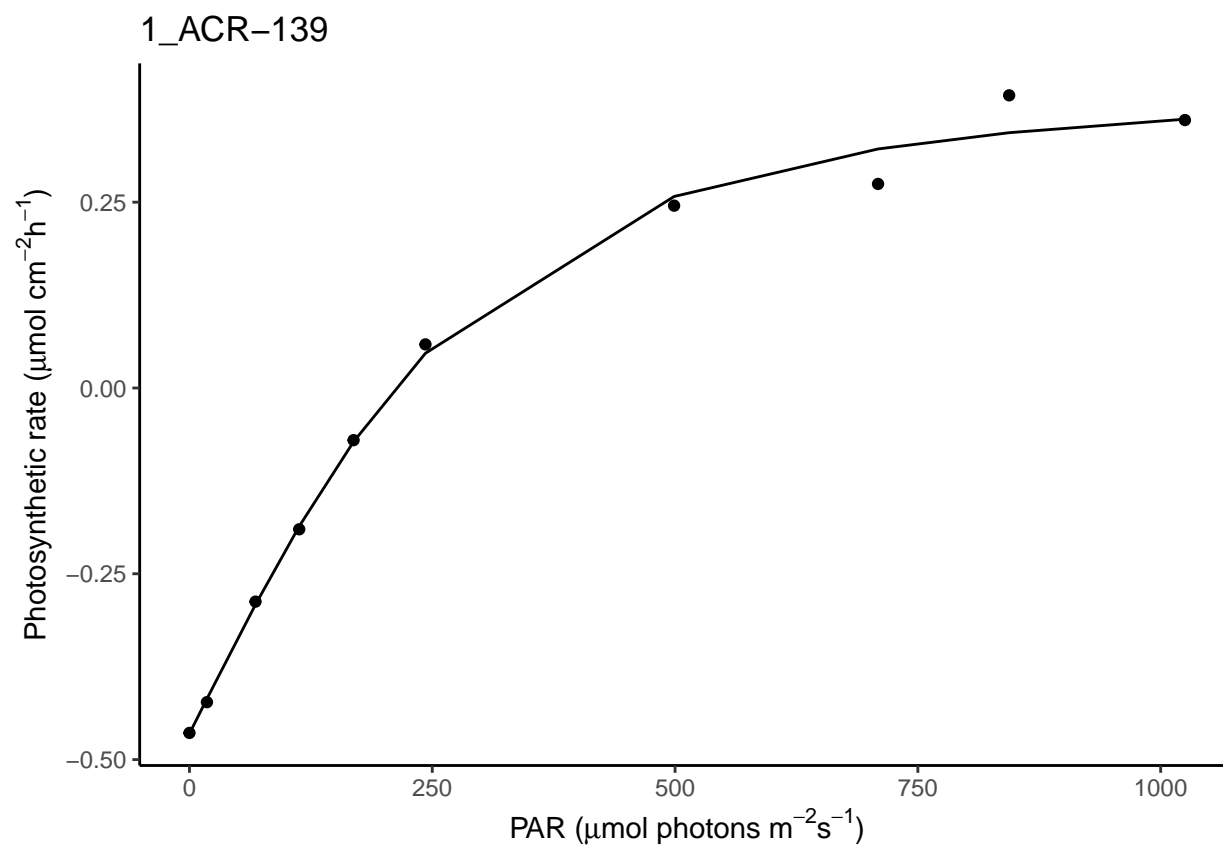
augmented\$colony_id: P0C-359



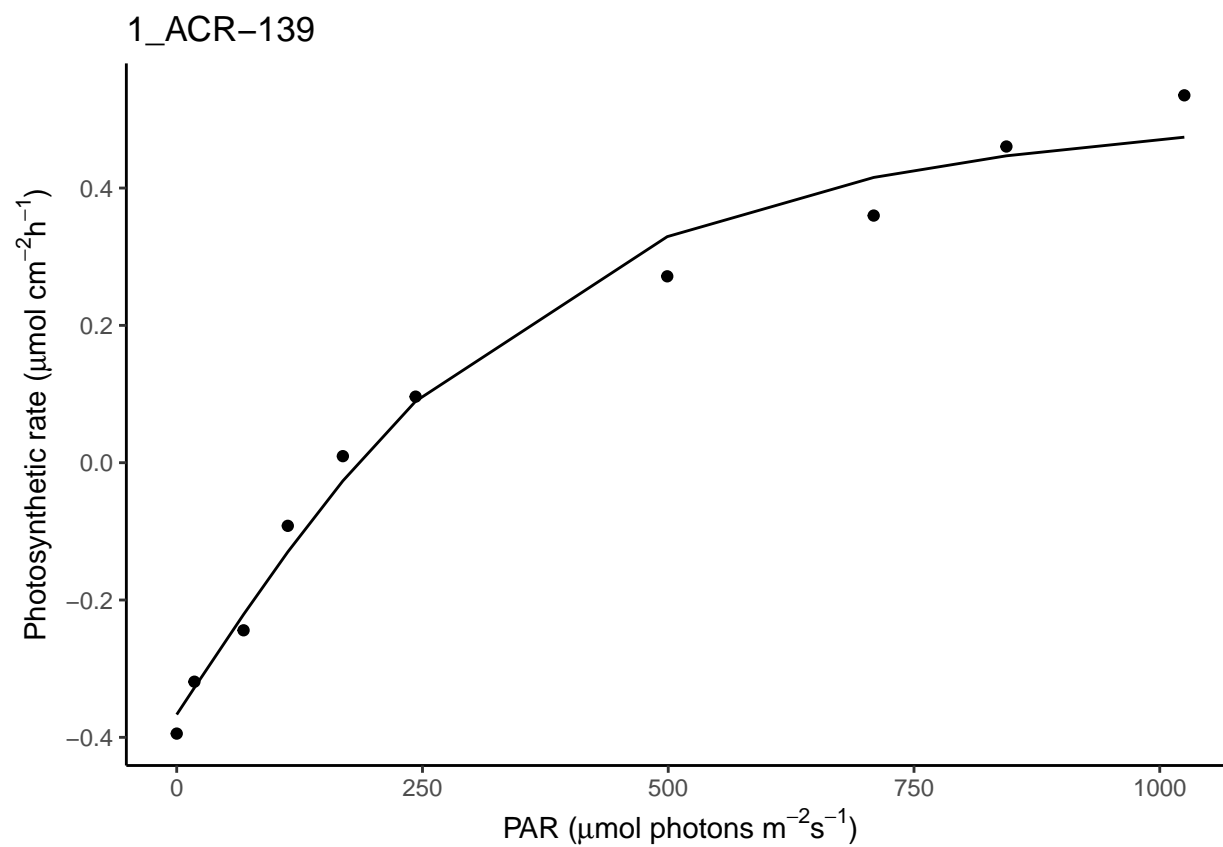
```
## -----  
## augmented$colony_id: P0C-366
```



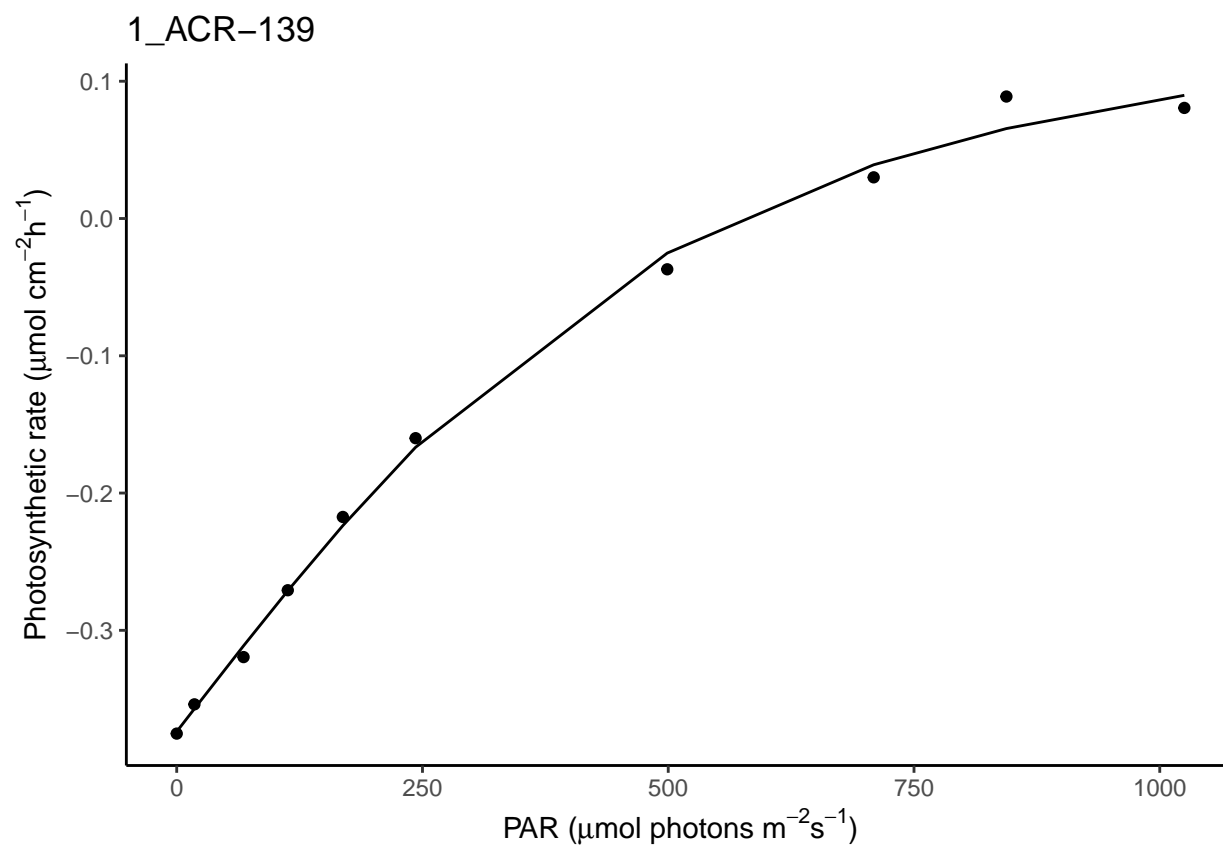
```
## -----  
## augmented$colony_id: POC-369
```



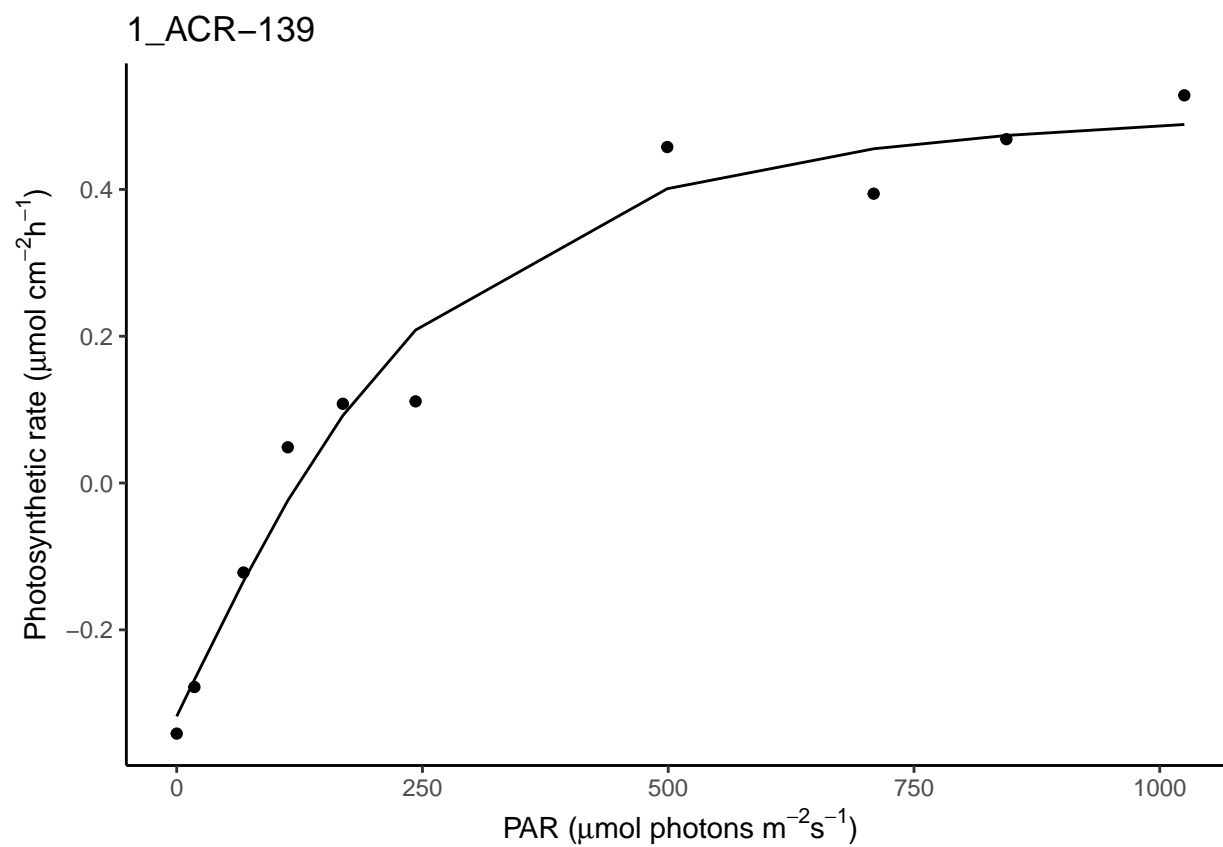
augmented\$colony_id: POC-371



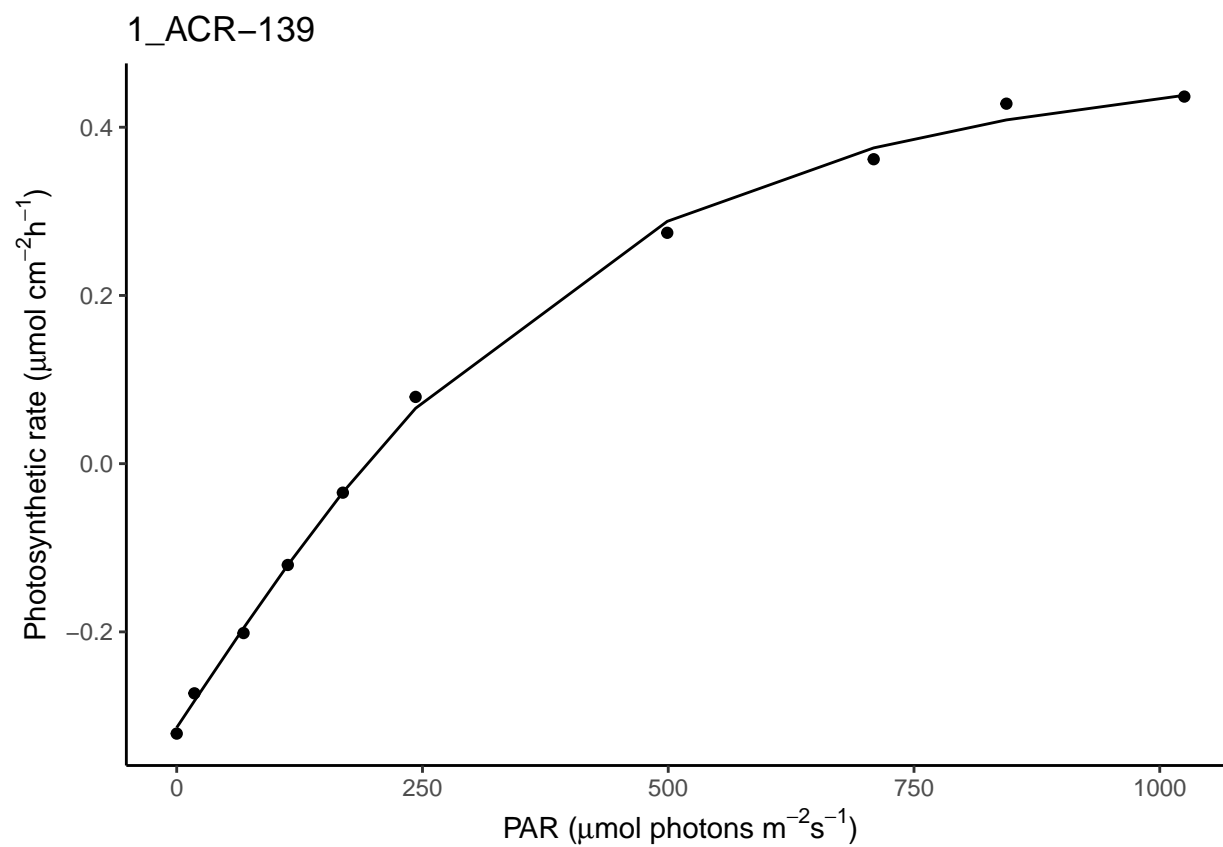
augmented\$colony_id: P0C-372



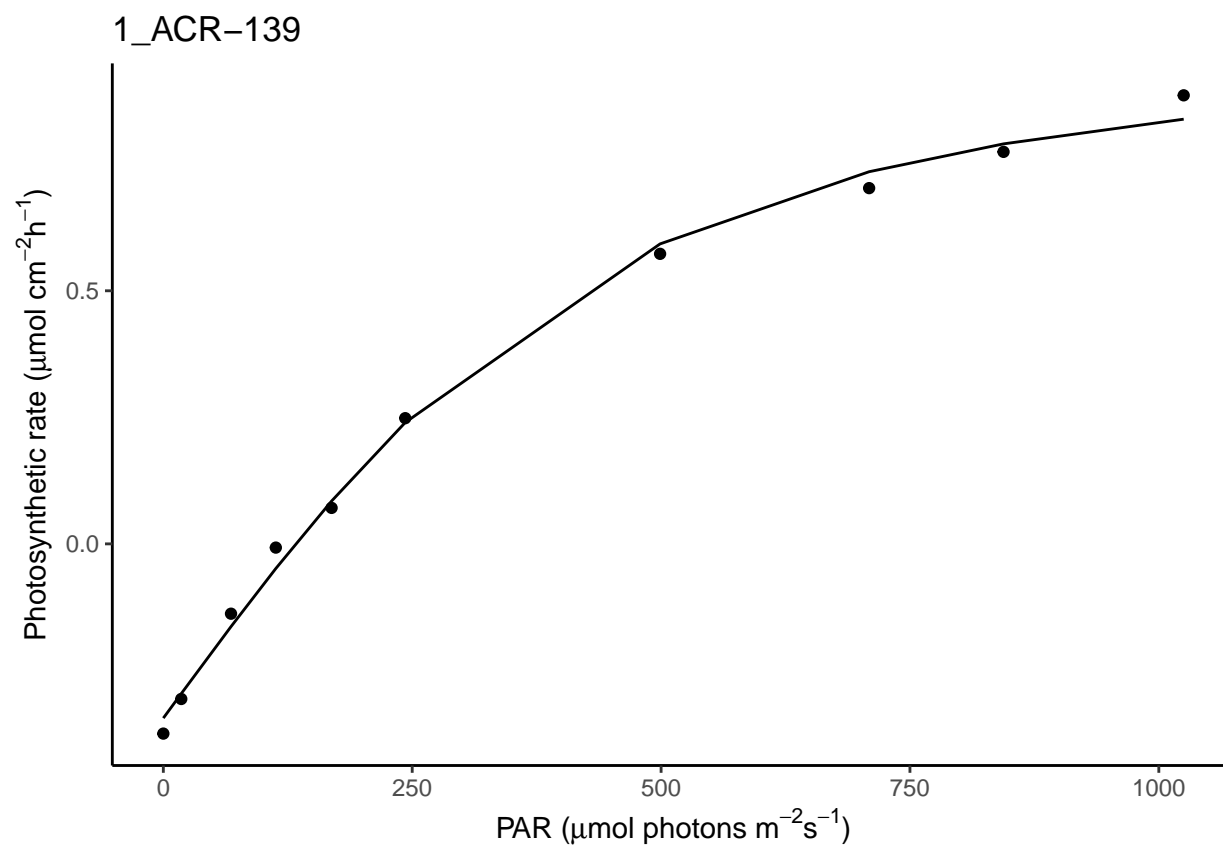
```
## -----  
## augmented$colony_id: P0C-373
```

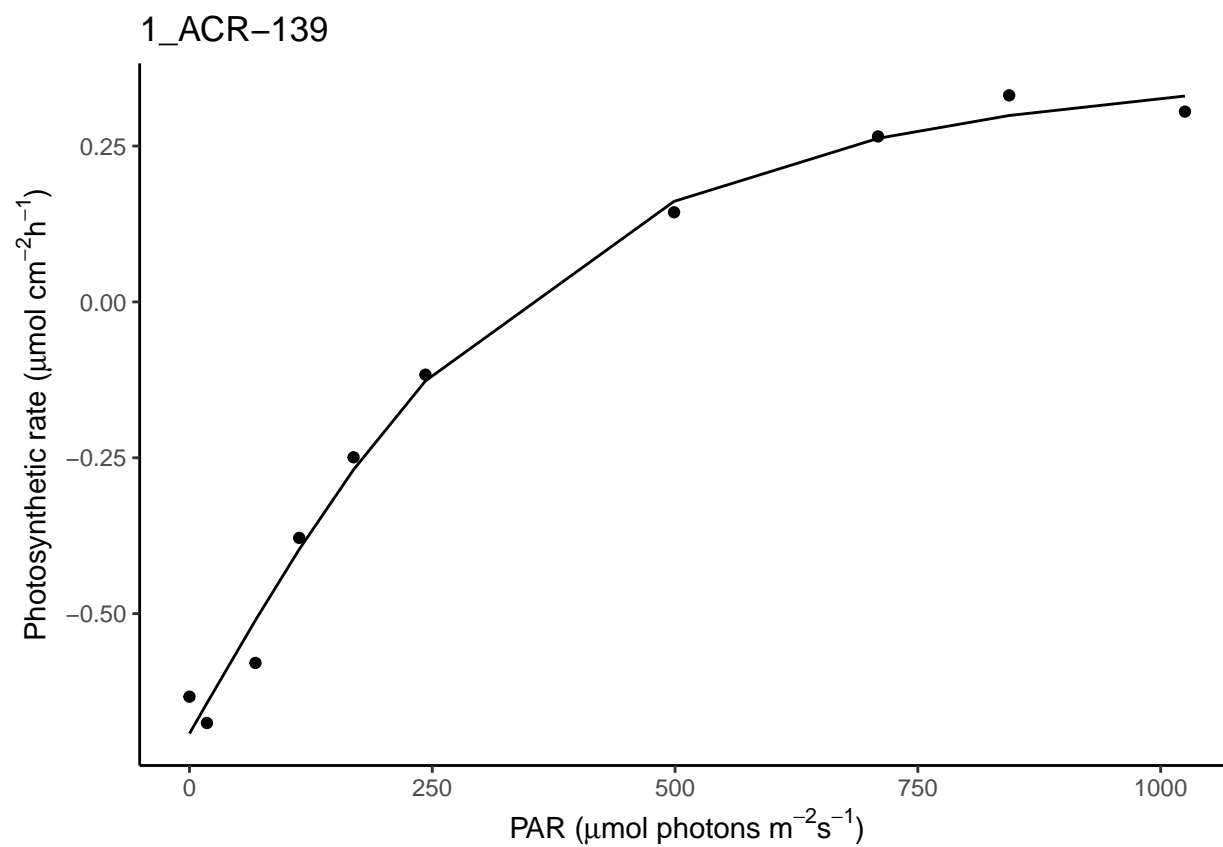
augmented\$colony_id: POC-375



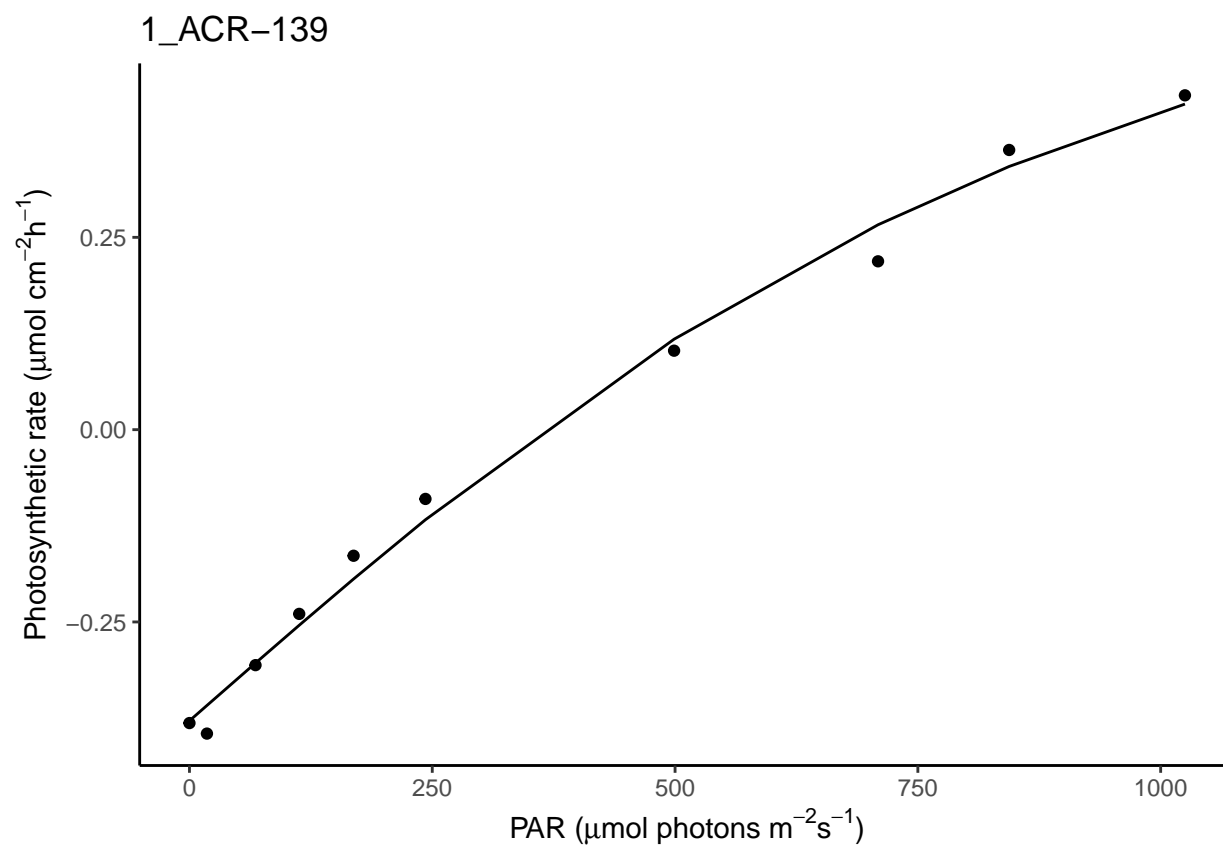
augmented\$colony_id: POC-377



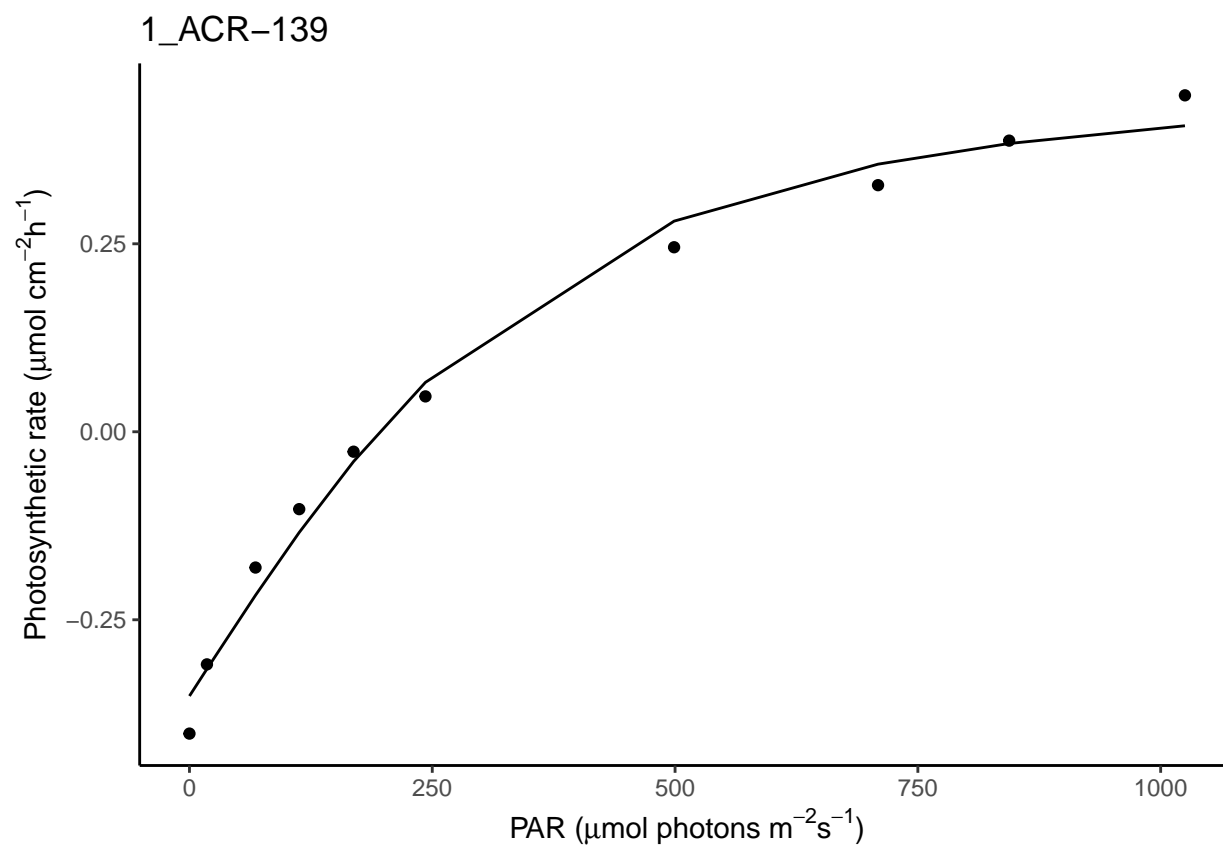
augmented\$colony_id: P0C-378



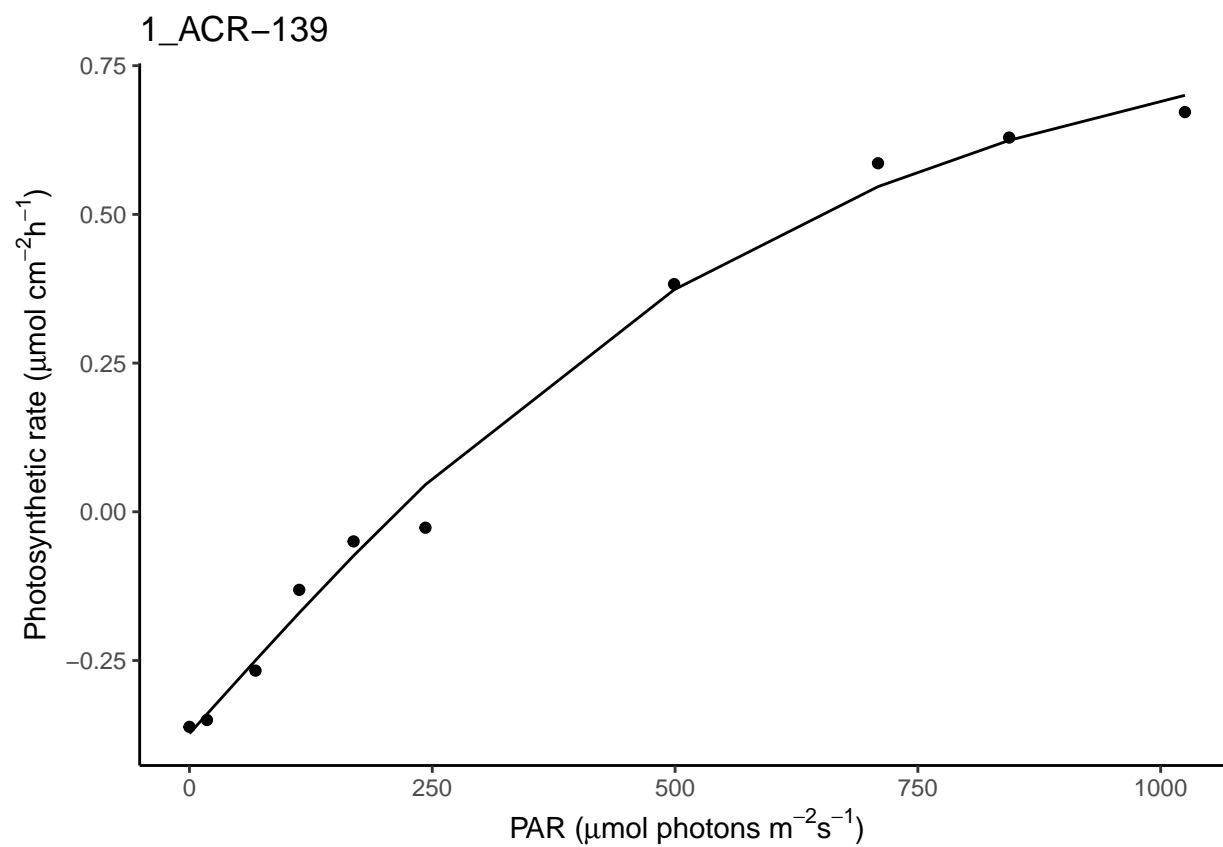
augmented\$colony_id: POC-386



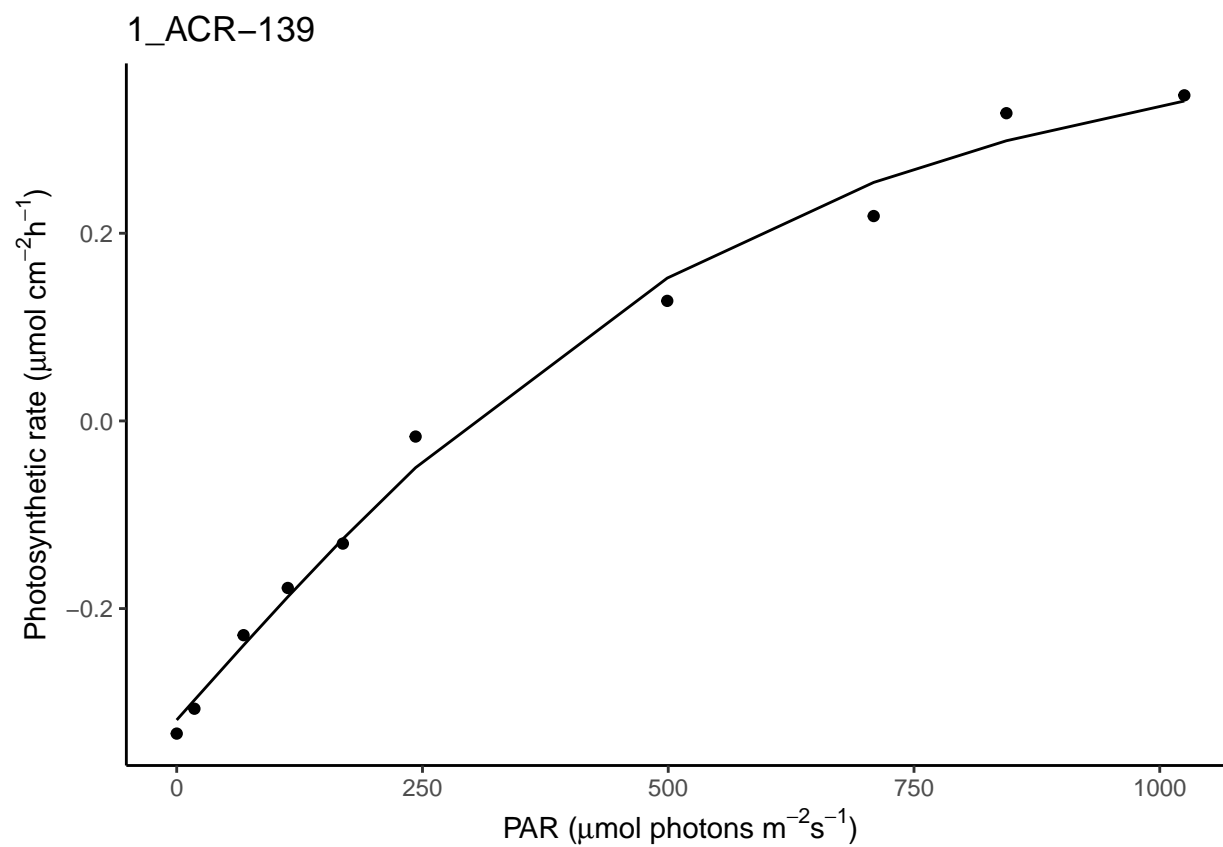
```
## -----  
## augmented$colony_id: POC-391
```



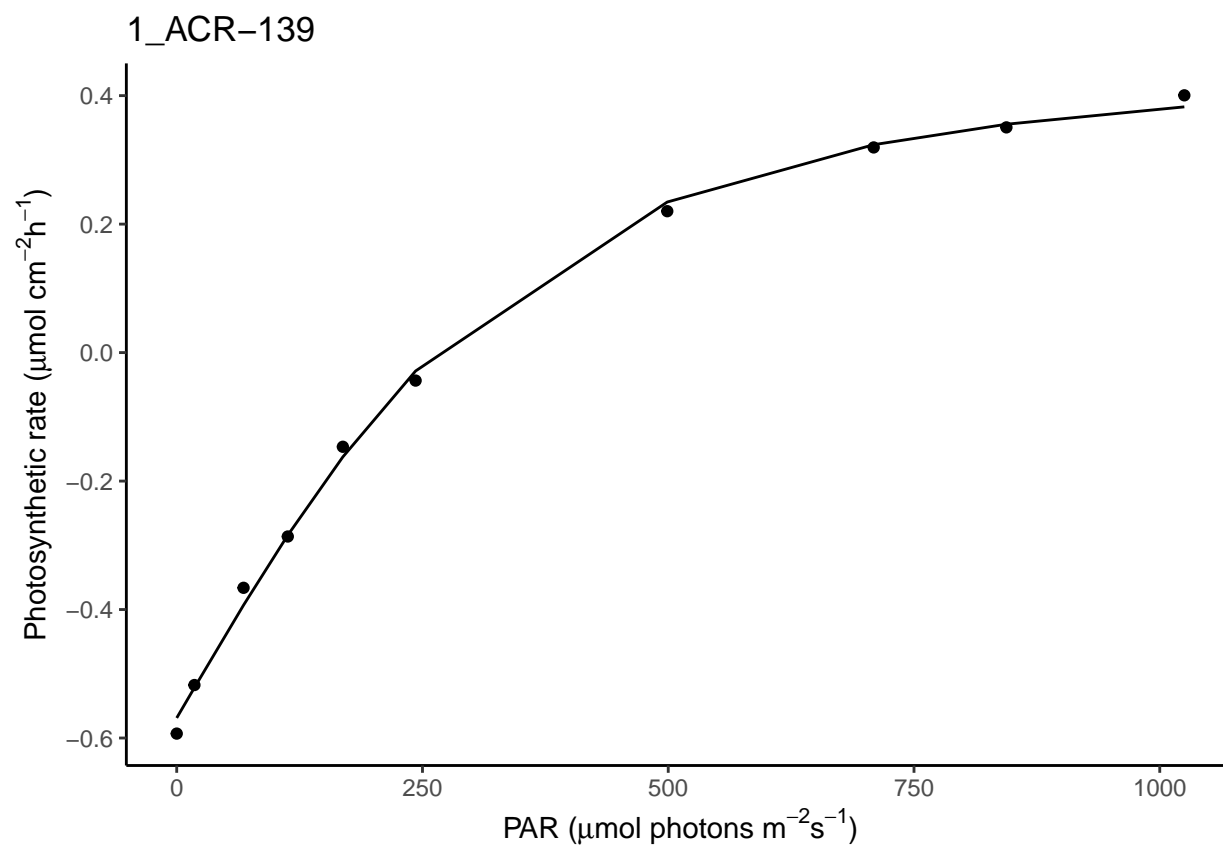
augmented\$colony_id: P0C-394



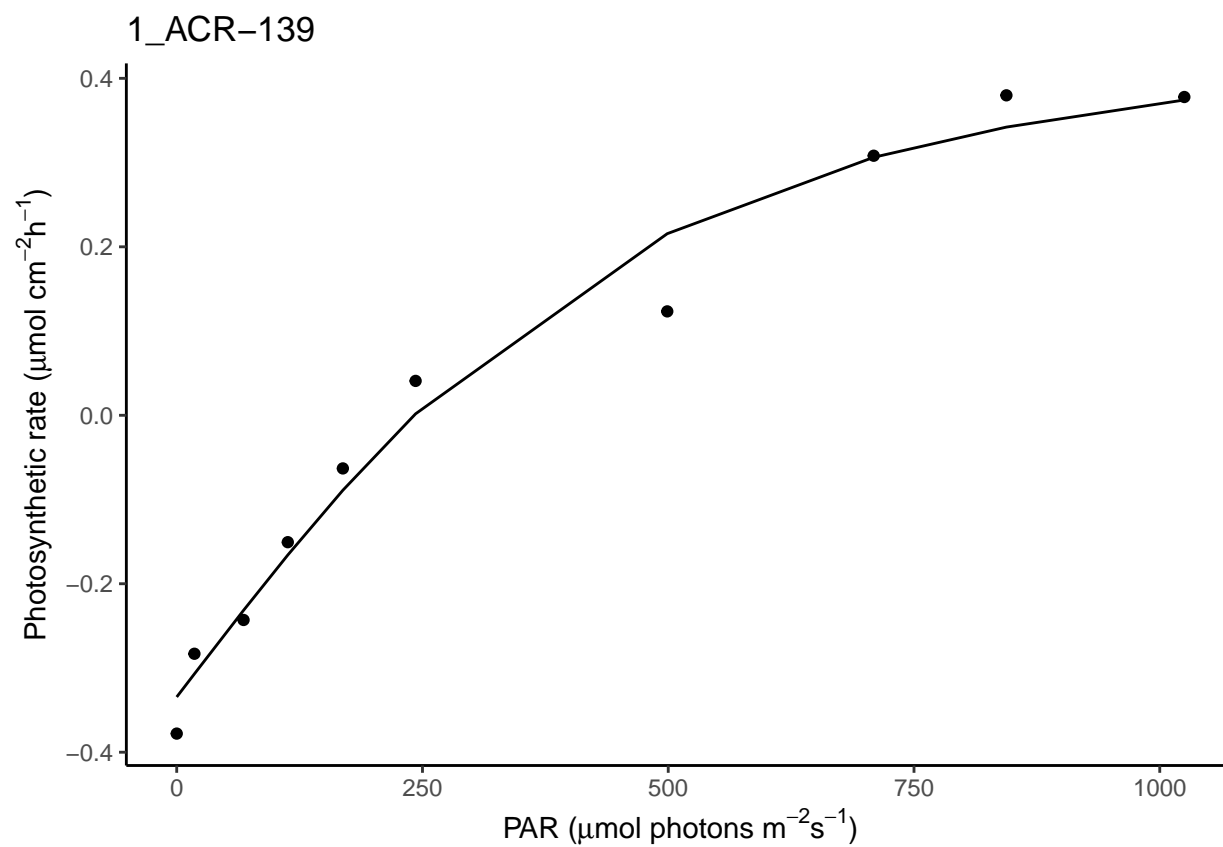
```
## -----  
## augmented$colony_id: P0C-395
```



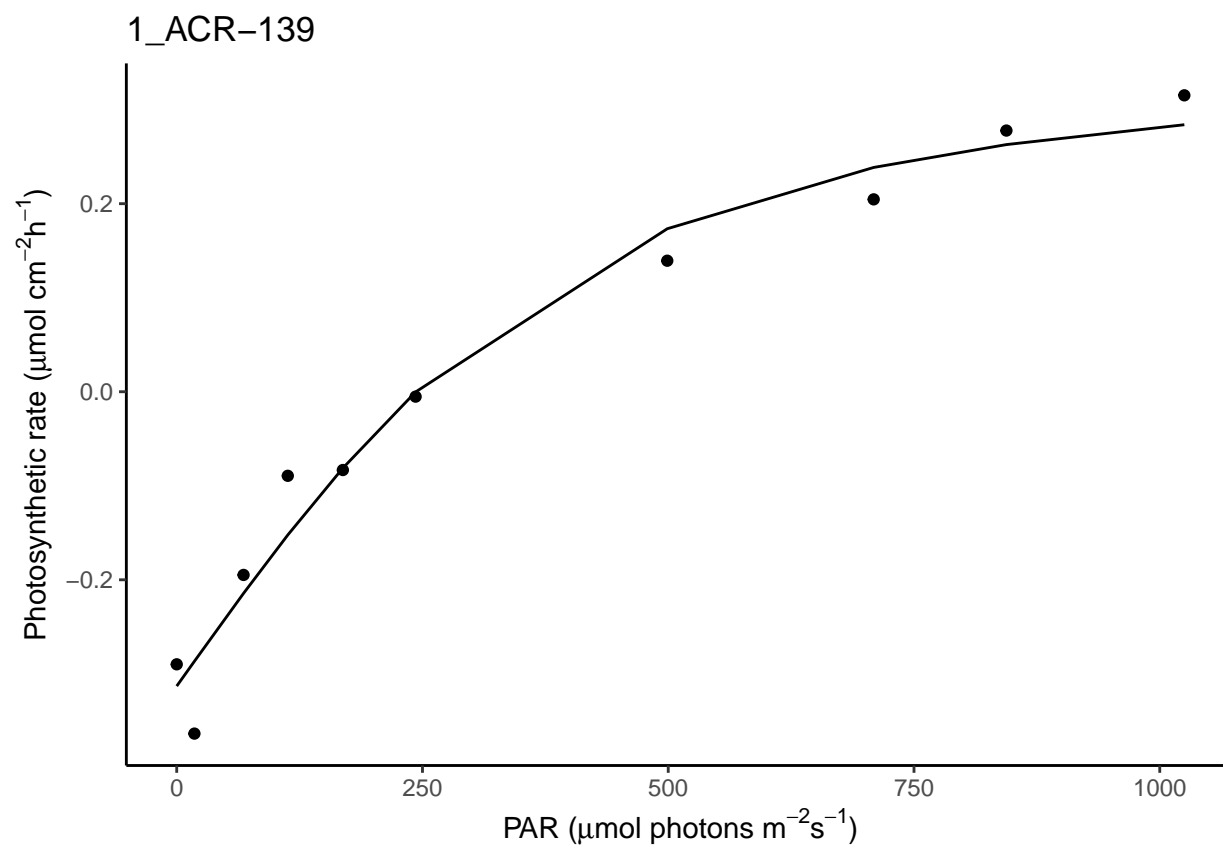
```
## -----  
## augmented$colony_id: POC-40
```

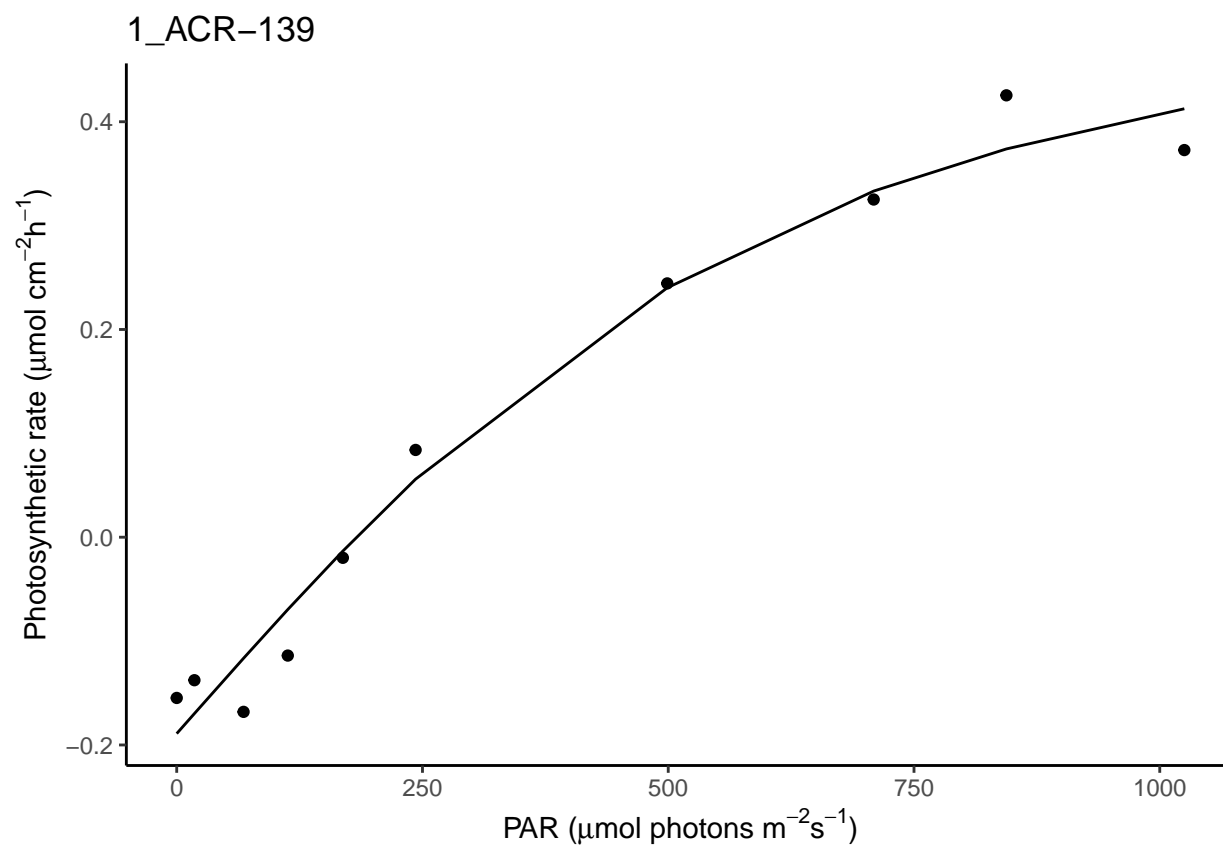
augmented\$colony_id: POC-41



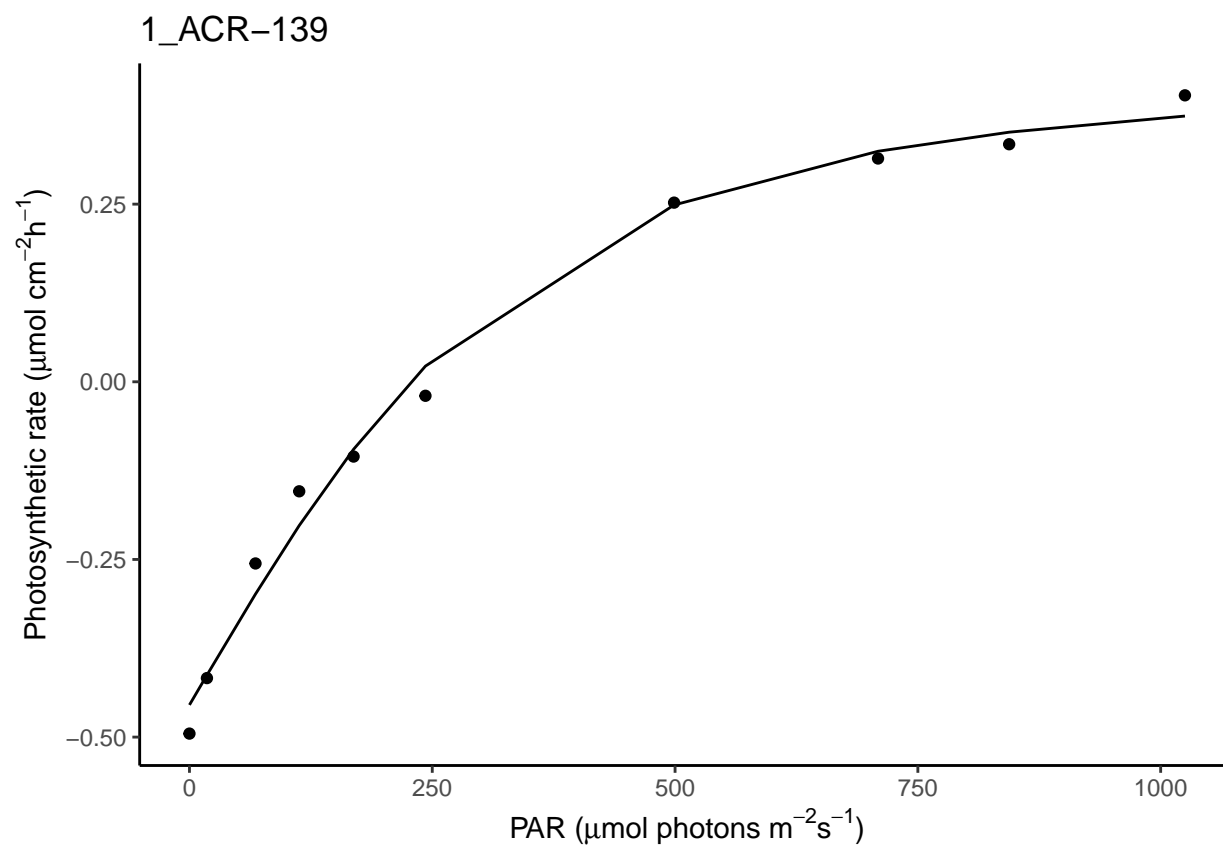
```
## -----  
## augmented$colony_id: POC-42
```



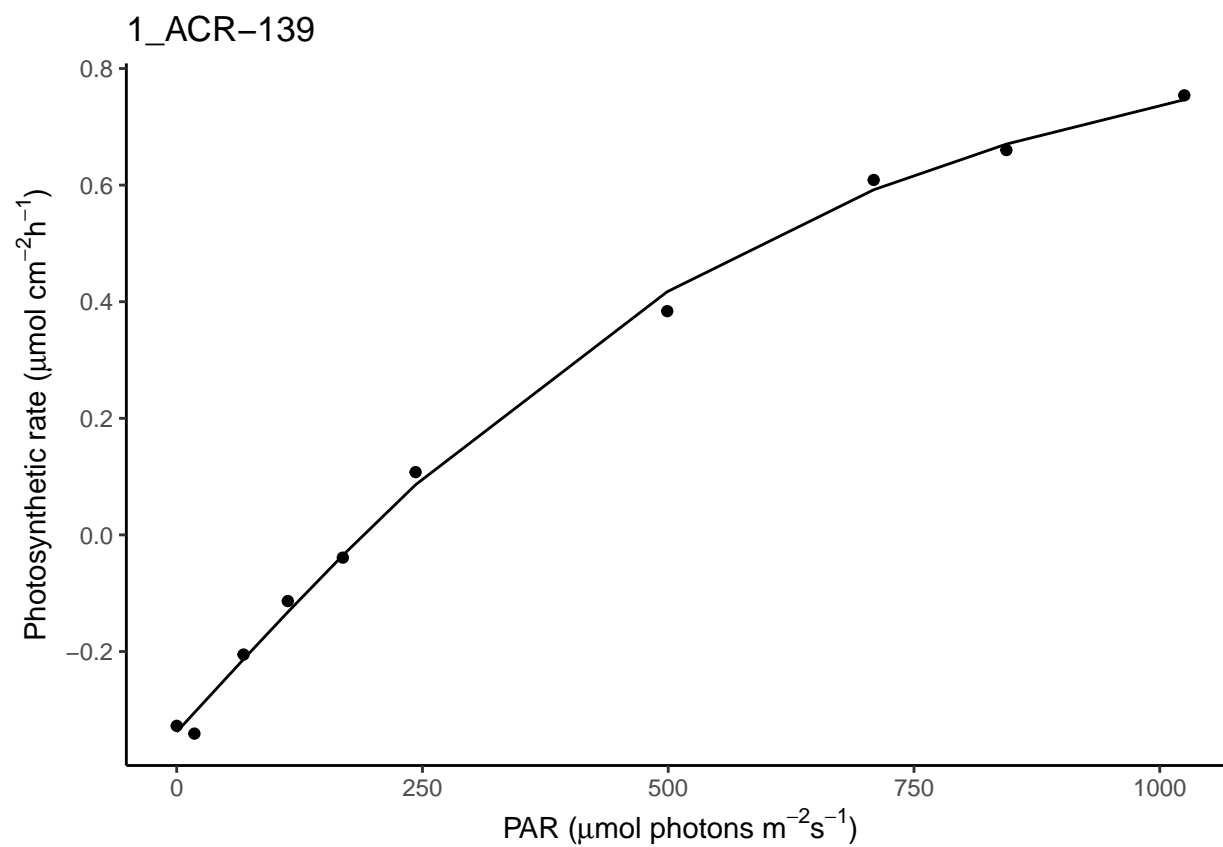
augmented\$colony_id: POC-43



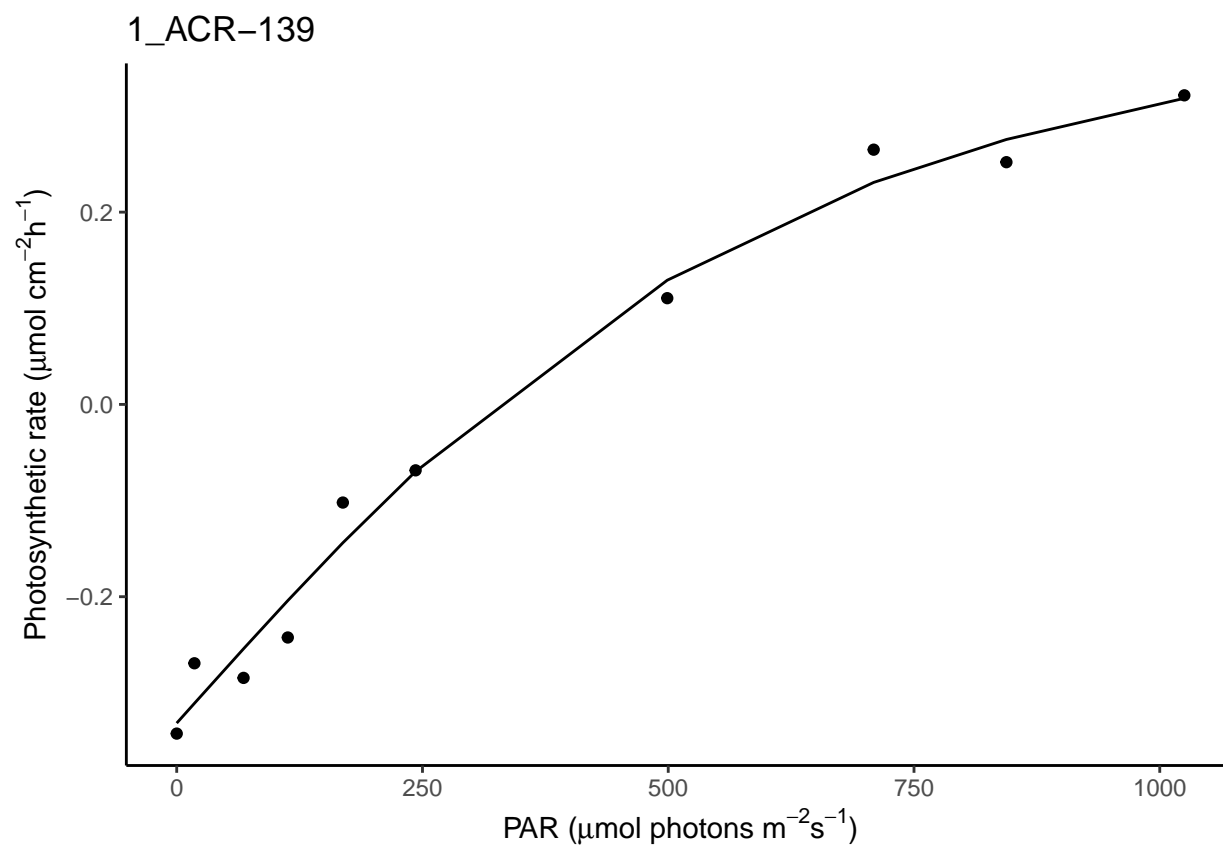
```
## -----  
## augmented$colony_id: POC-44
```



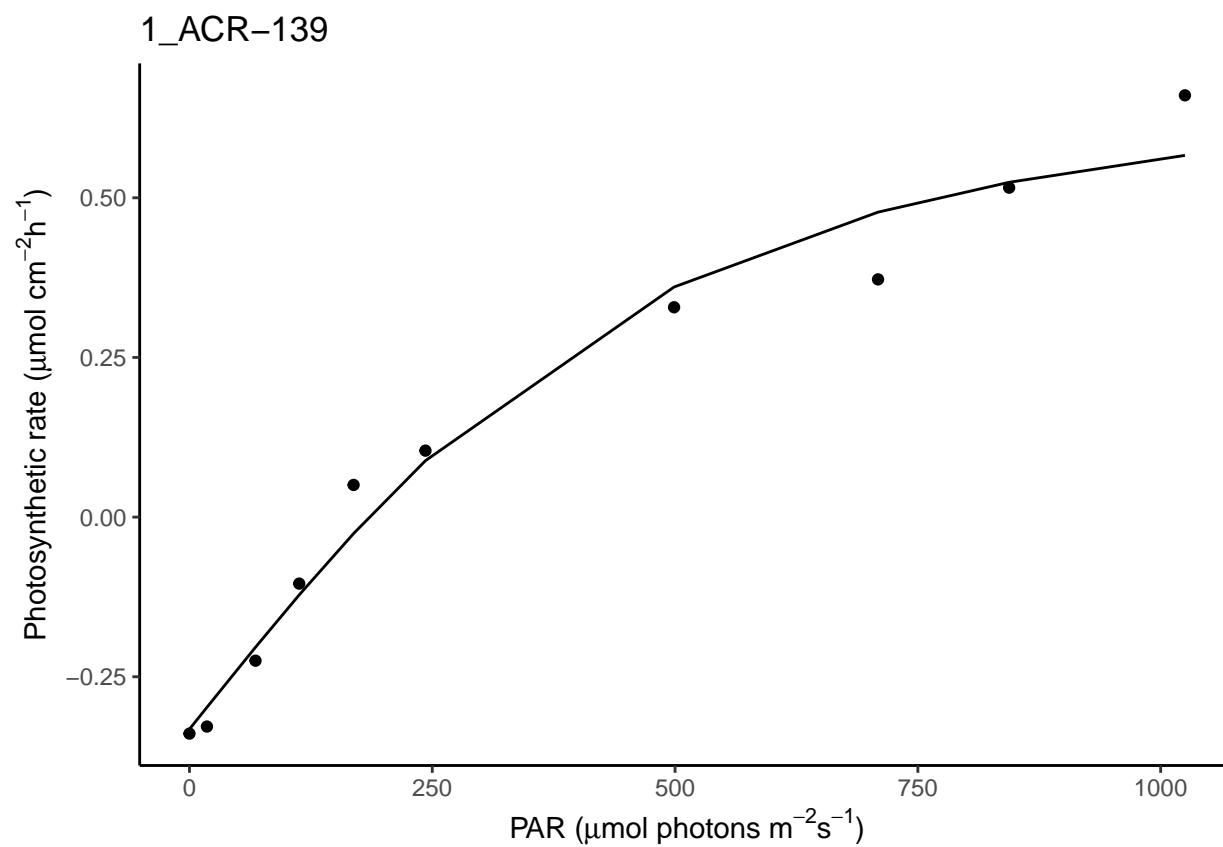
augmented\$colony_id: POC-45



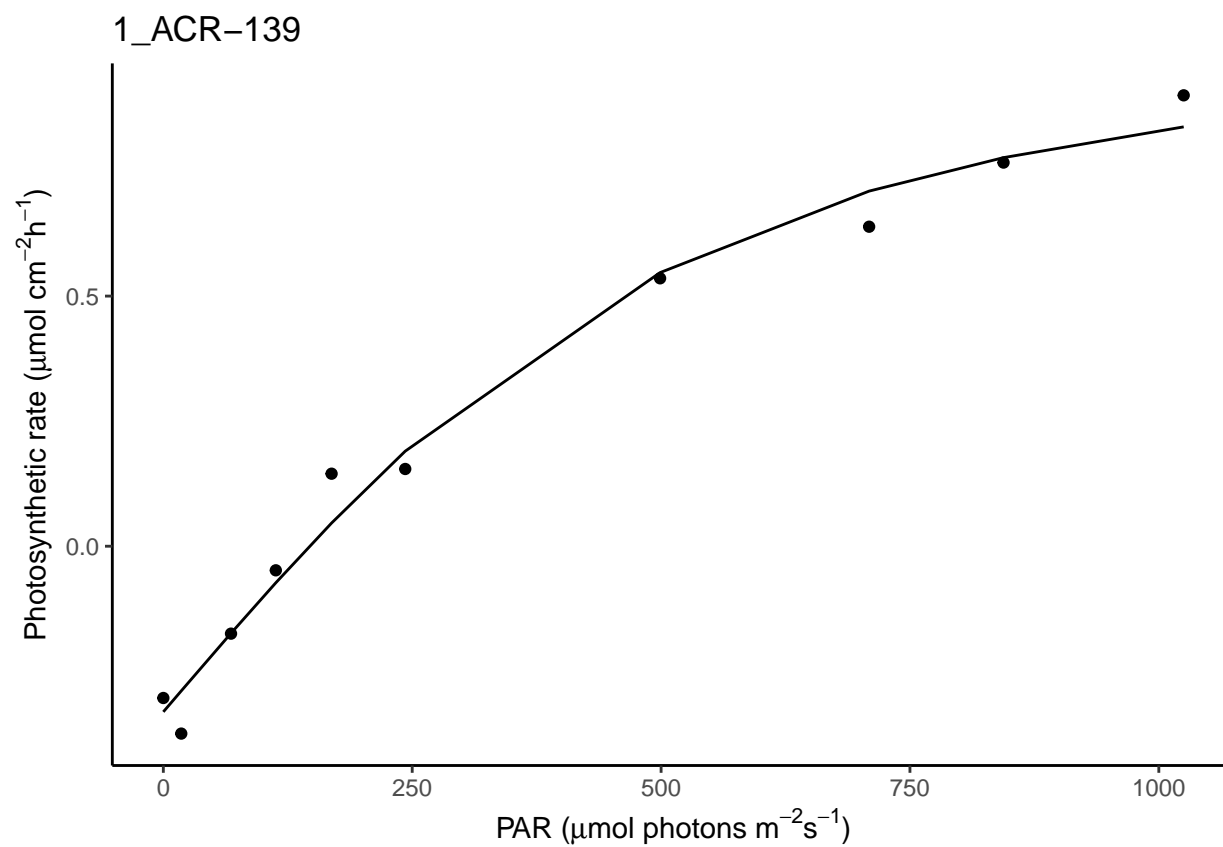
augmented\$colony_id: POC-47



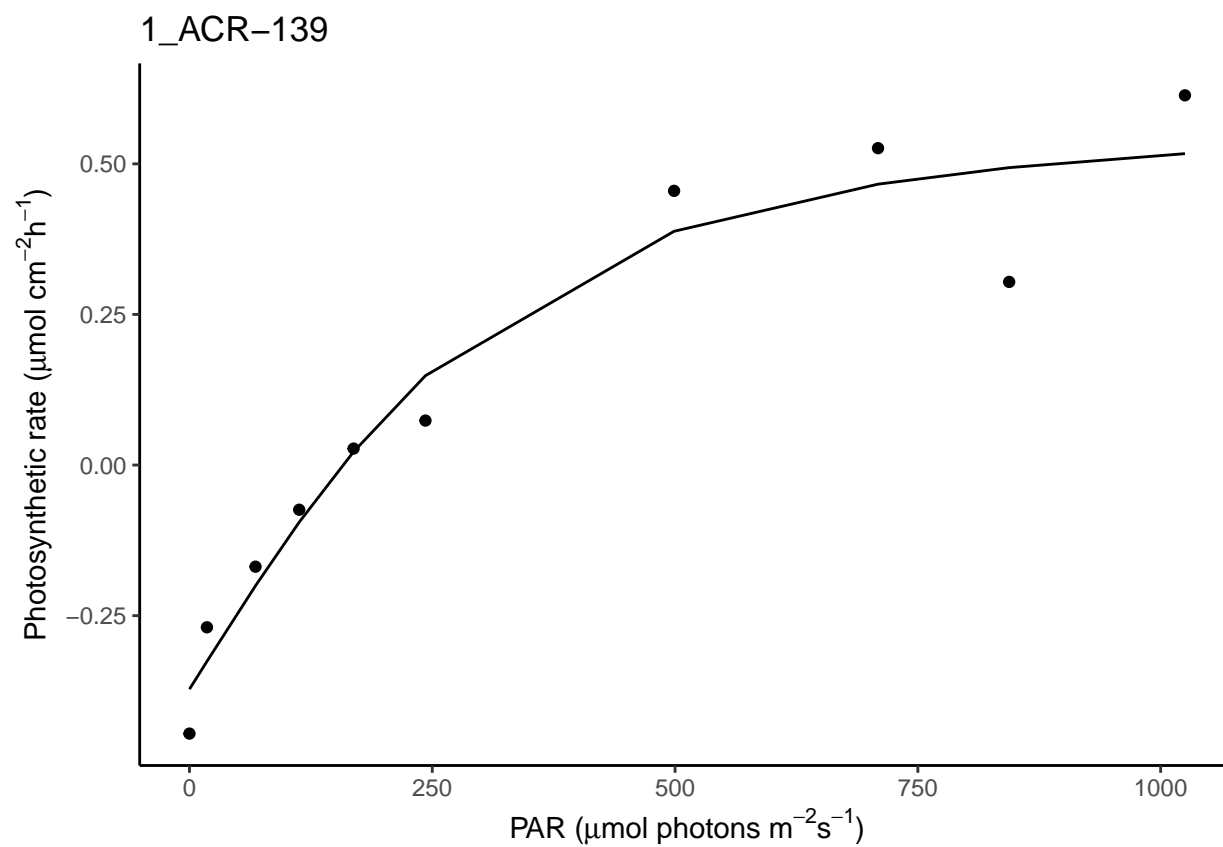
```
## -----  
## augmented$colony_id: POC-48
```



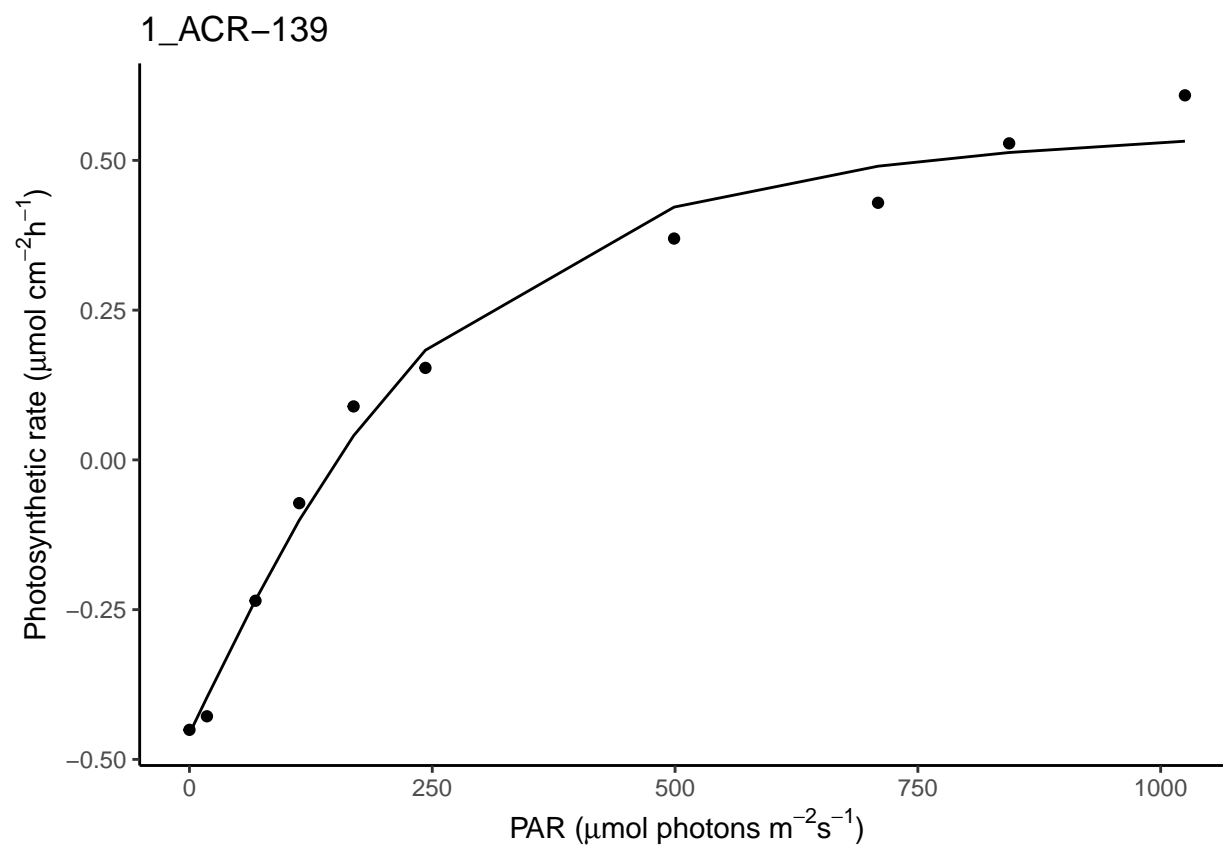
```
## -----  
## augmented$colony_id: POC-50
```

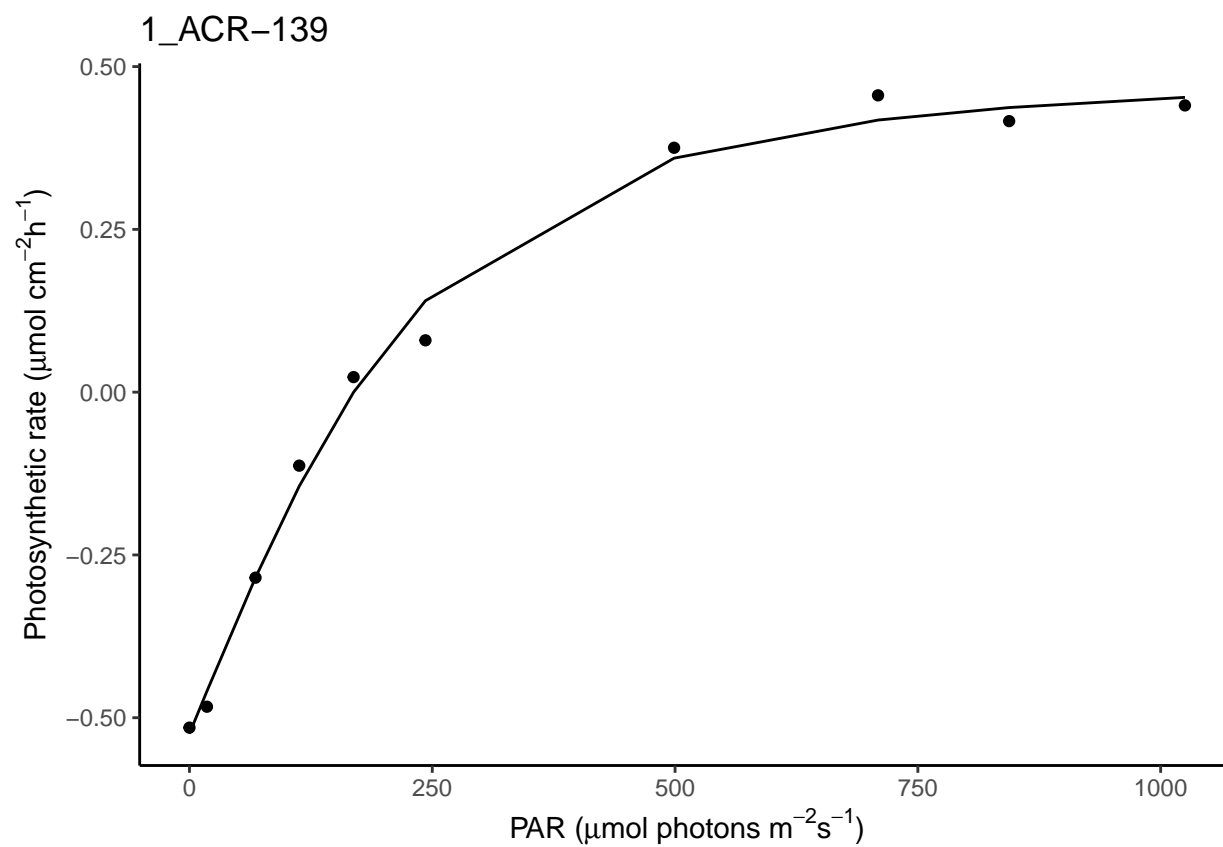
```
## -----  
## augmented$colony_id: POC-52
```



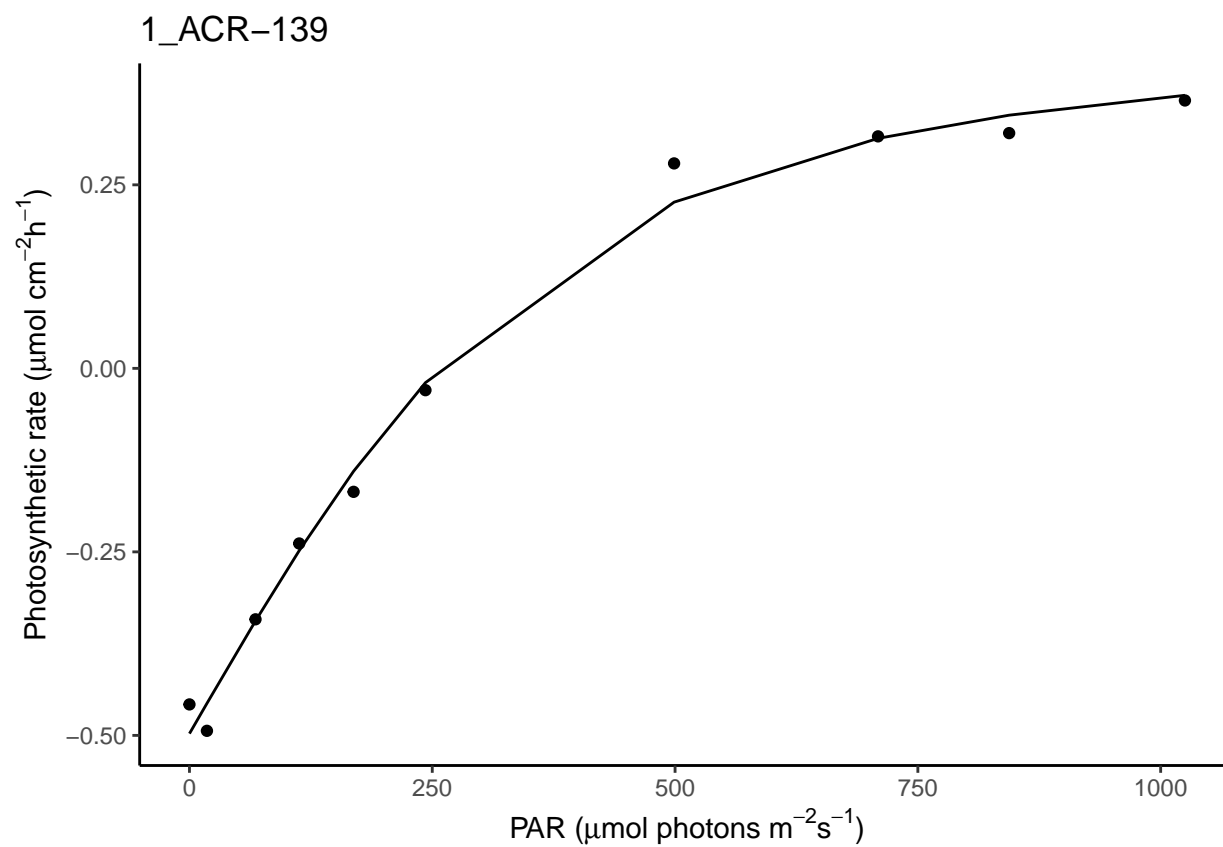
```
## -----  
## augmented$colony_id: POC-53
```



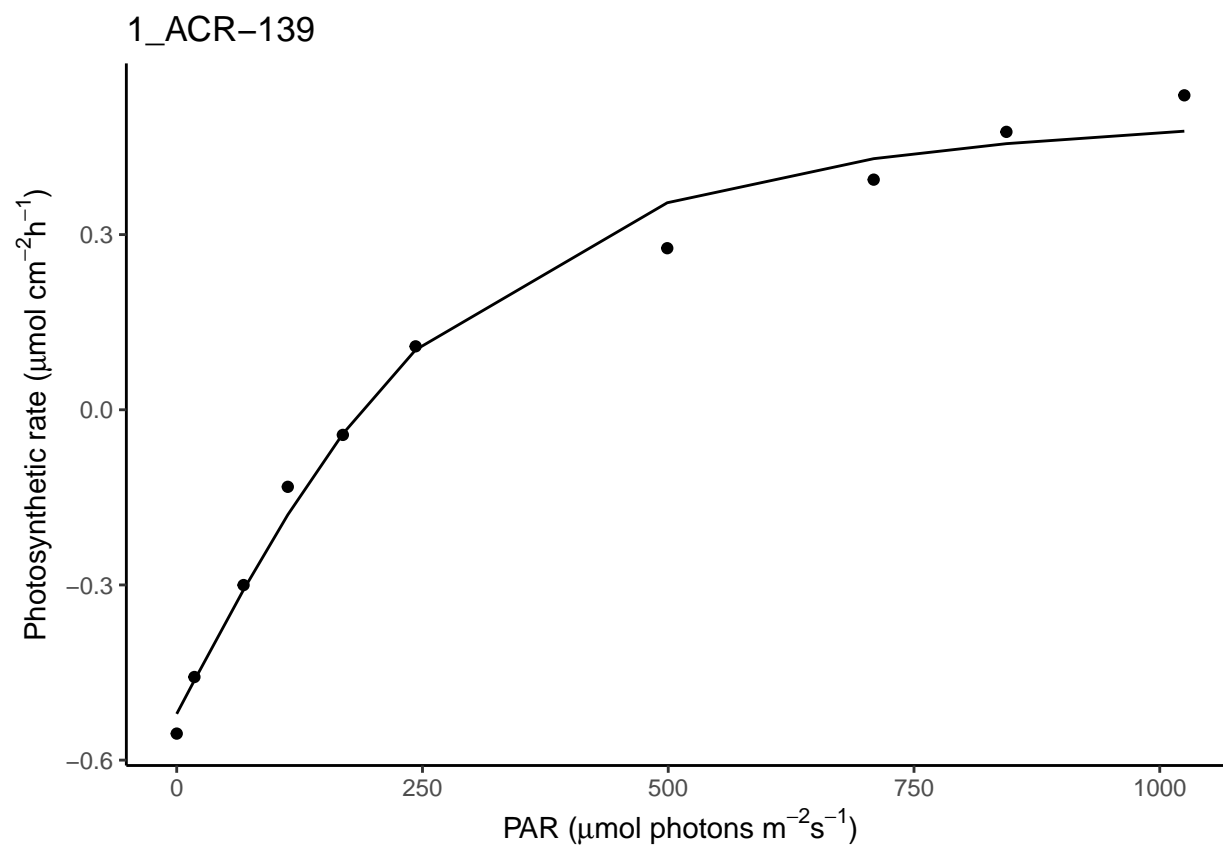
augmented\$colony_id: POC-55



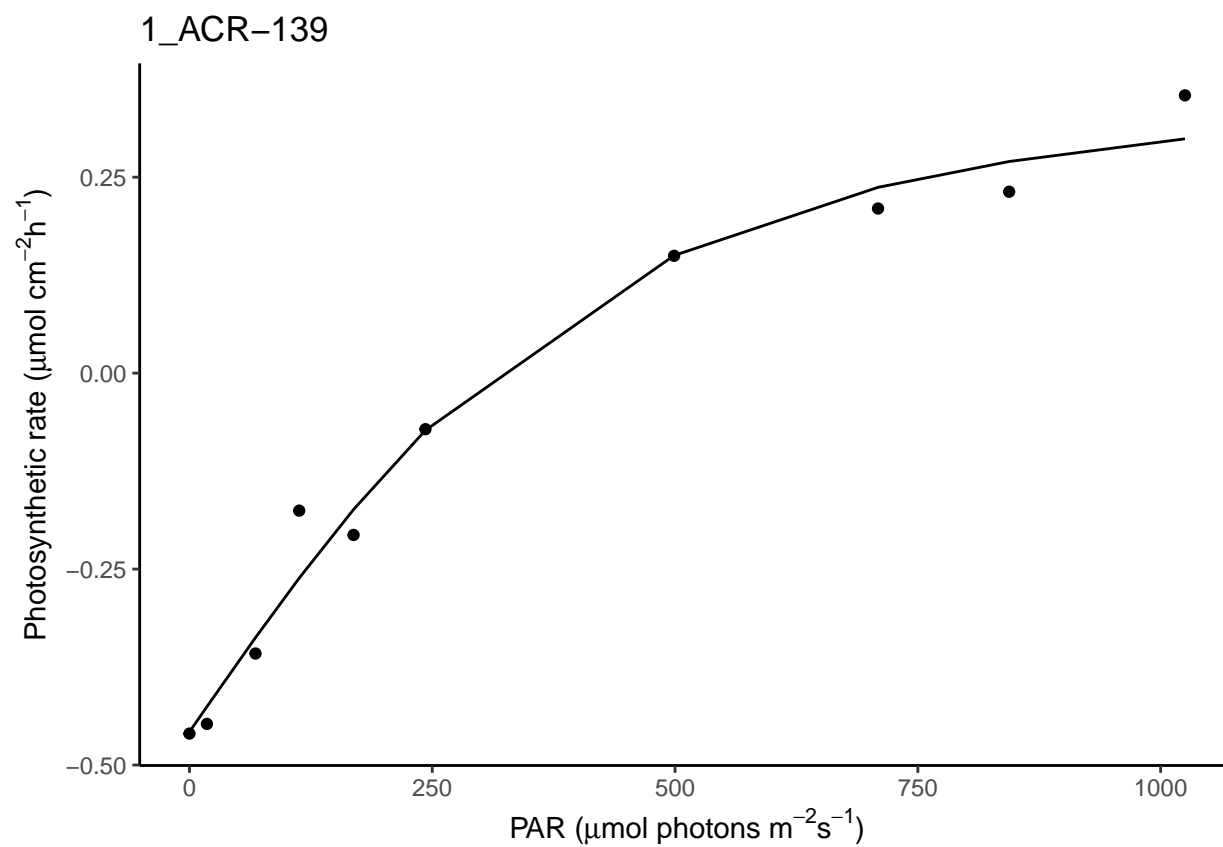
augmented\$colony_id: POC-56



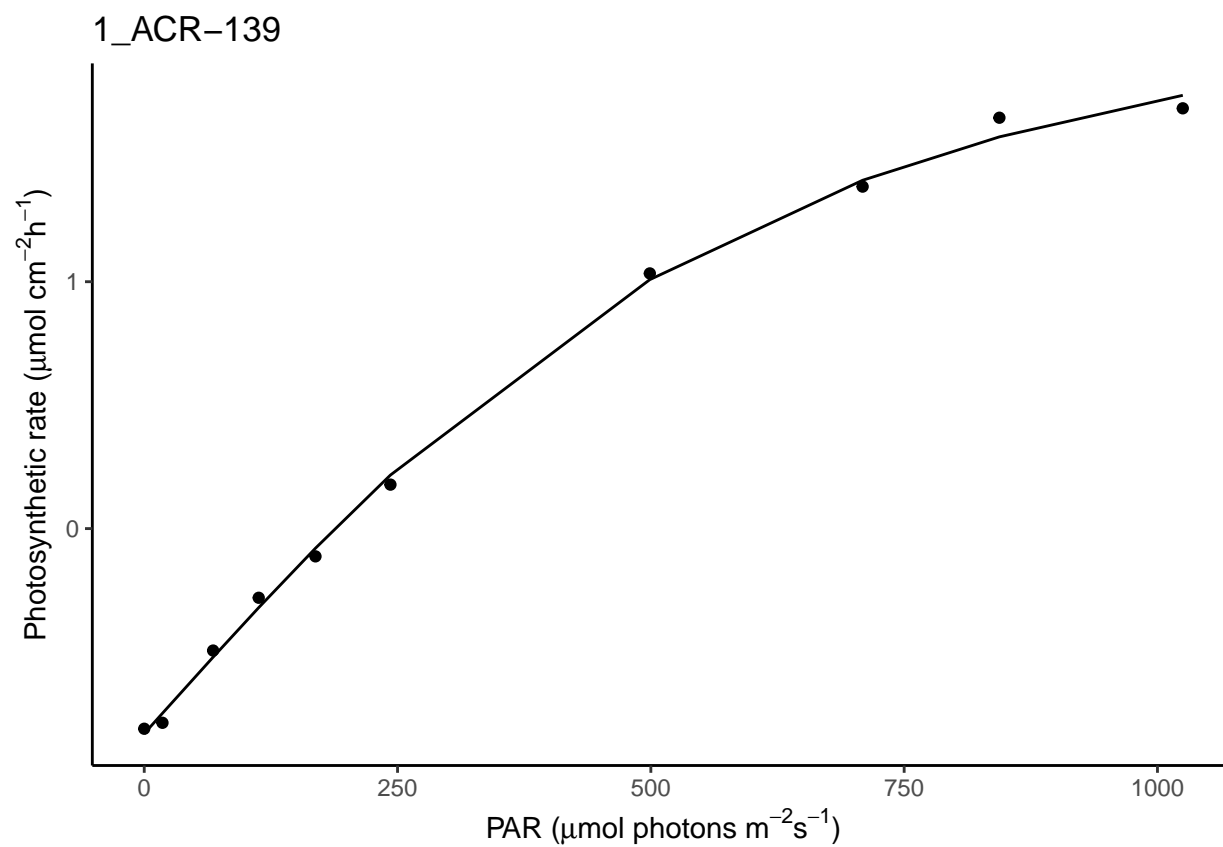
augmented\$colony_id: POC-57



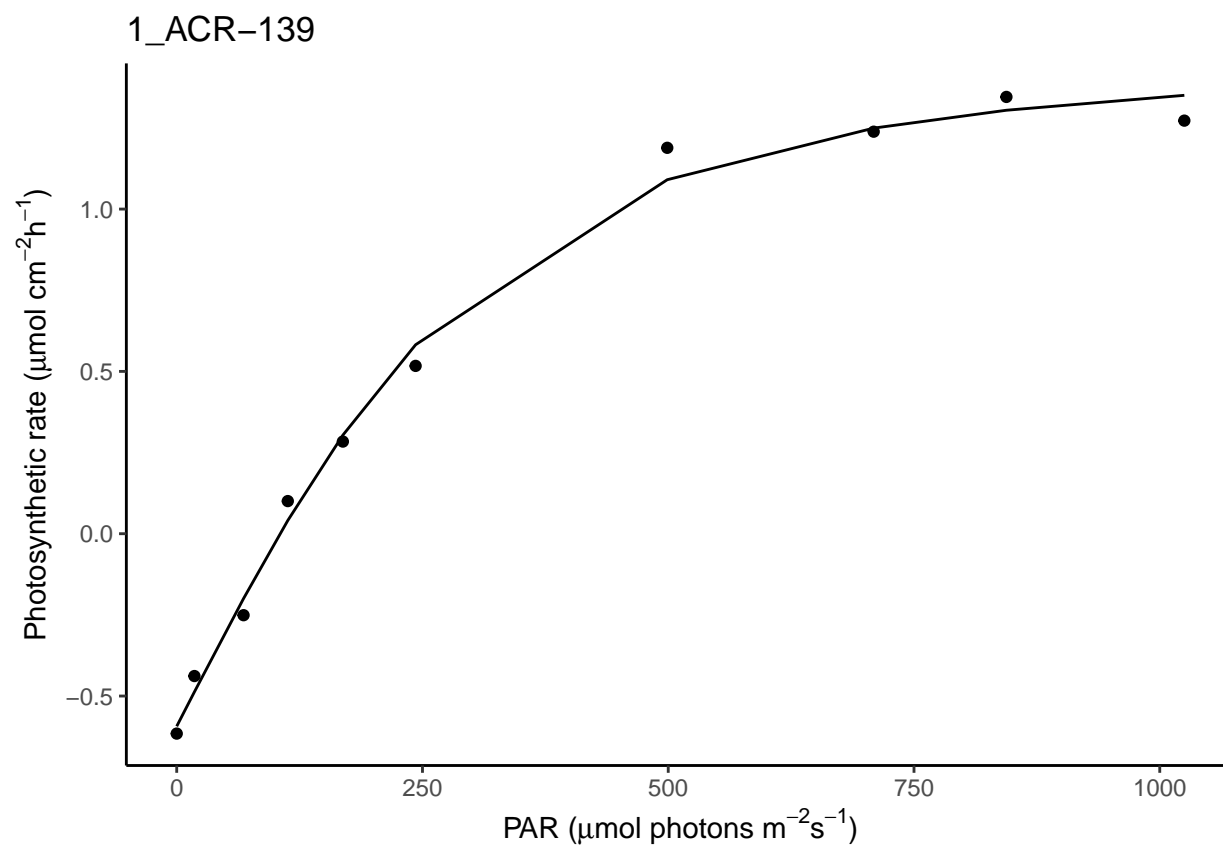
augmented\$colony_id: POC-68



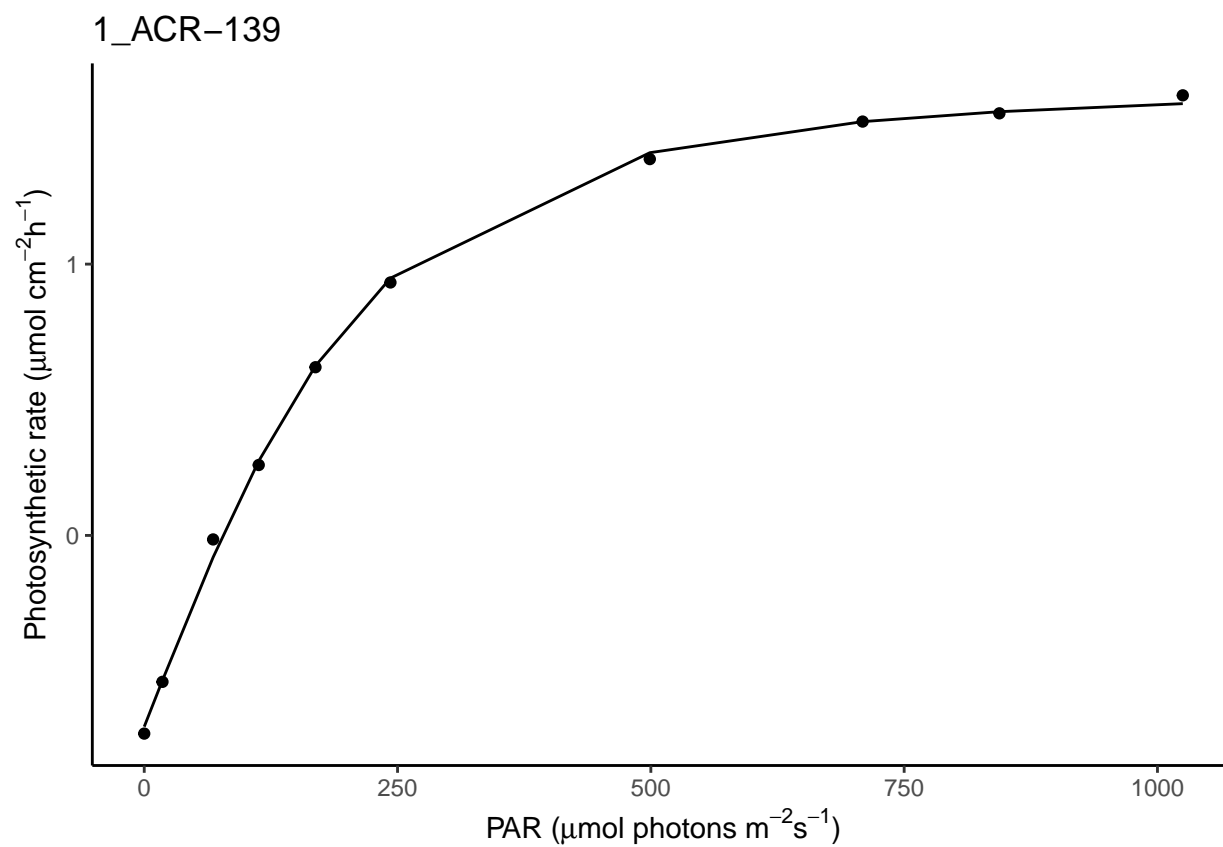
augmented\$colony_id: POR-206



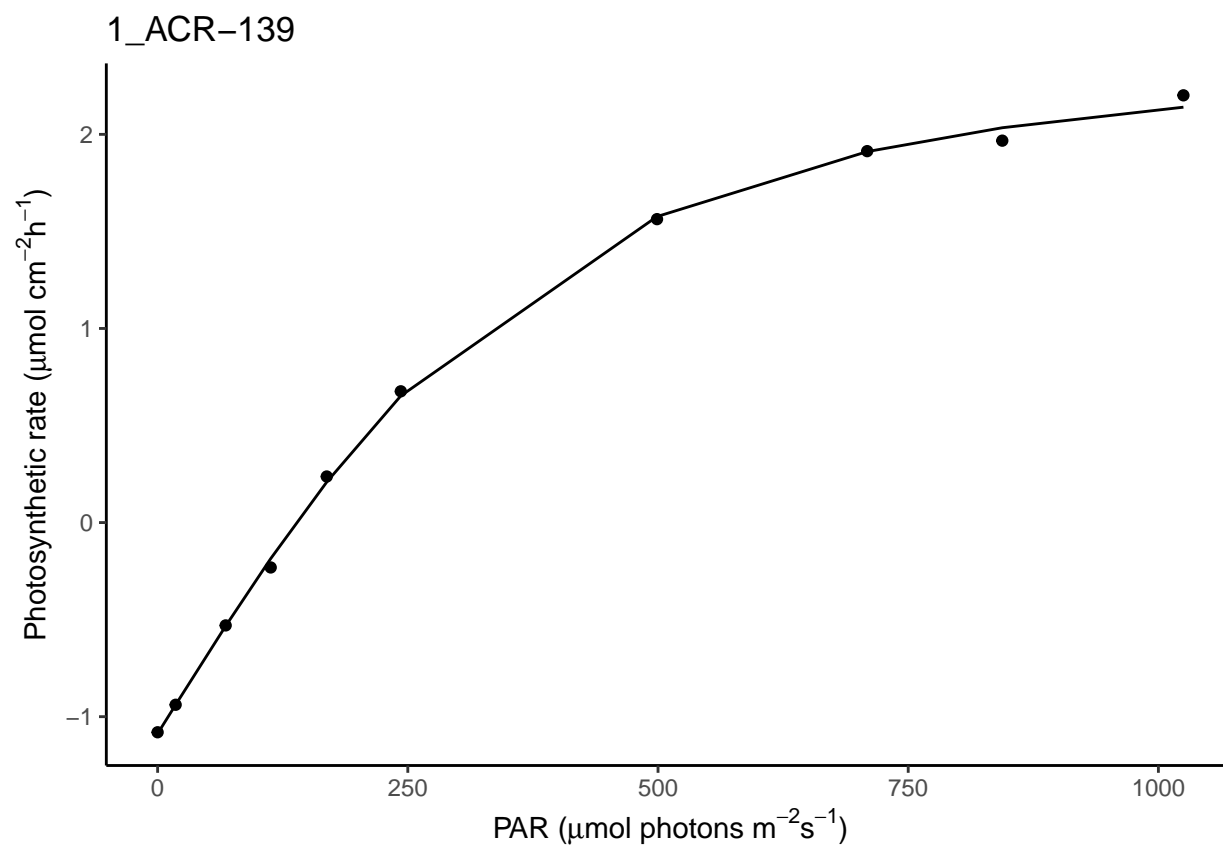
augmented\$colony_id: POR-209



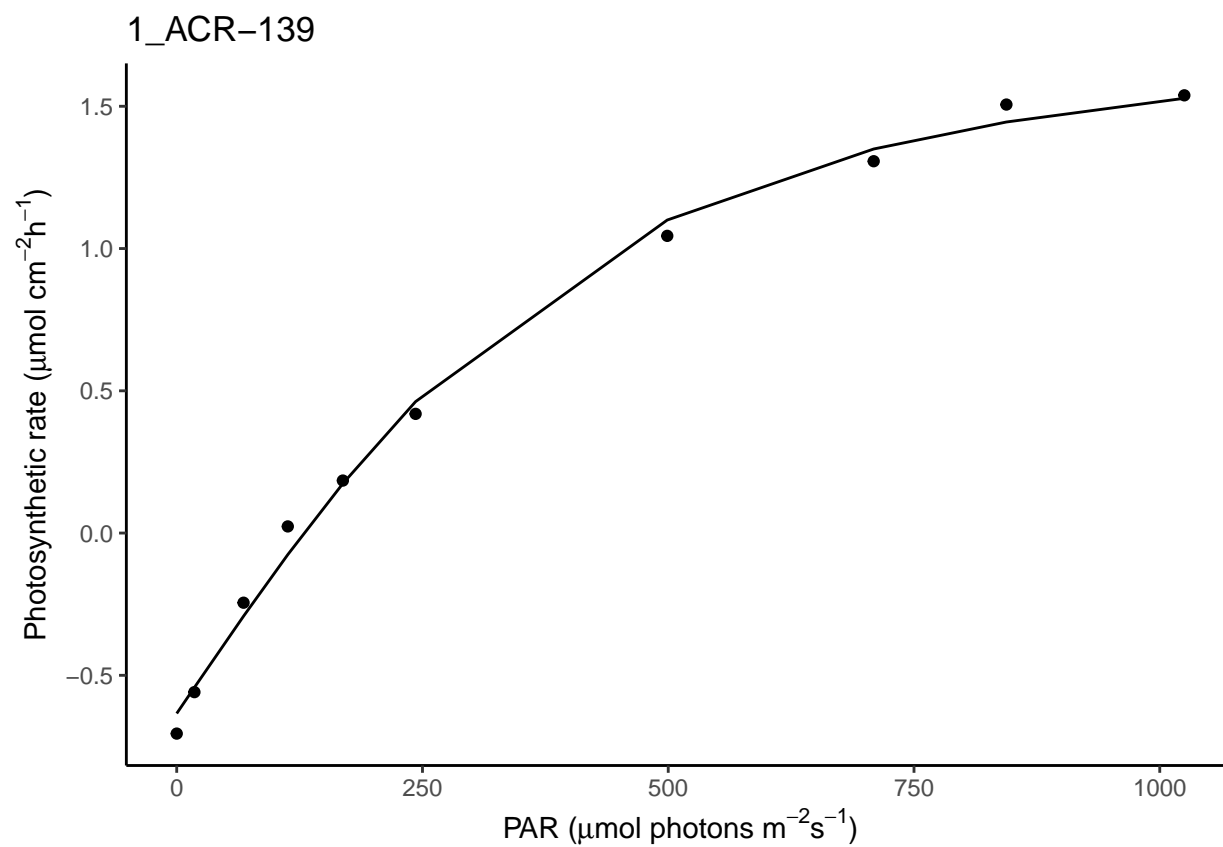
augmented\$colony_id: POR-214



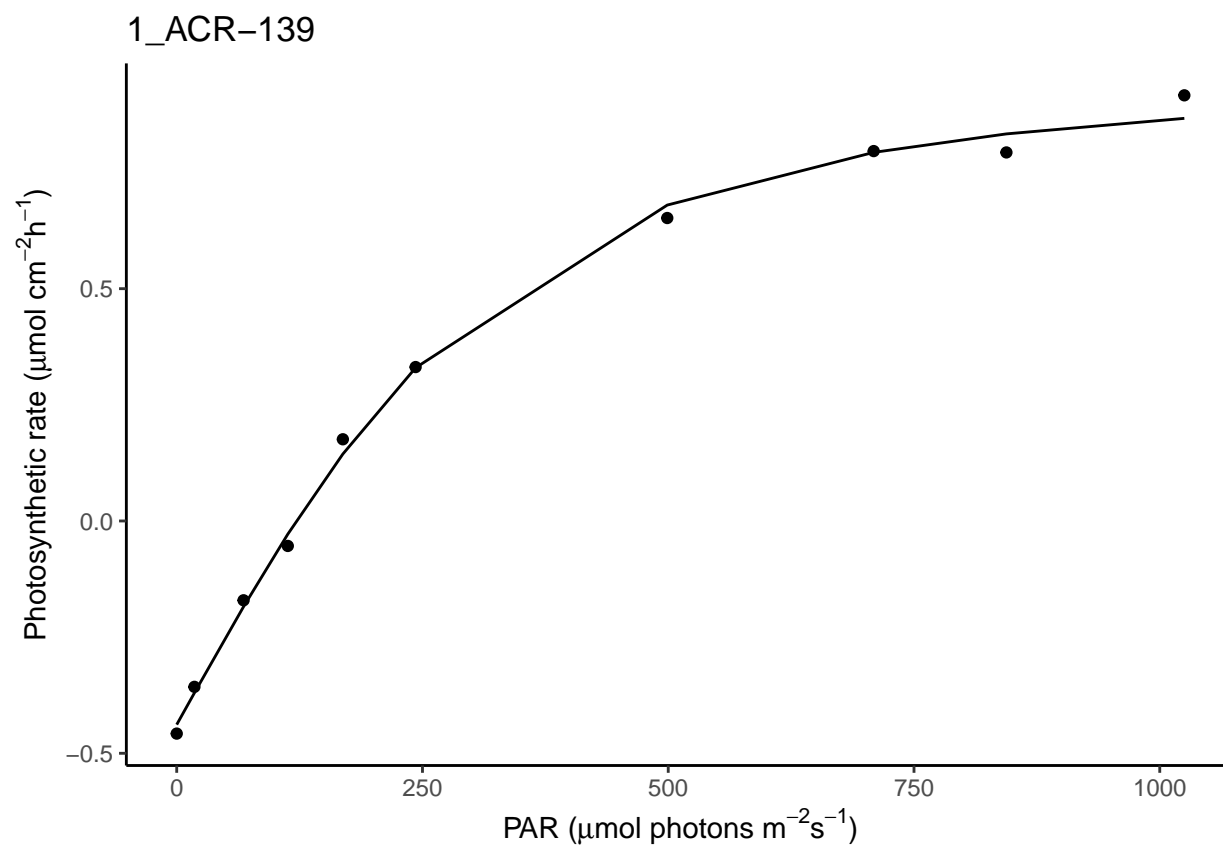
augmented\$colony_id: POR-216



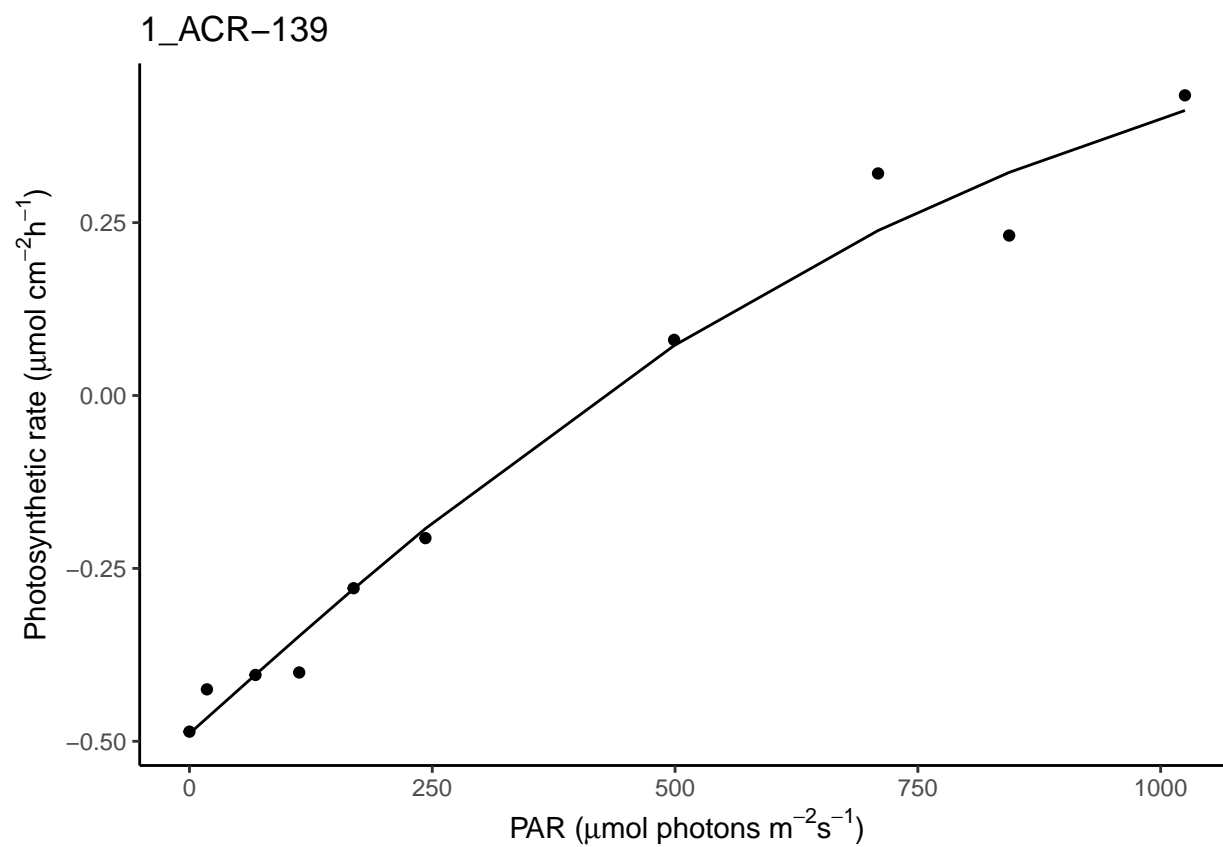
augmented\$colony_id: POR-221



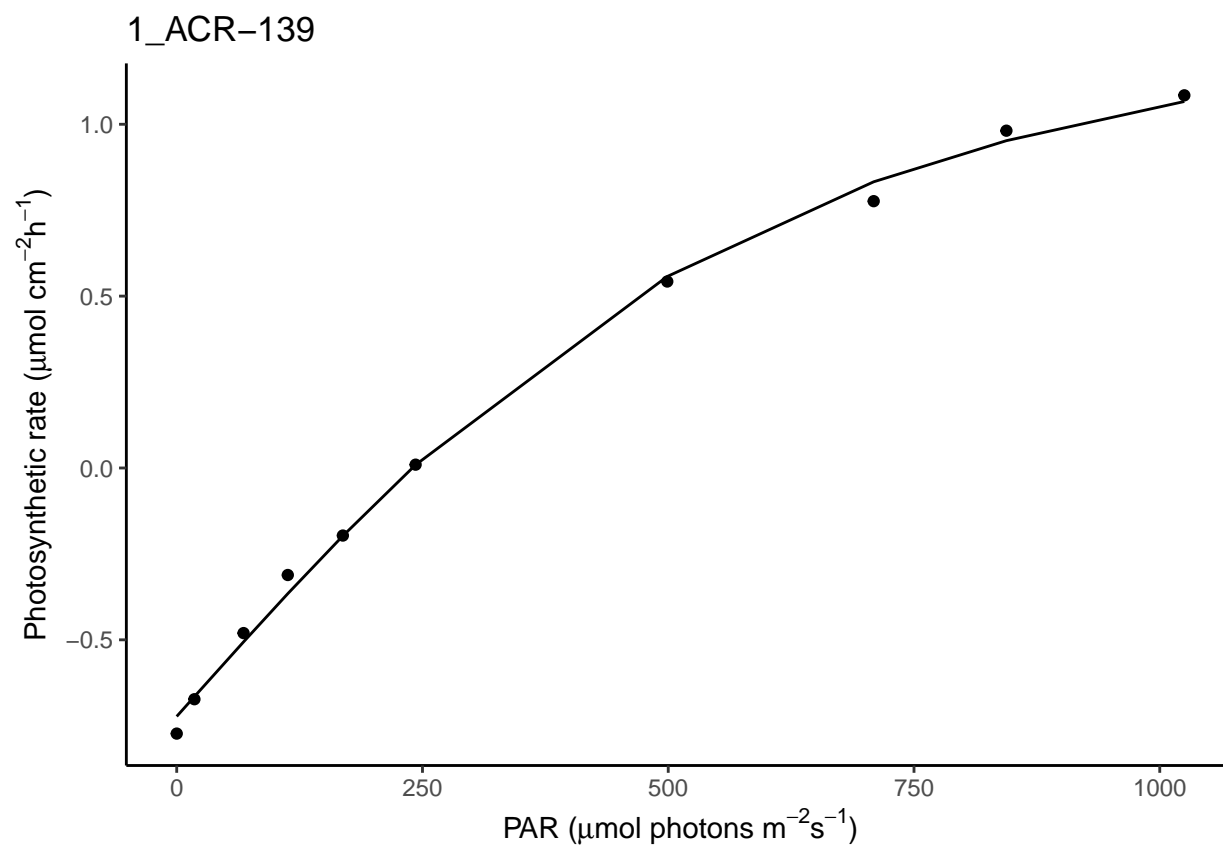
augmented\$colony_id: POR-224



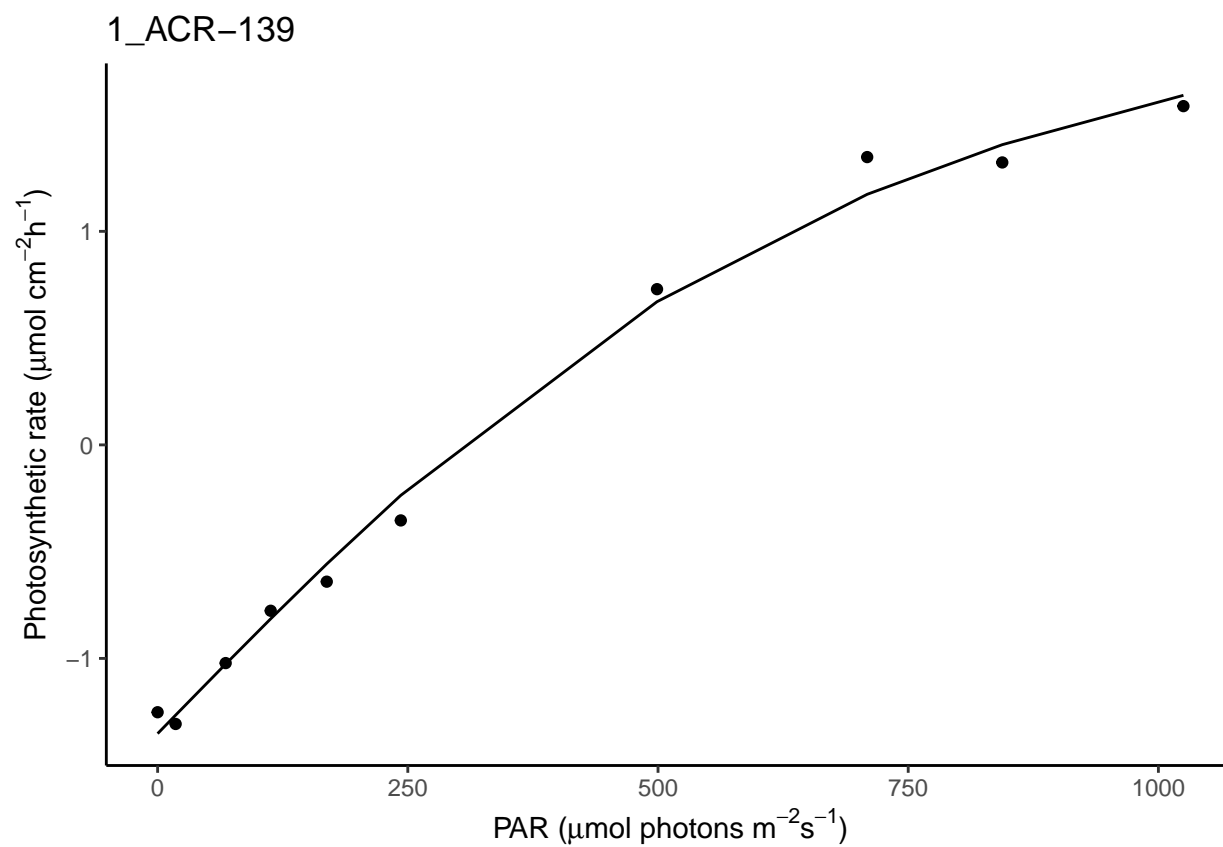
augmented\$colony_id: POR-235



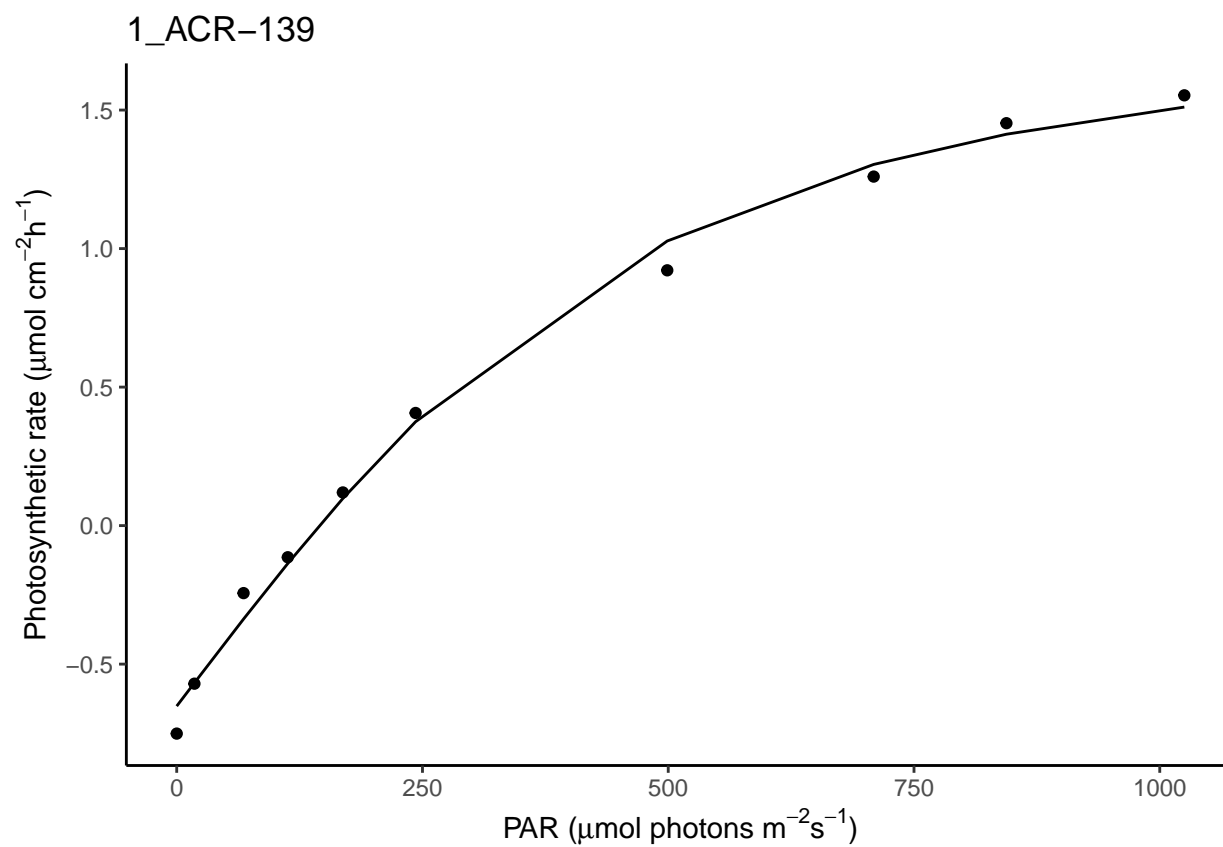
augmented\$colony_id: POR-236



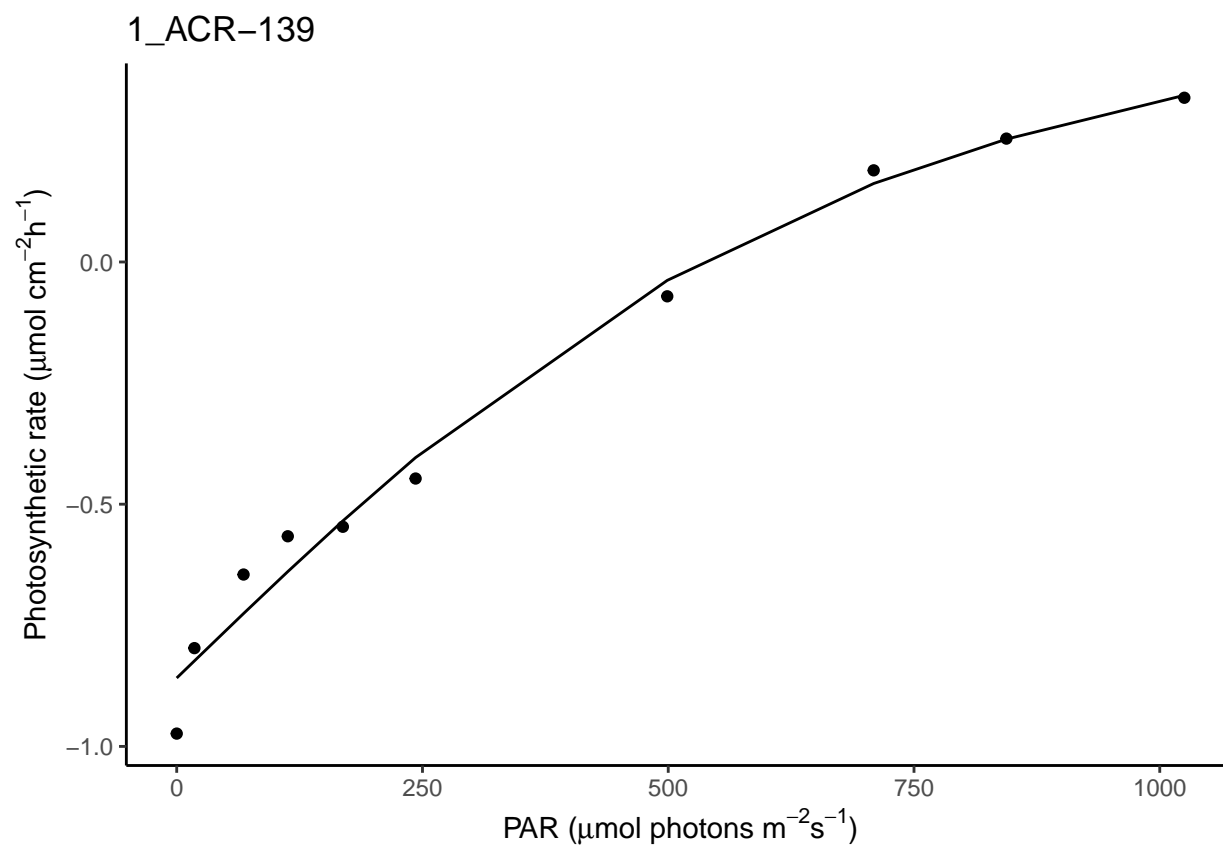
augmented\$colony_id: POR-240



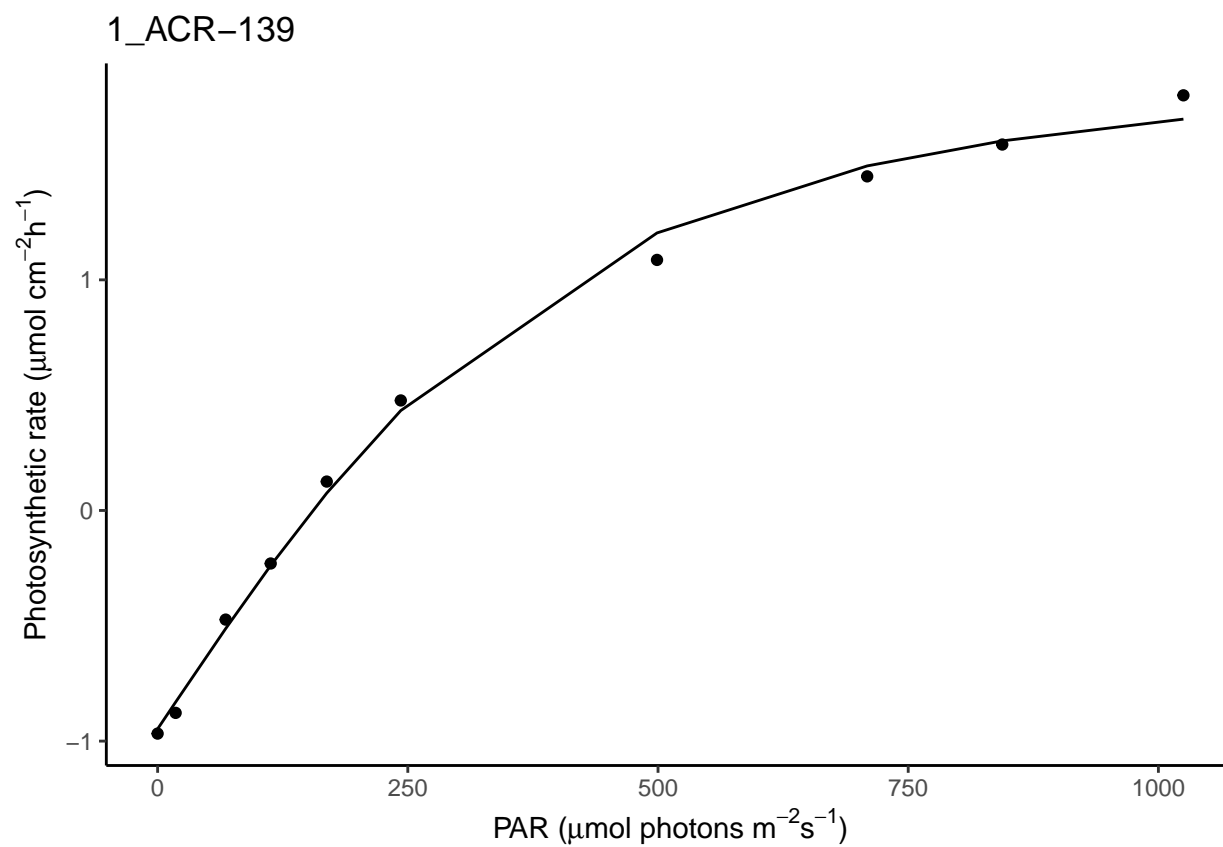
```
## -----  
## augmented$colony_id: POR-242
```

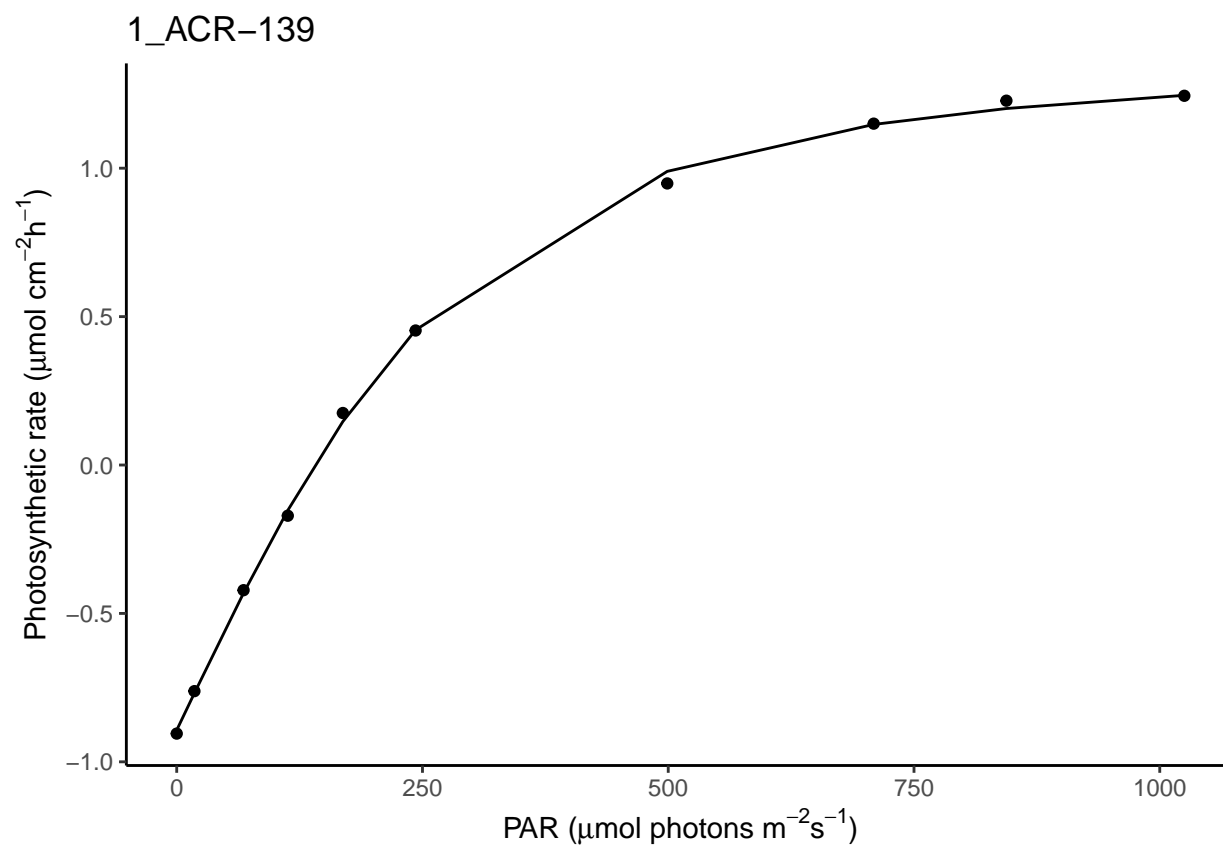
augmented\$colony_id: POR-245



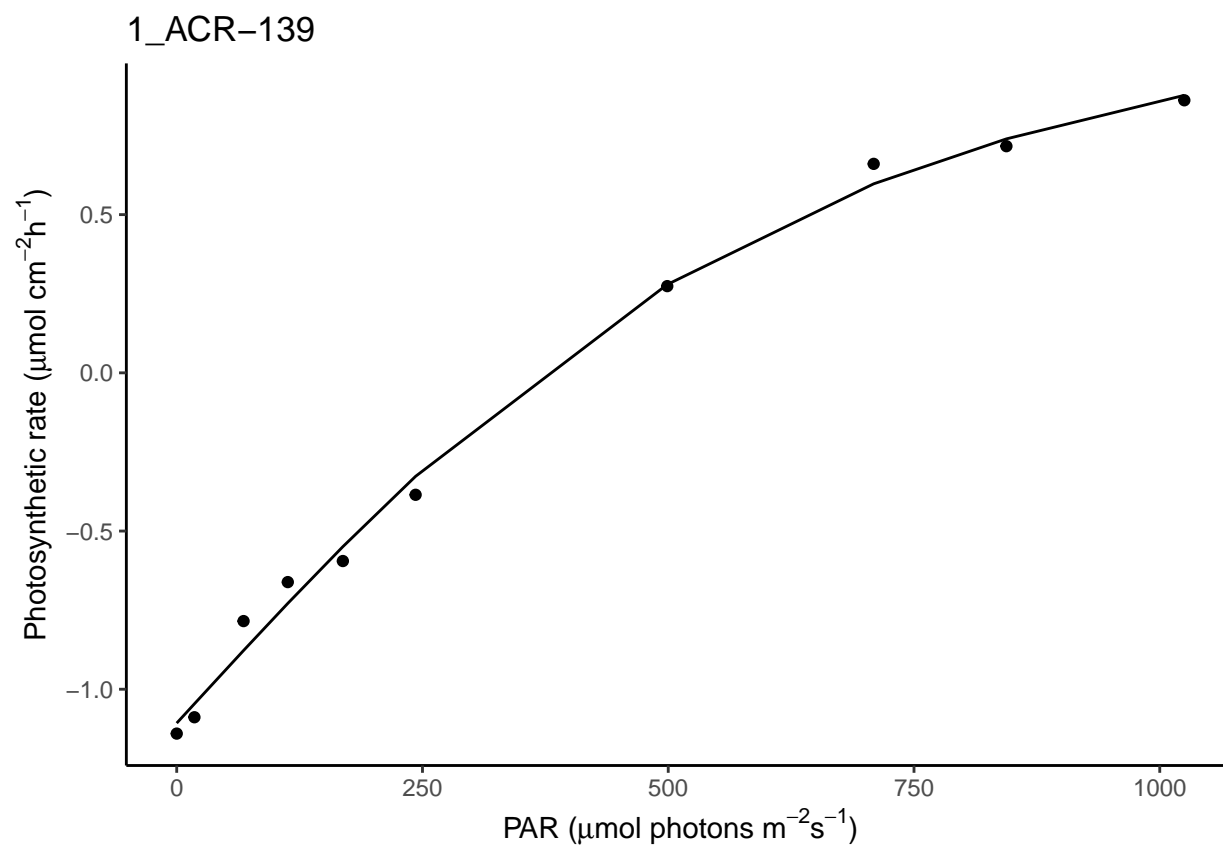
```
## -----  
## augmented$colony_id: POR-253
```



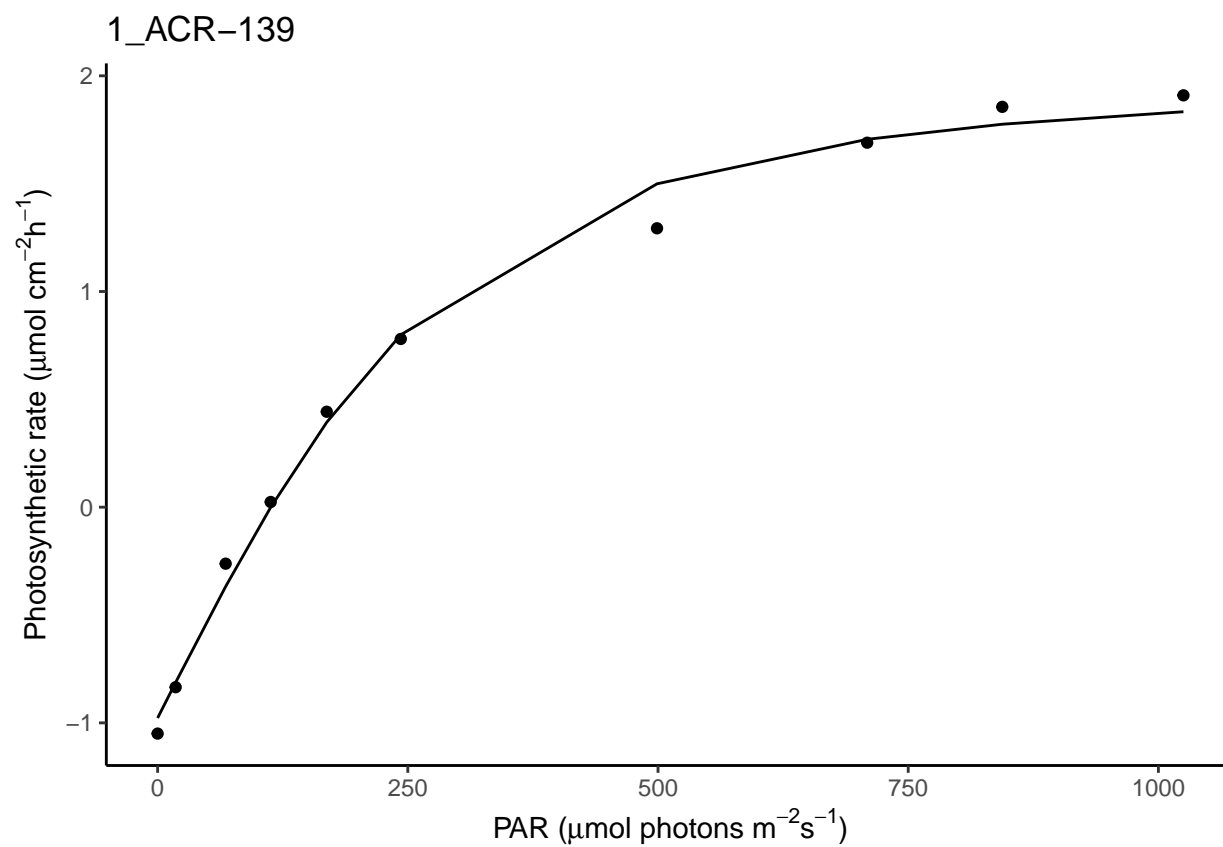
augmented\$colony_id: POR-260



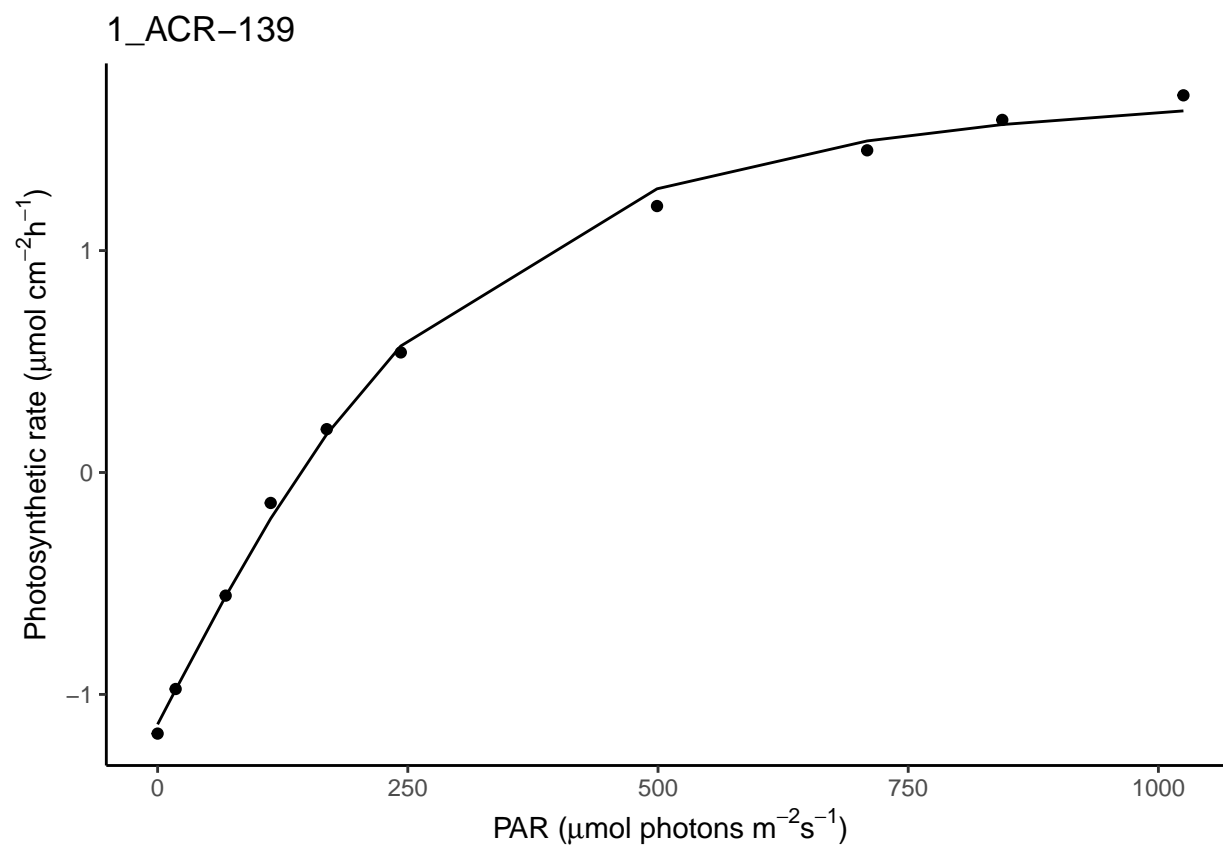
augmented\$colony_id: POR-262



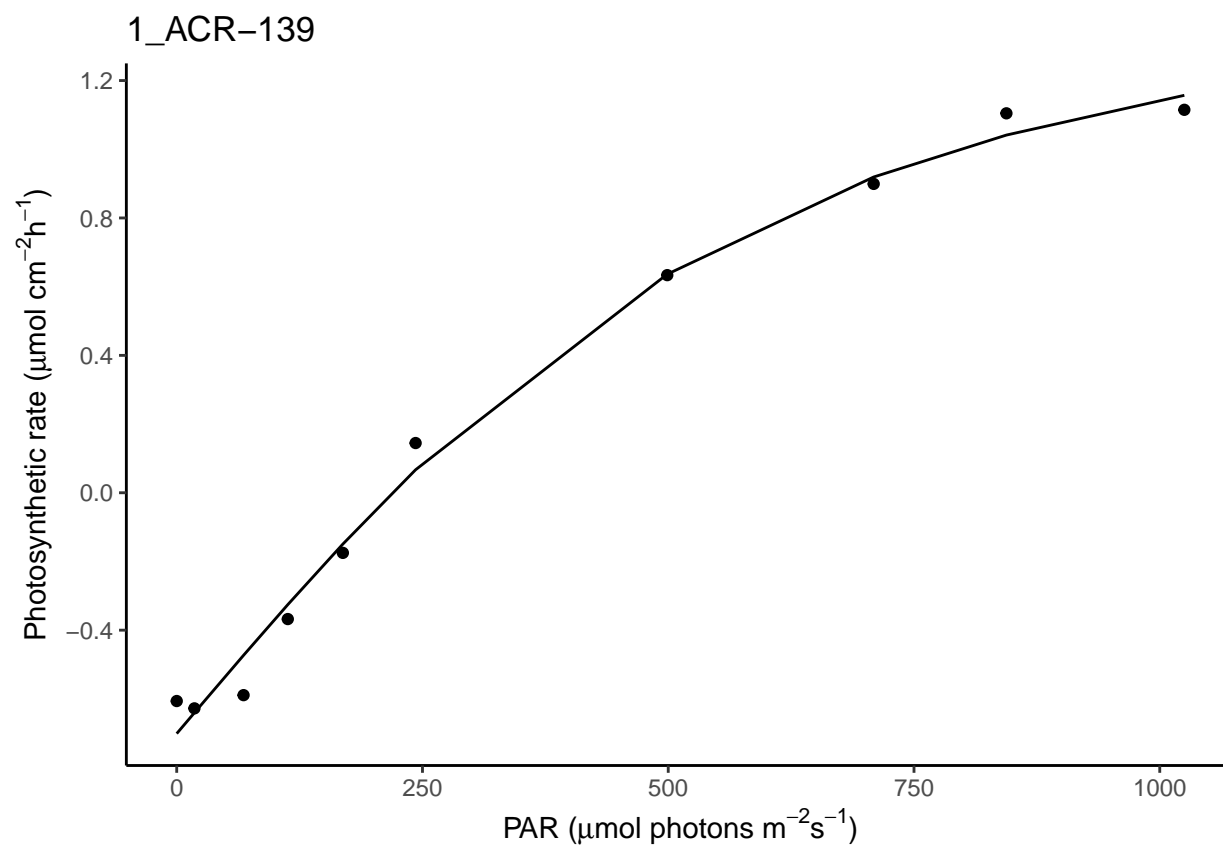
augmented\$colony_id: POR-266



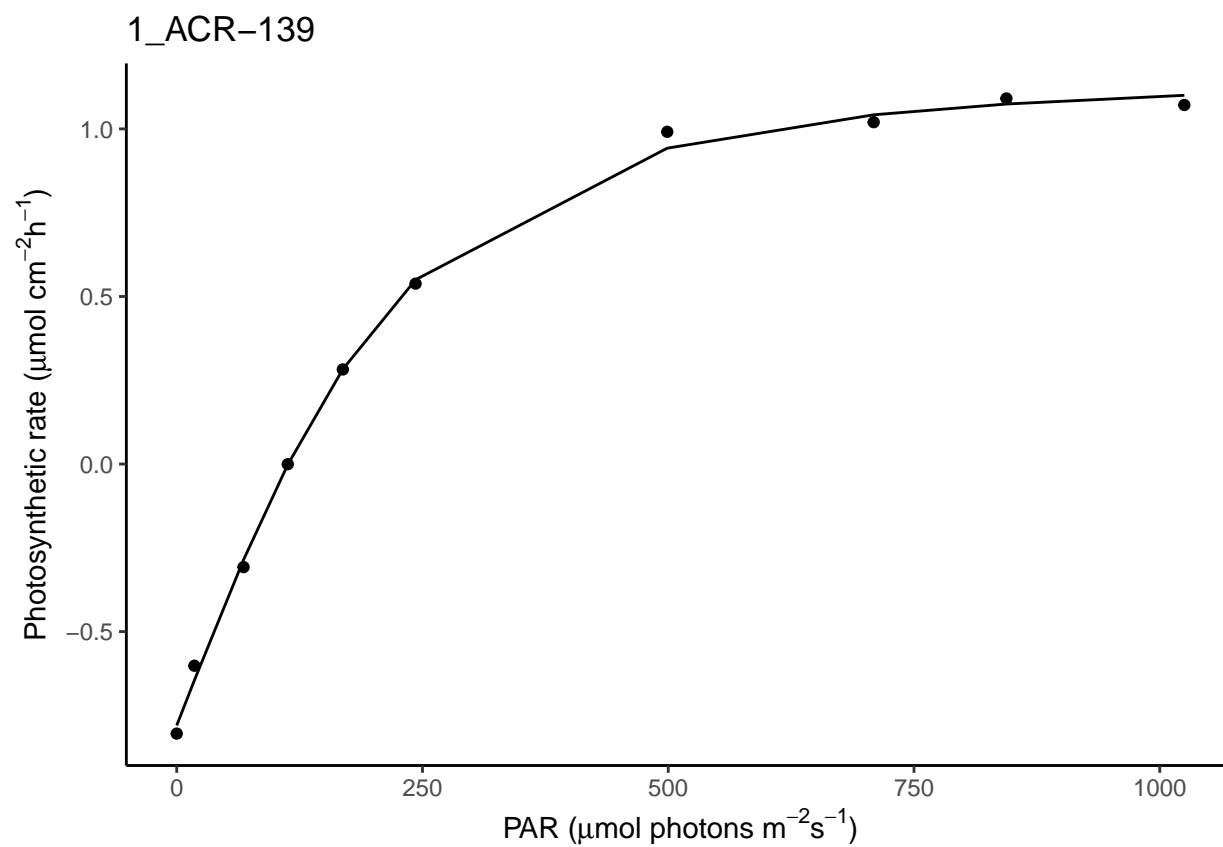
```
## -----  
## augmented$colony_id: POR-338
```



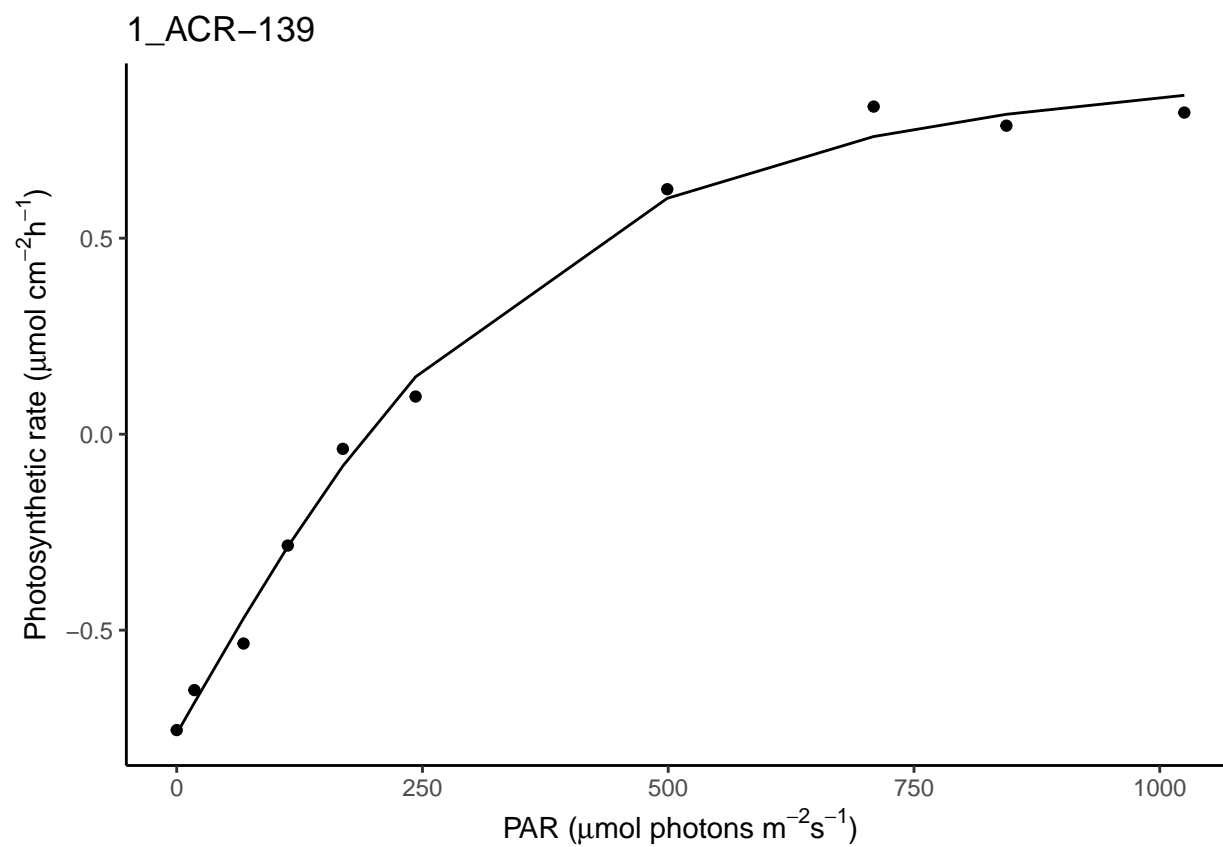
augmented\$colony_id: POR-340



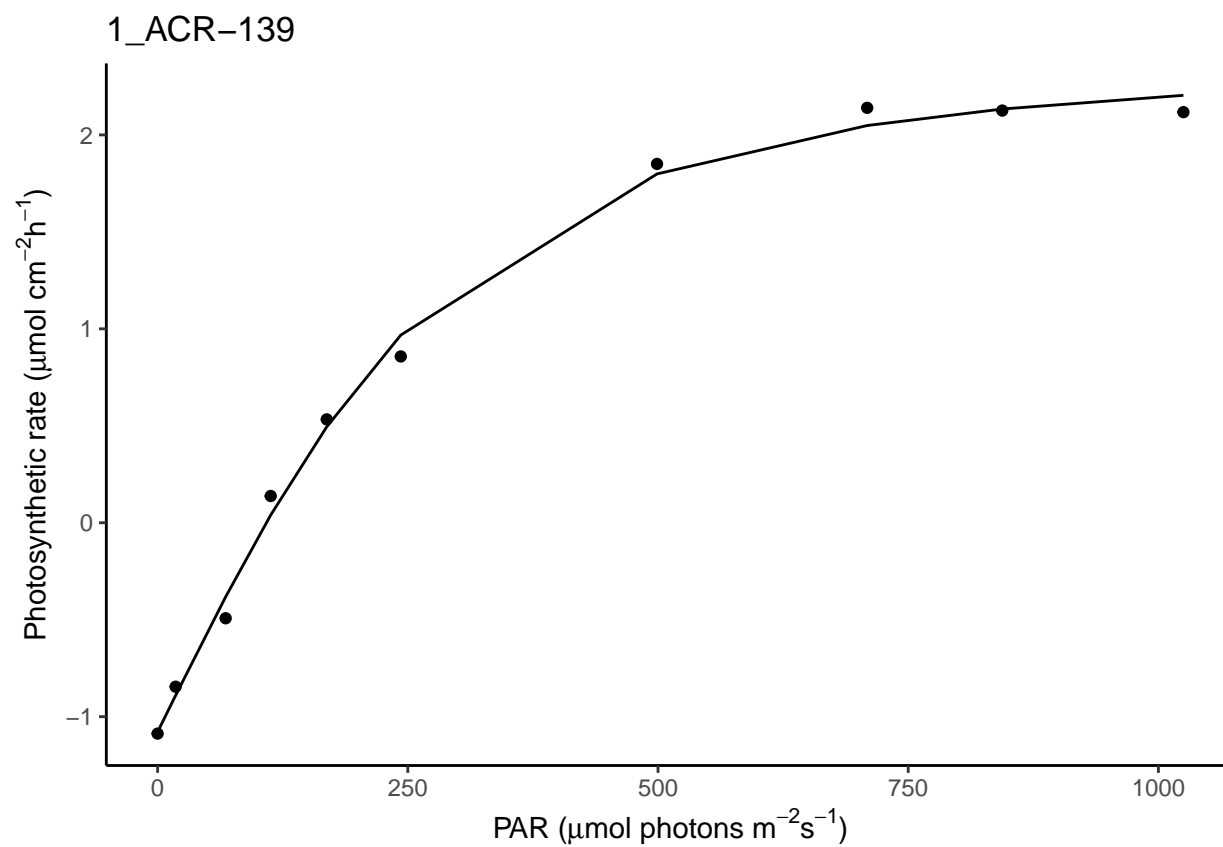
```
## -----  
## augmented$colony_id: POR-341
```

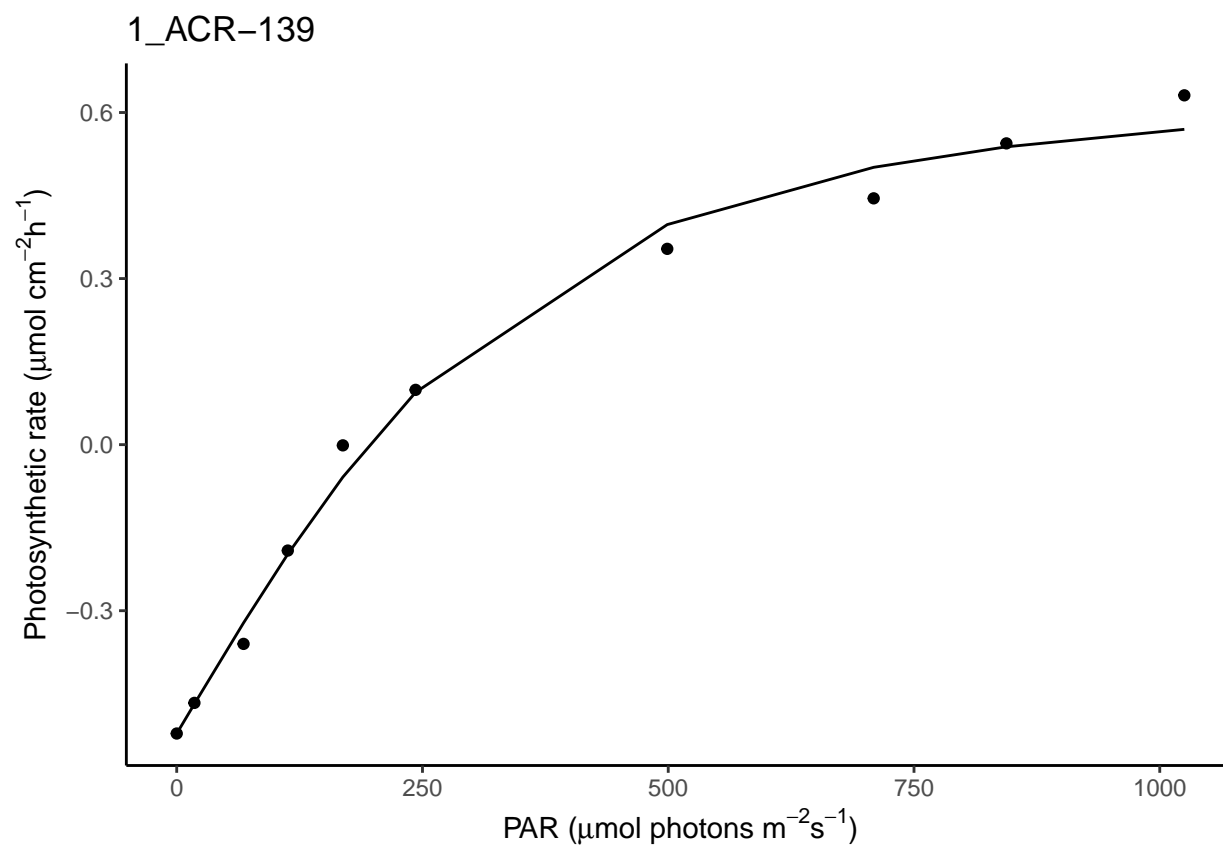
augmented\$colony_id: POR-349



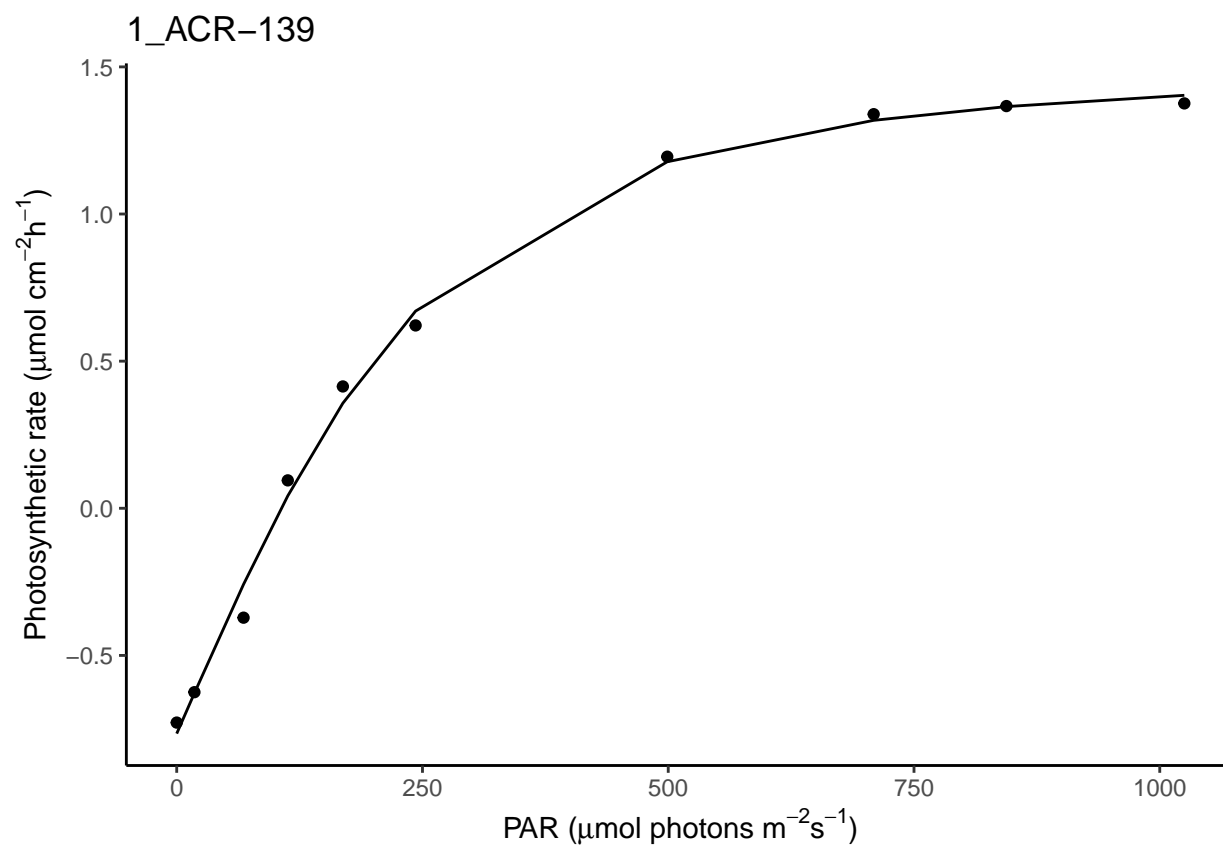
augmented\$colony_id: POR-353



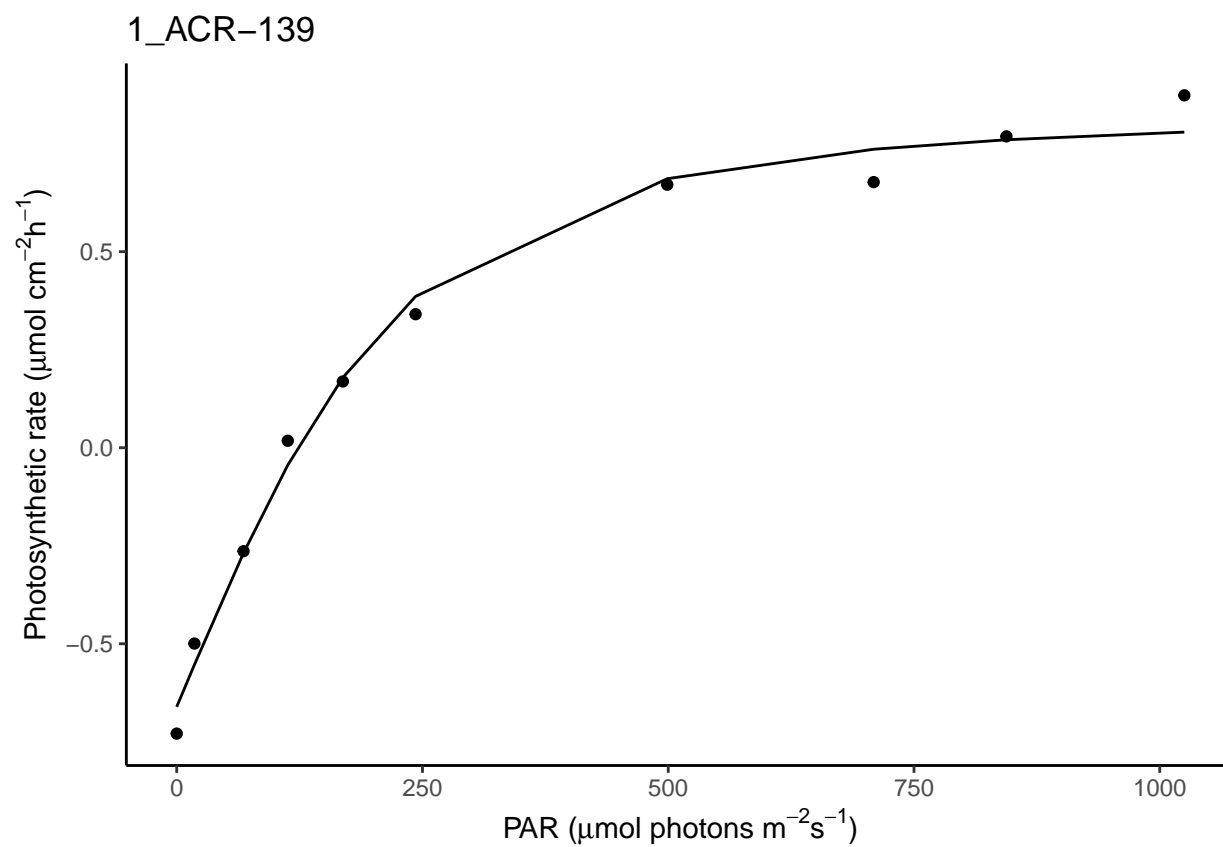
augmented\$colony_id: POR-354



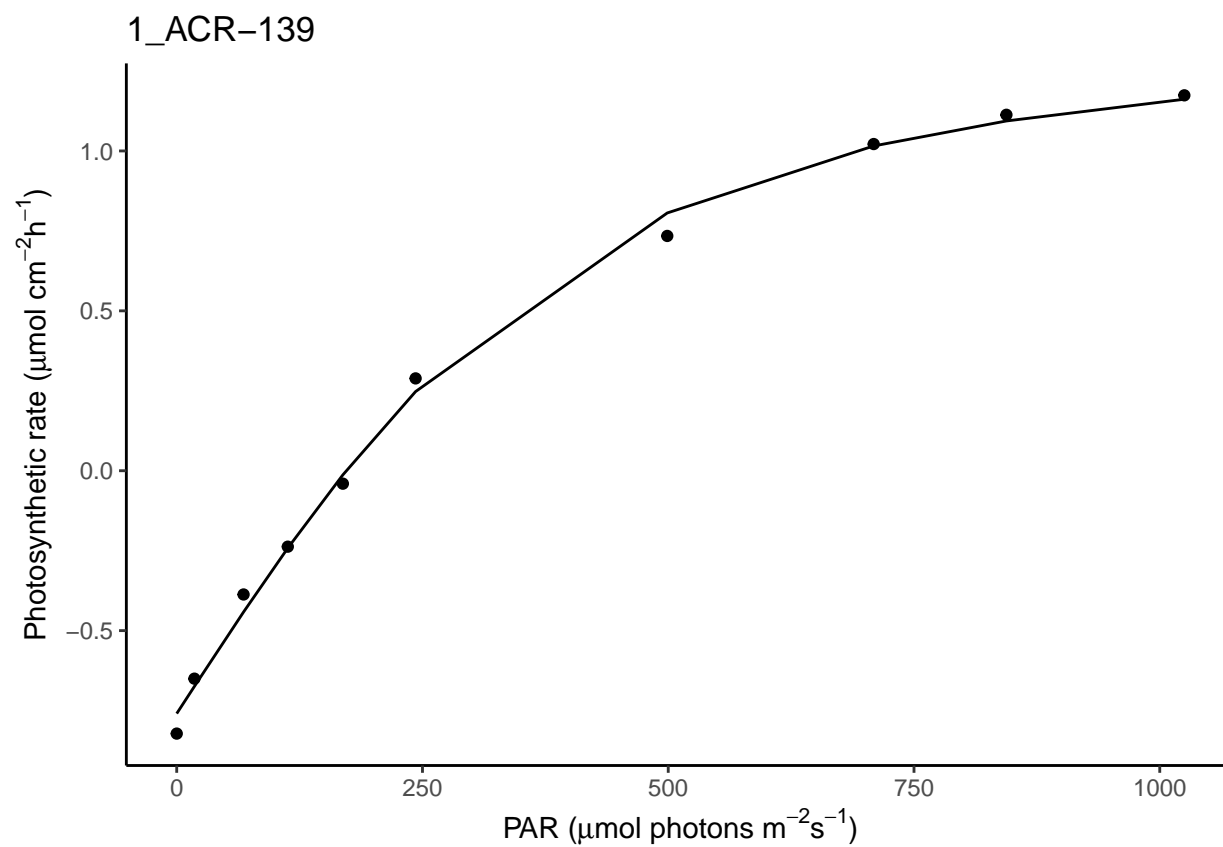
augmented\$colony_id: POR-355



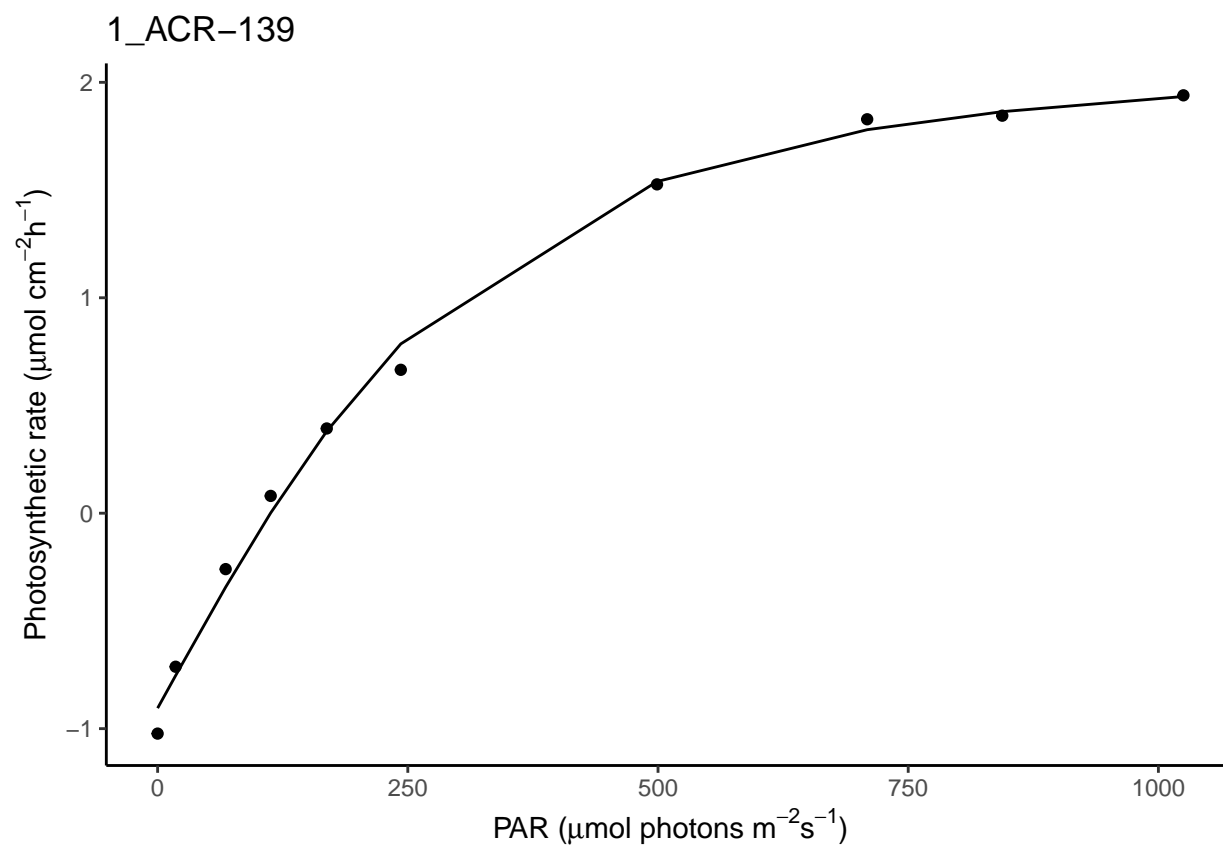
augmented\$colony_id: POR-357



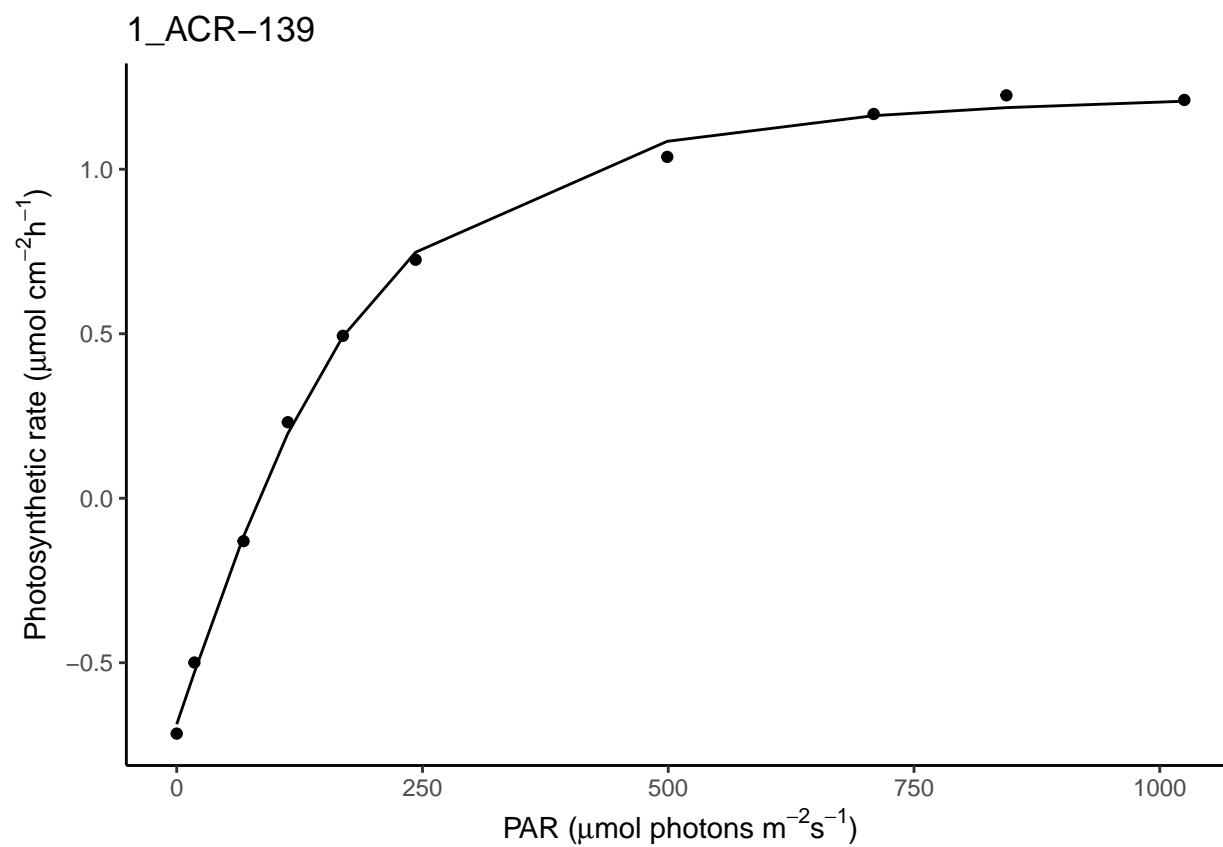
augmented\$colony_id: POR-365



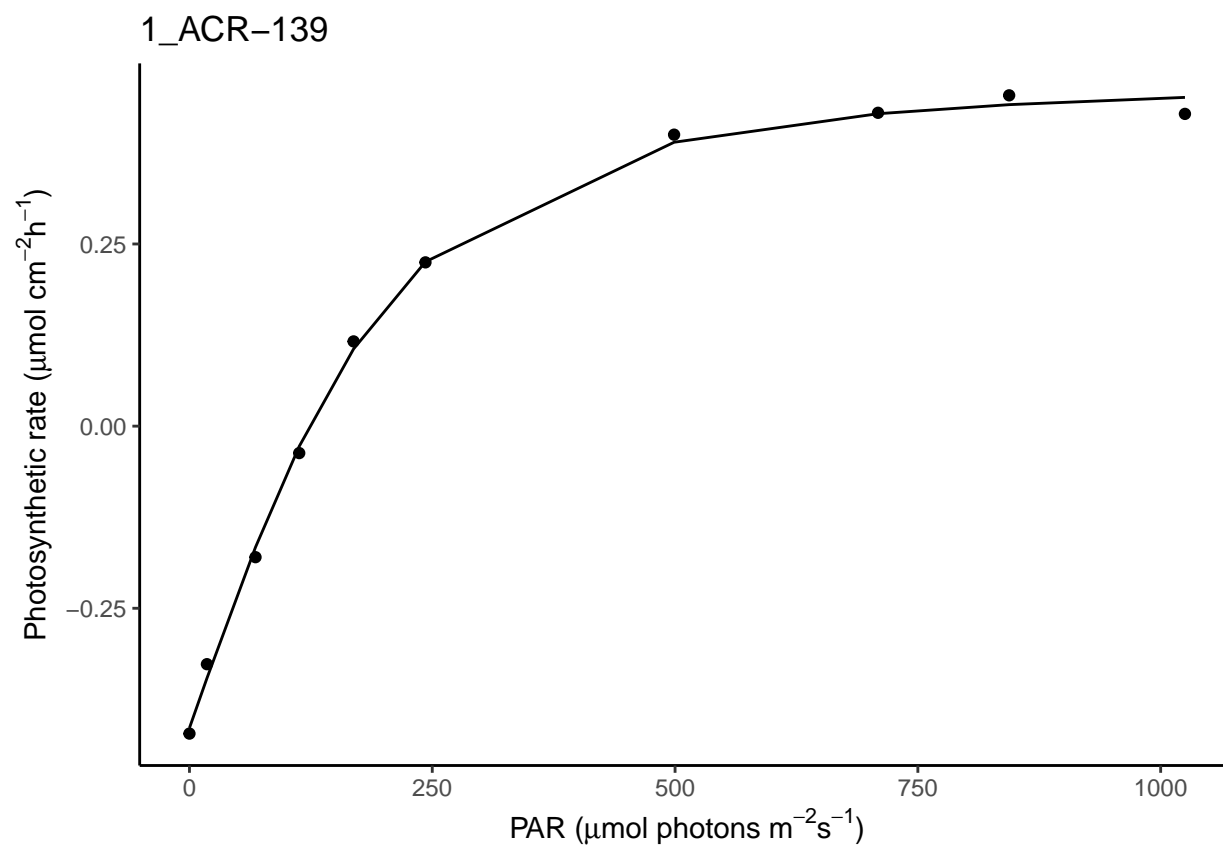
augmented\$colony_id: POR-367



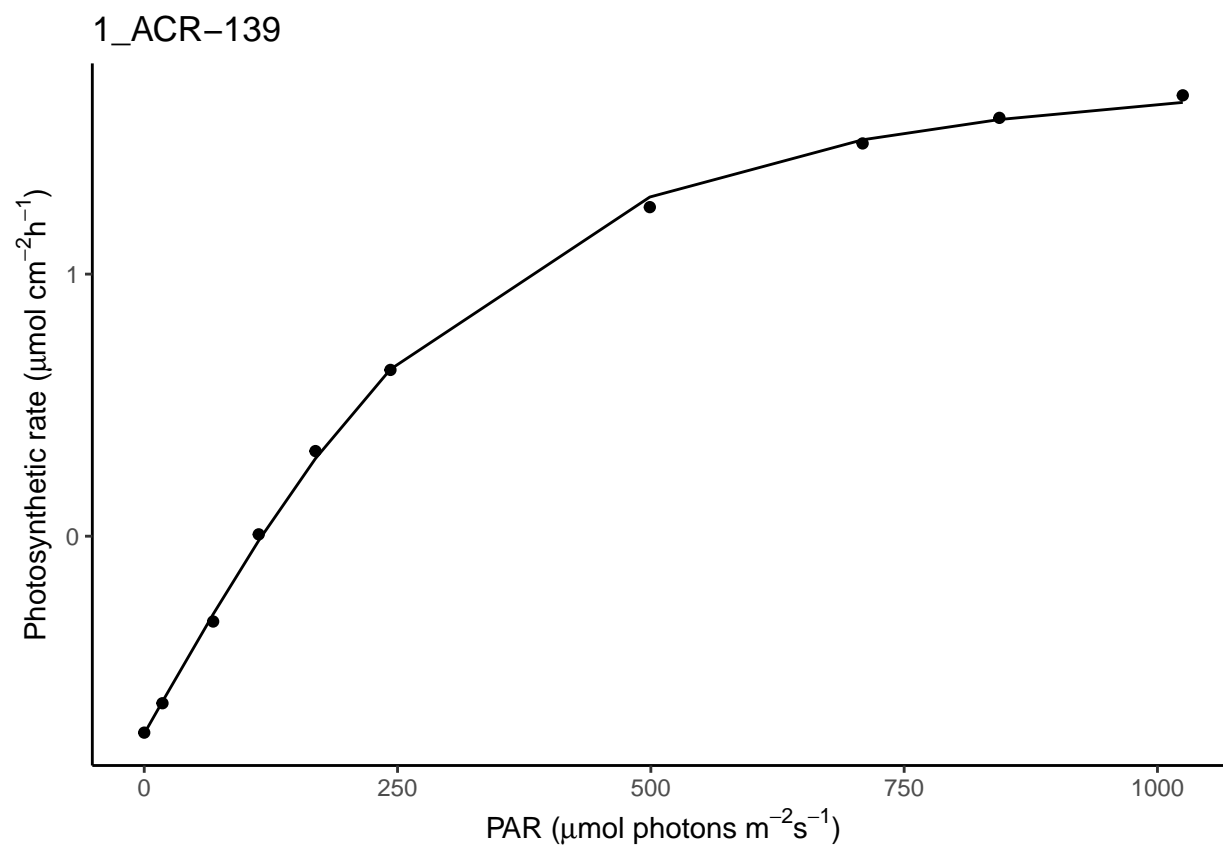
augmented\$colony_id: POR-381



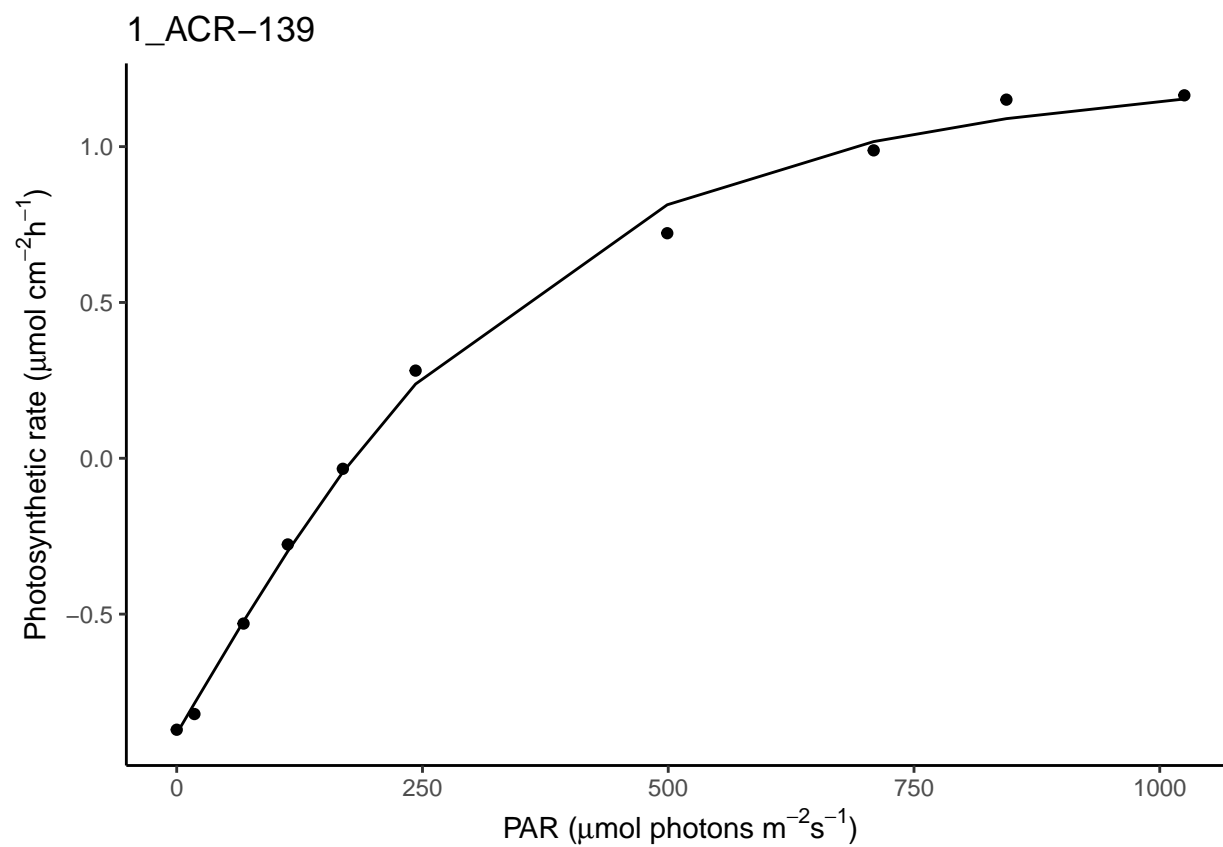
augmented\$colony_id: POR-383



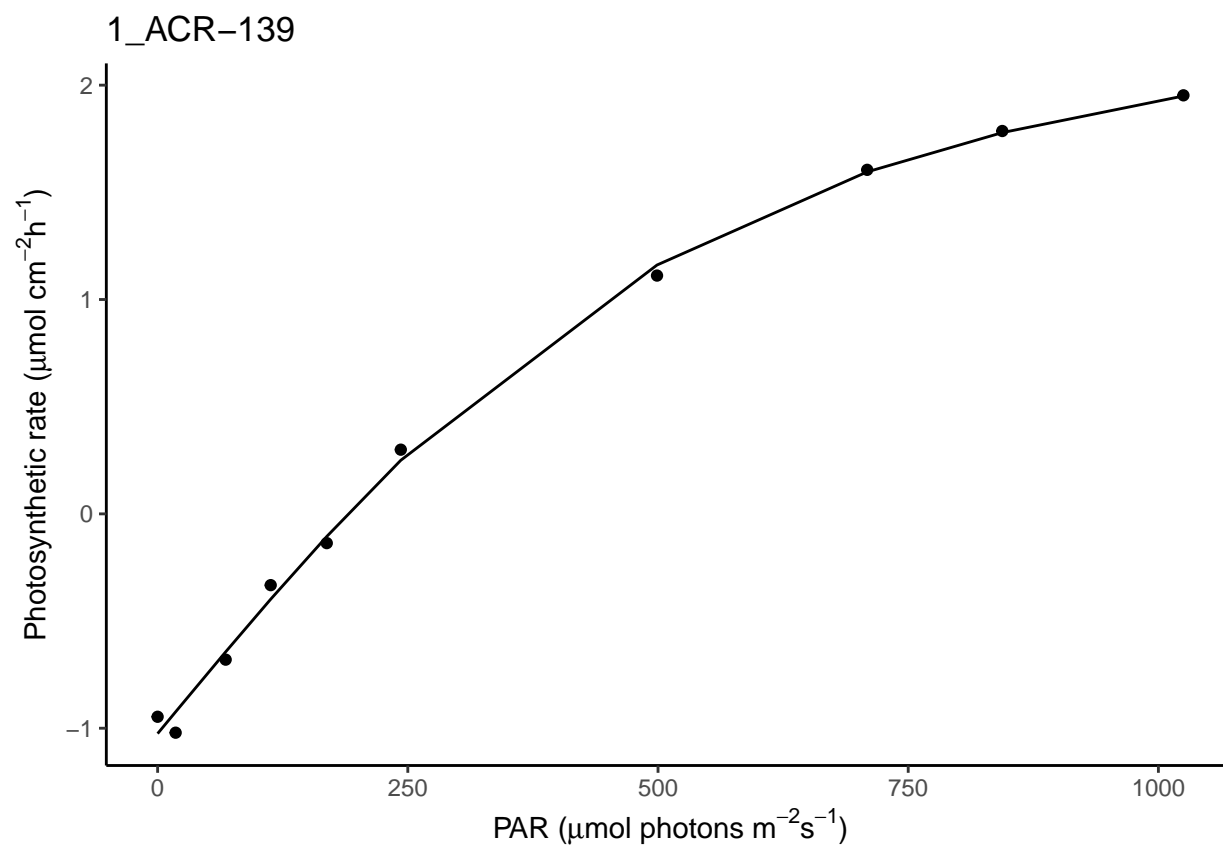
augmented\$colony_id: POR-384



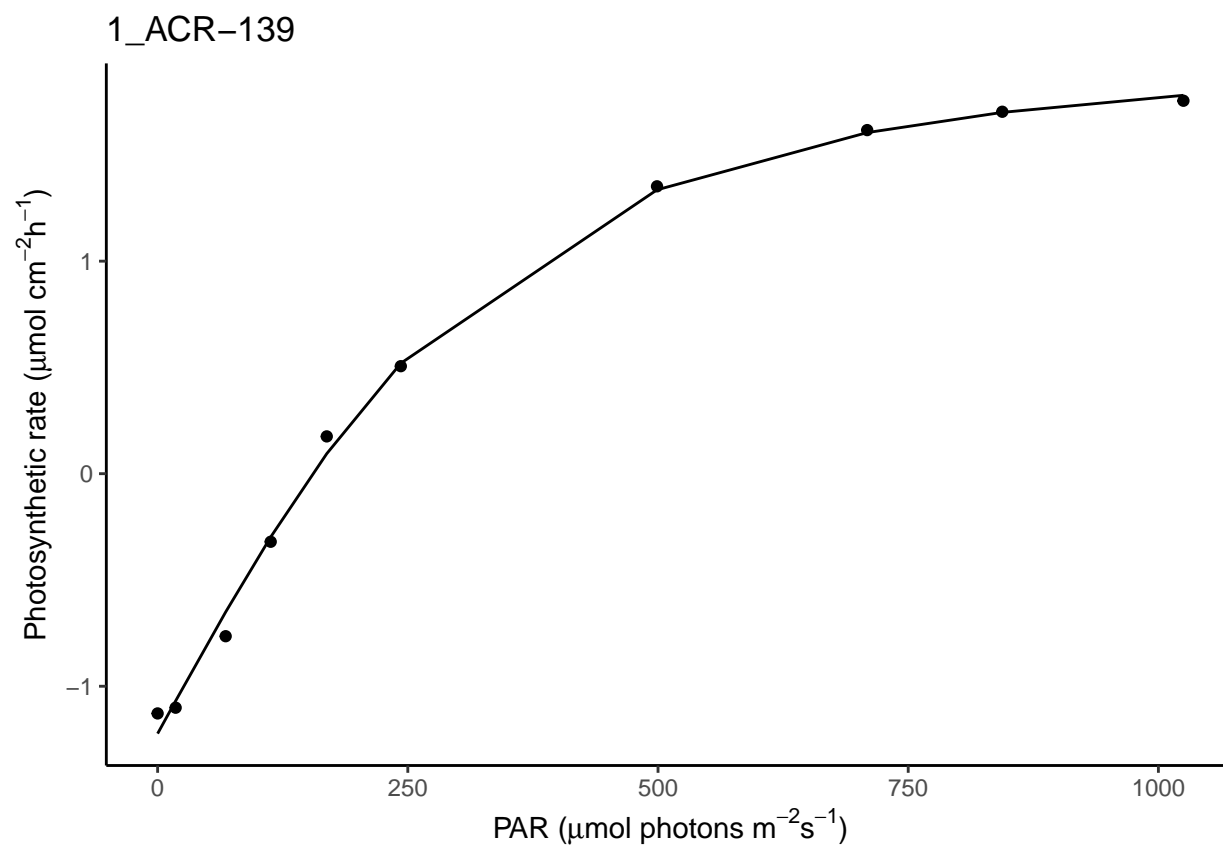
augmented\$colony_id: POR-385



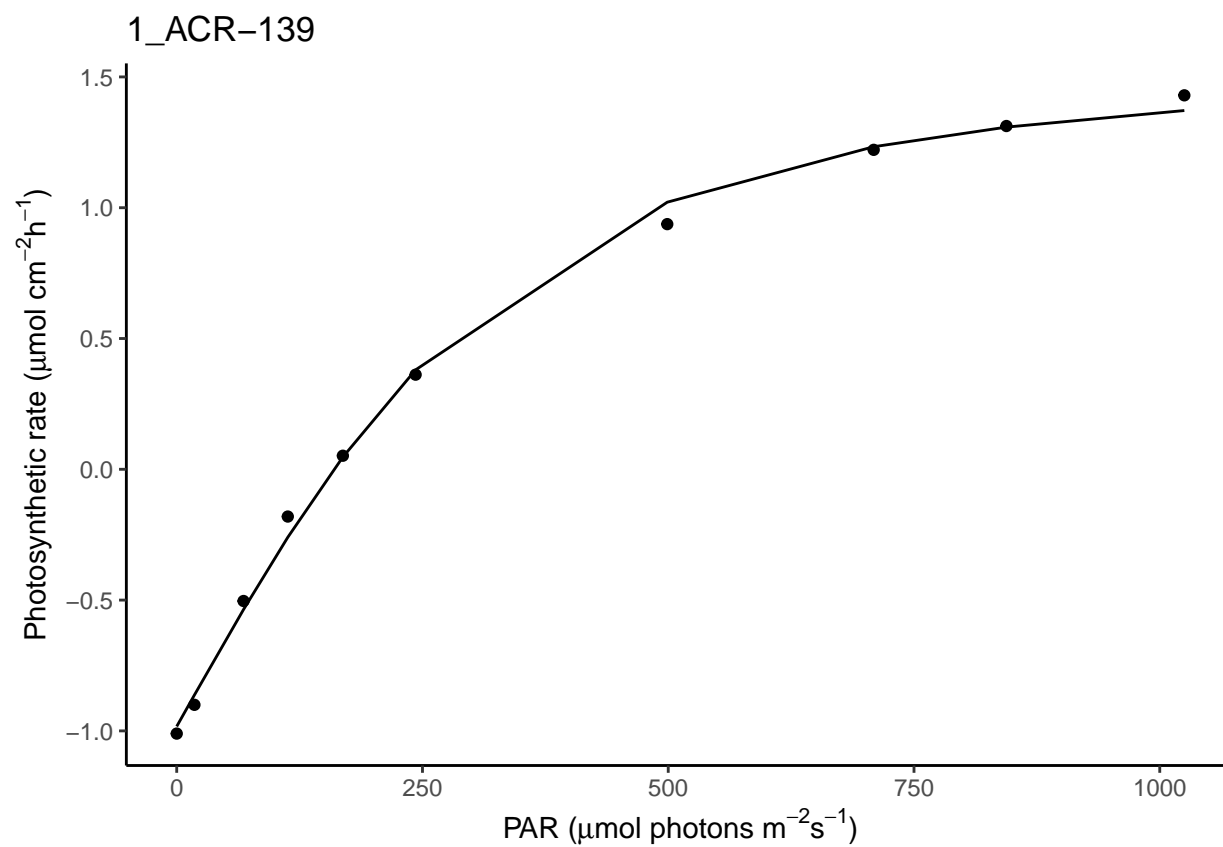
augmented\$colony_id: POR-69



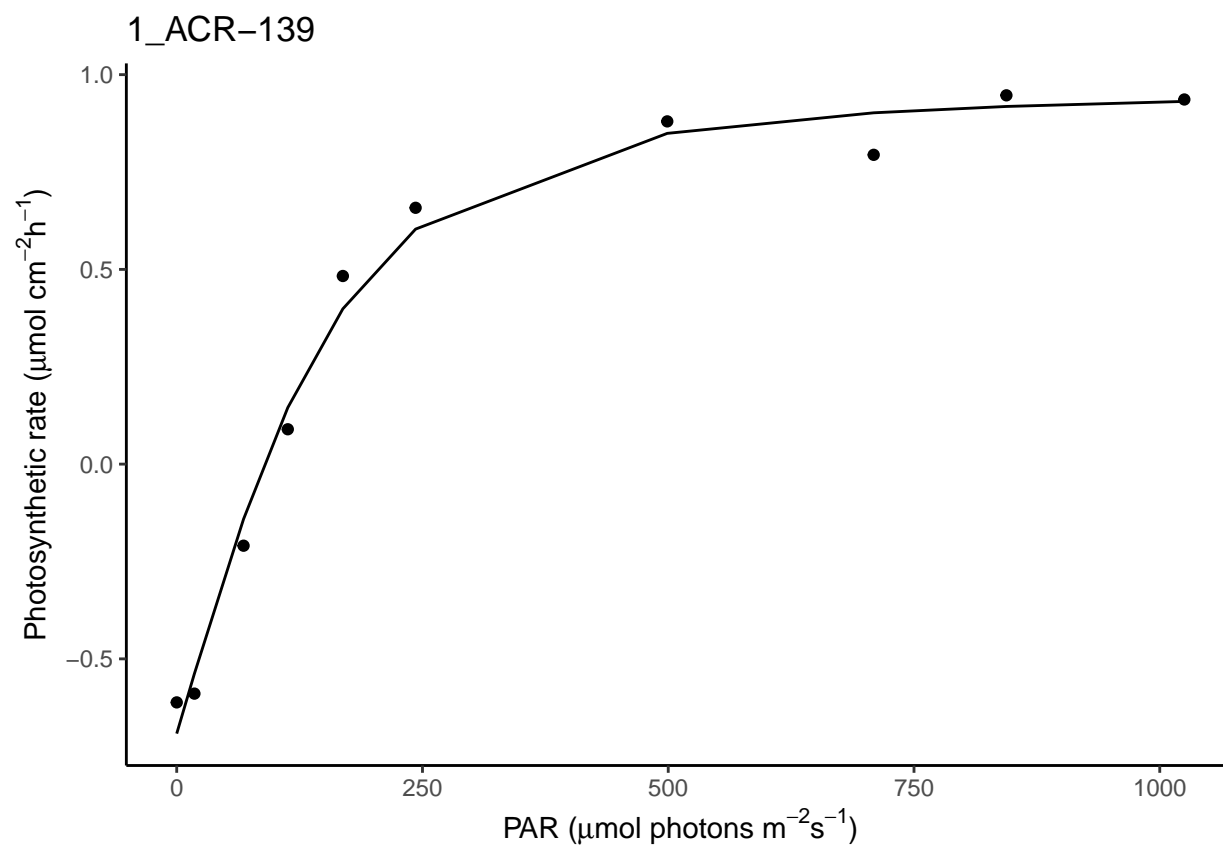
```
## -----  
## augmented$colony_id: POR-70
```



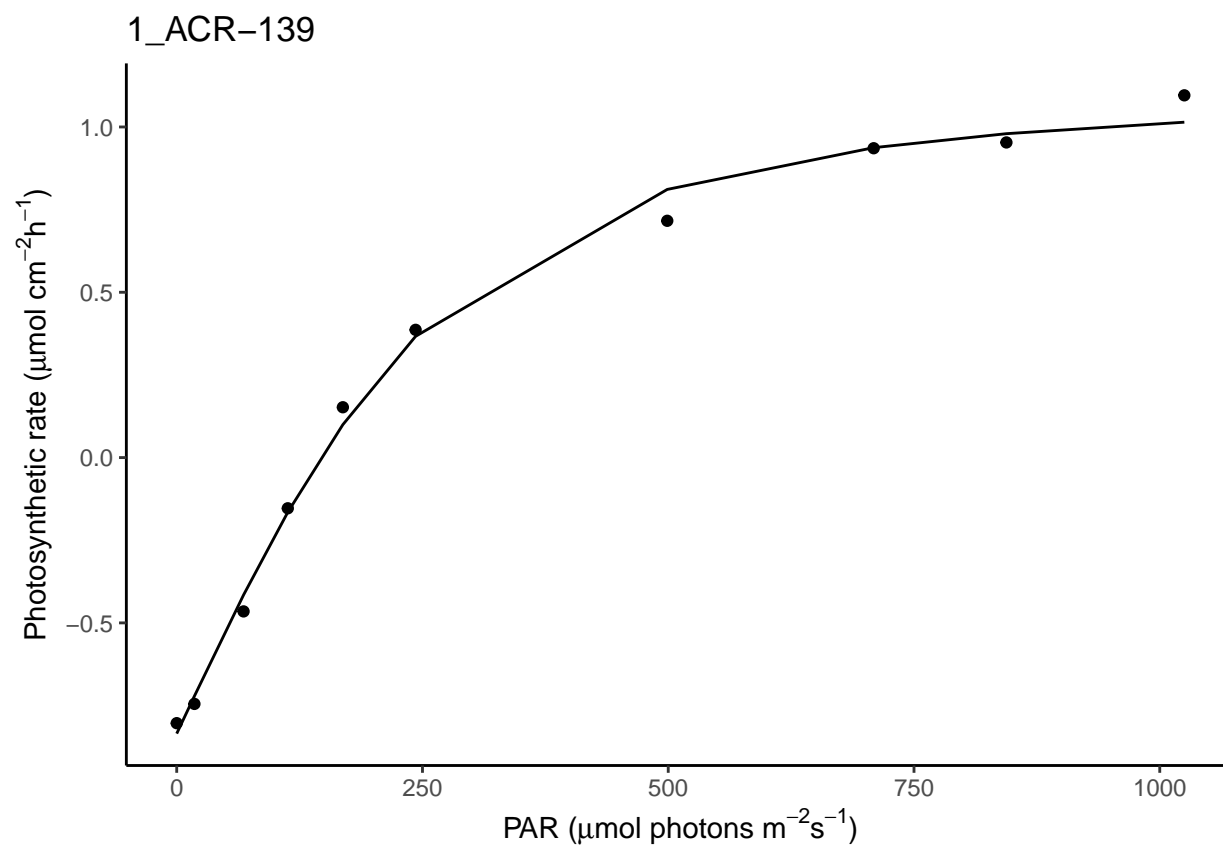
augmented\$colony_id: POR-71



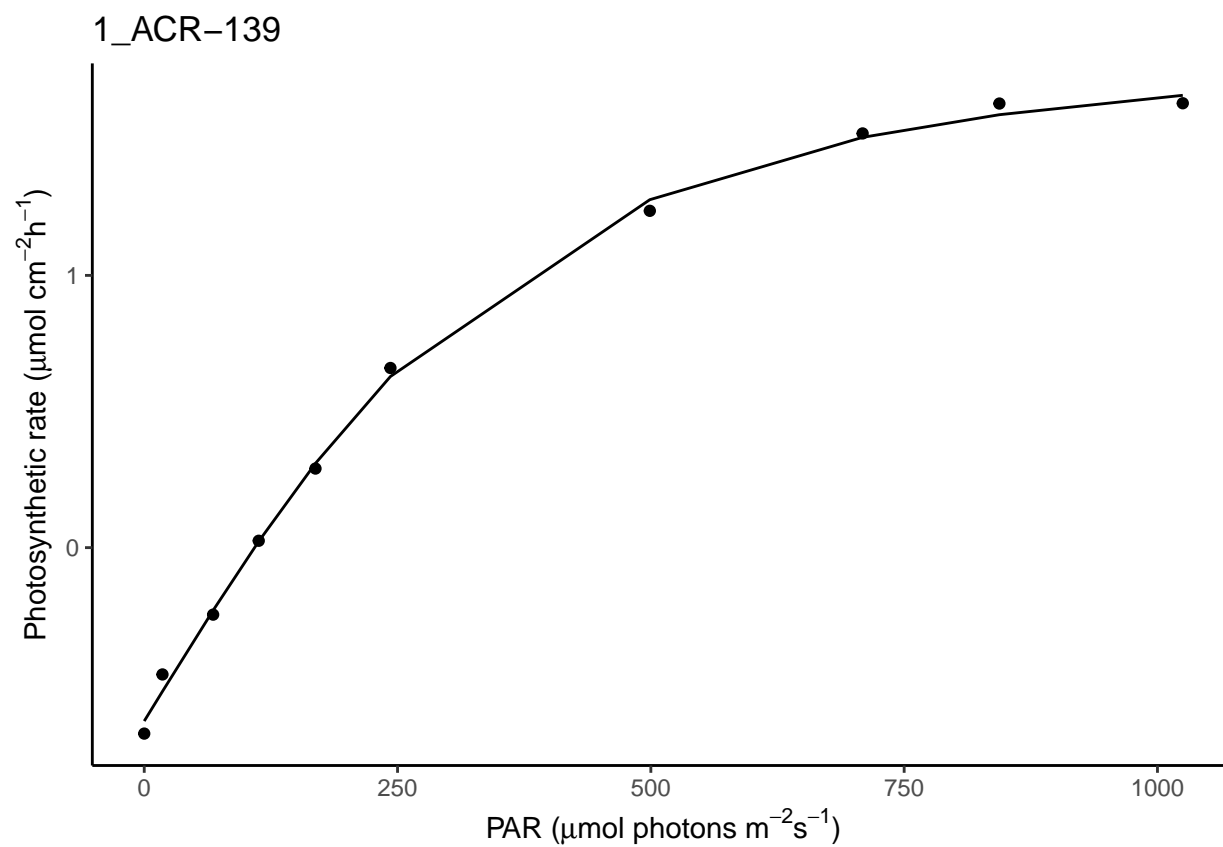
augmented\$colony_id: POR-72



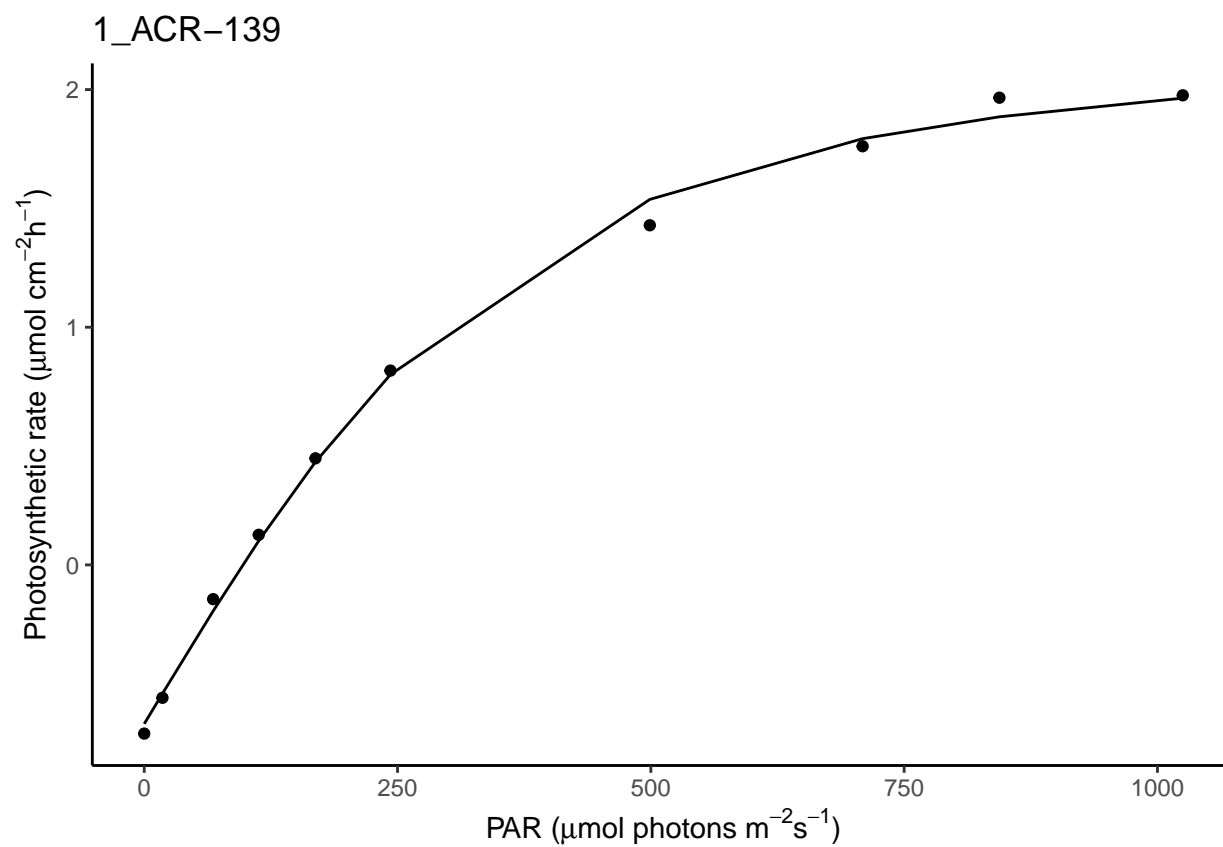
augmented\$colony_id: POR-73



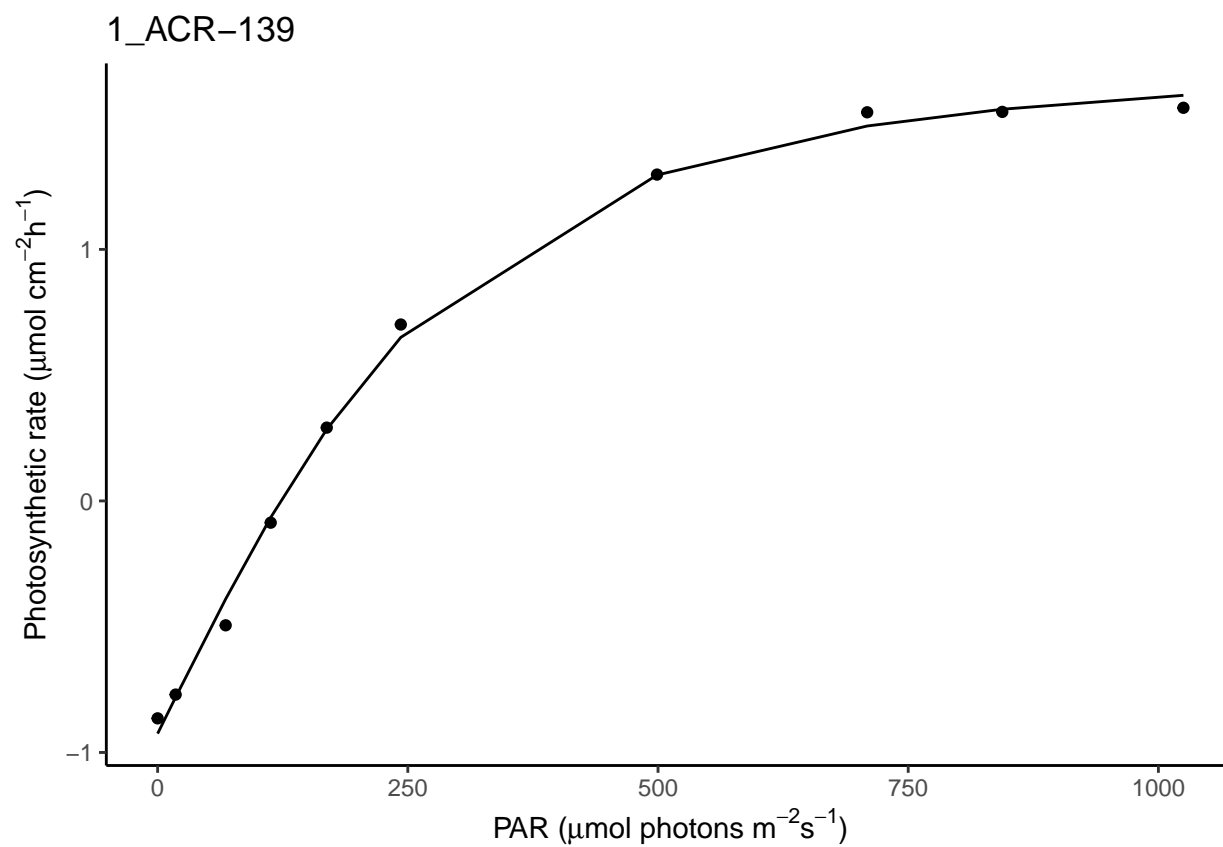
augmented\$colony_id: POR-74



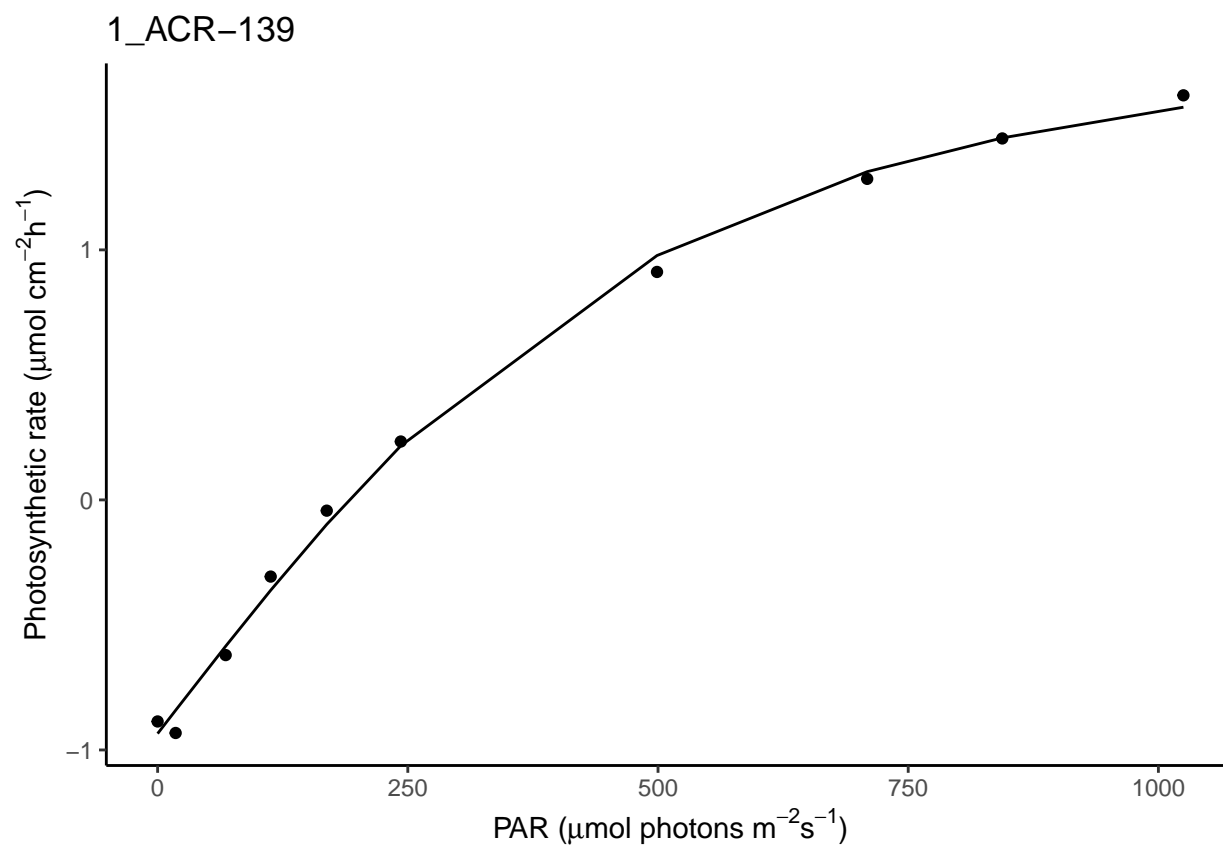
augmented\$colony_id: POR-75



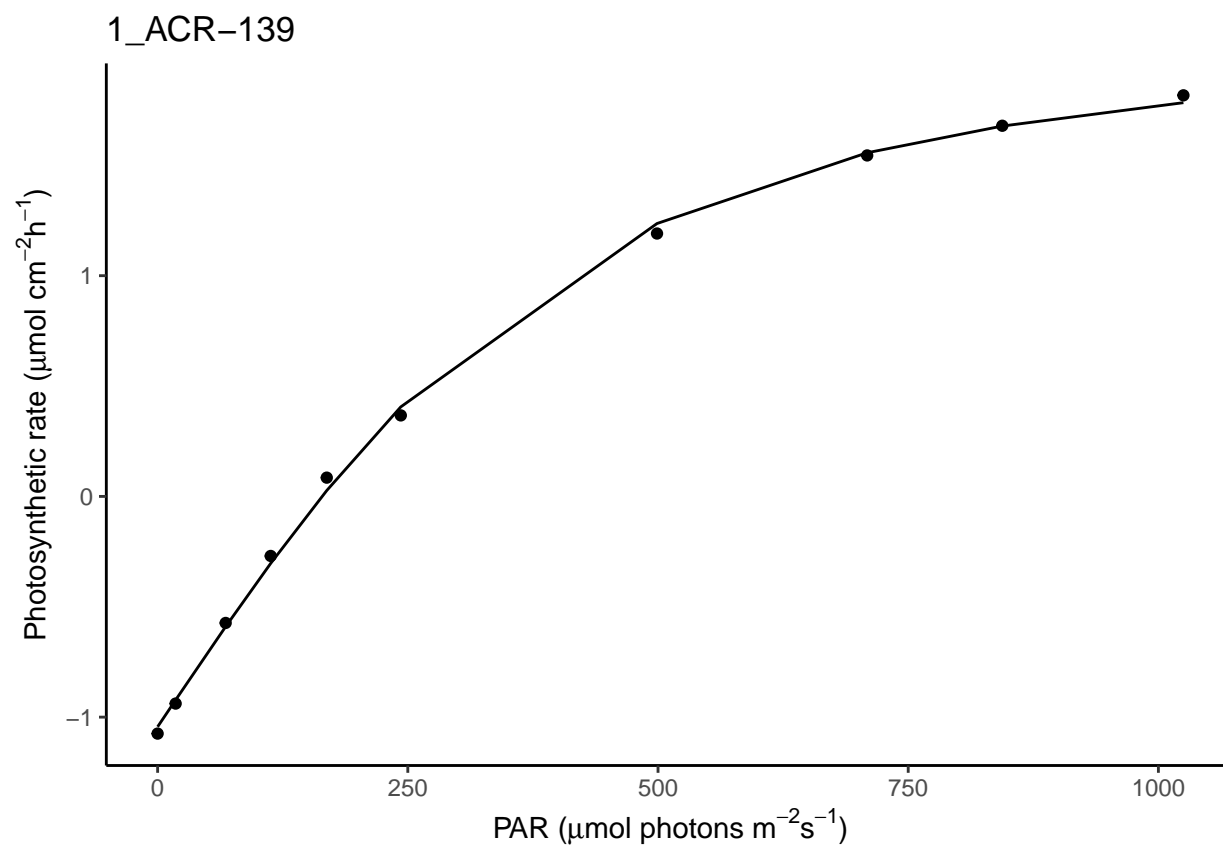
augmented\$colony_id: POR-76



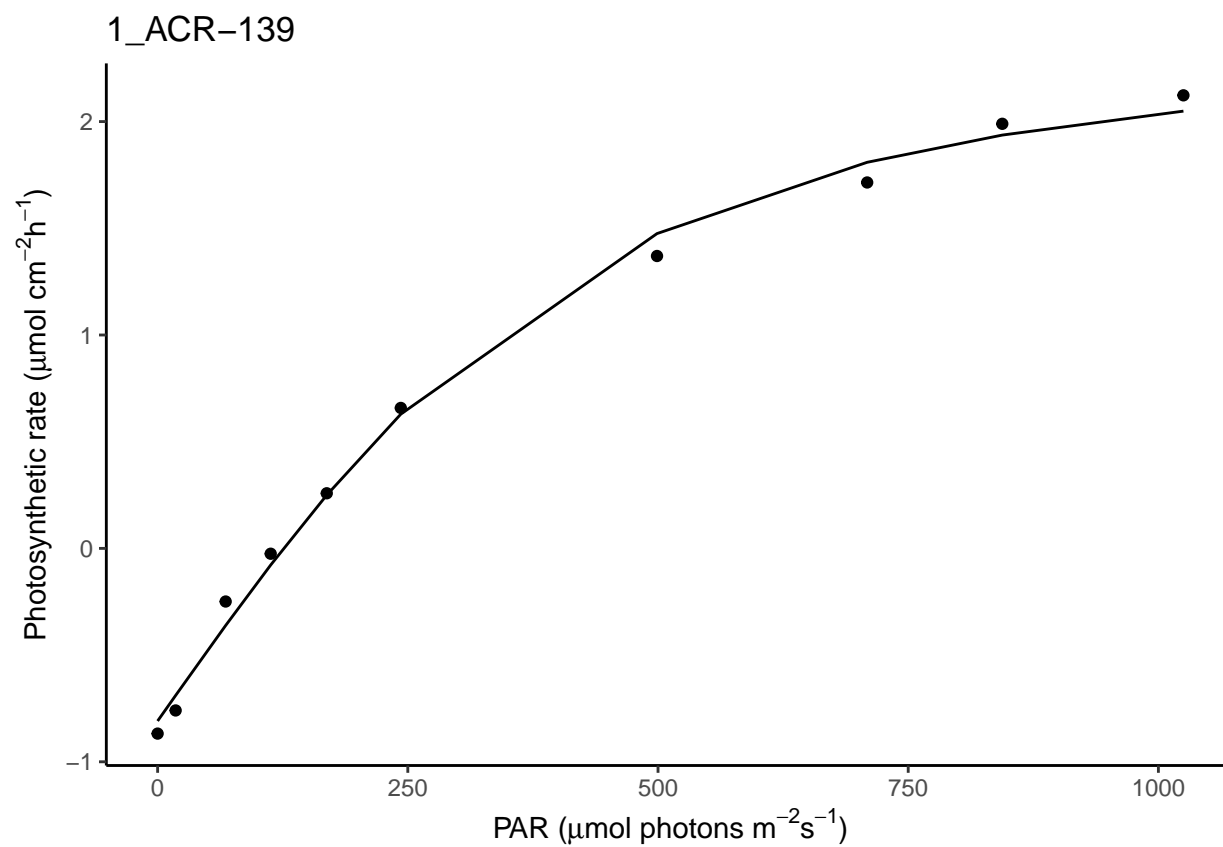
augmented\$colony_id: POR-77



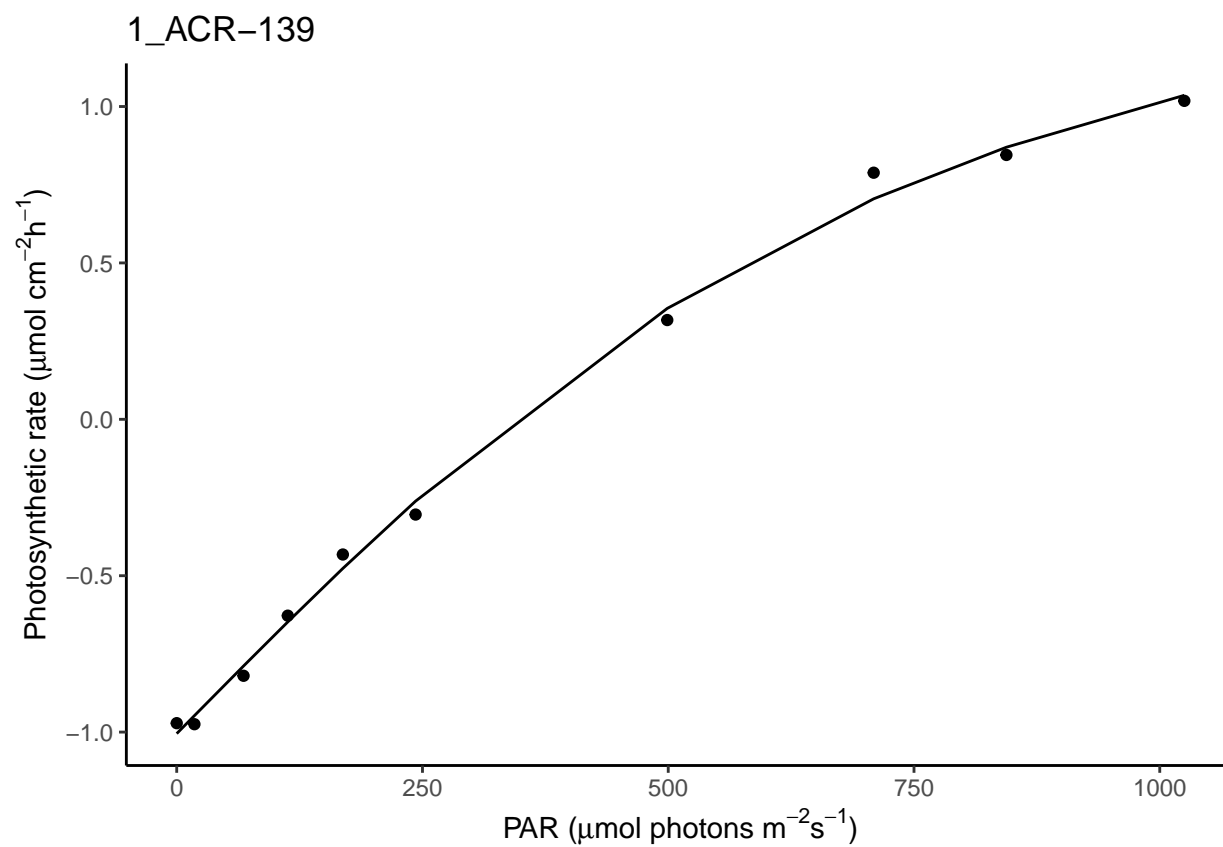
augmented\$colony_id: POR-78



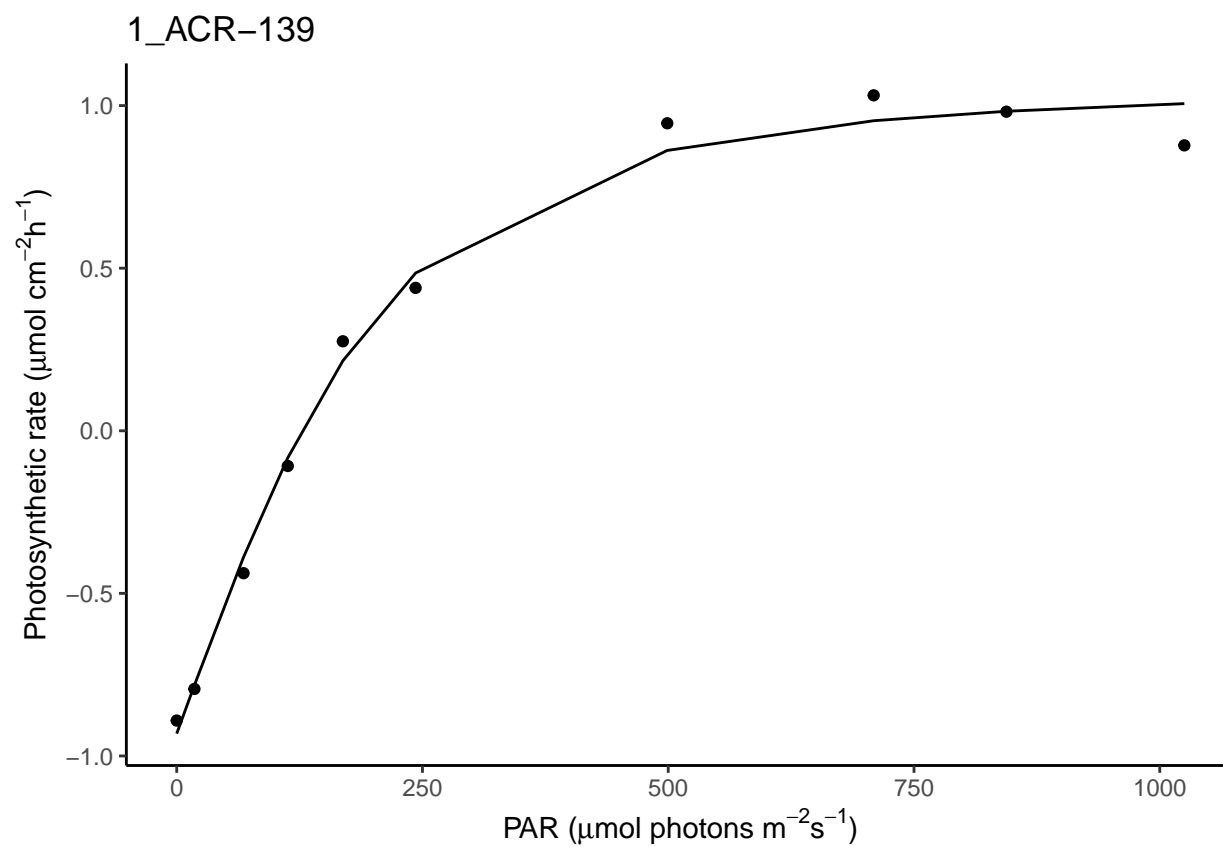
augmented\$colony_id: POR-79



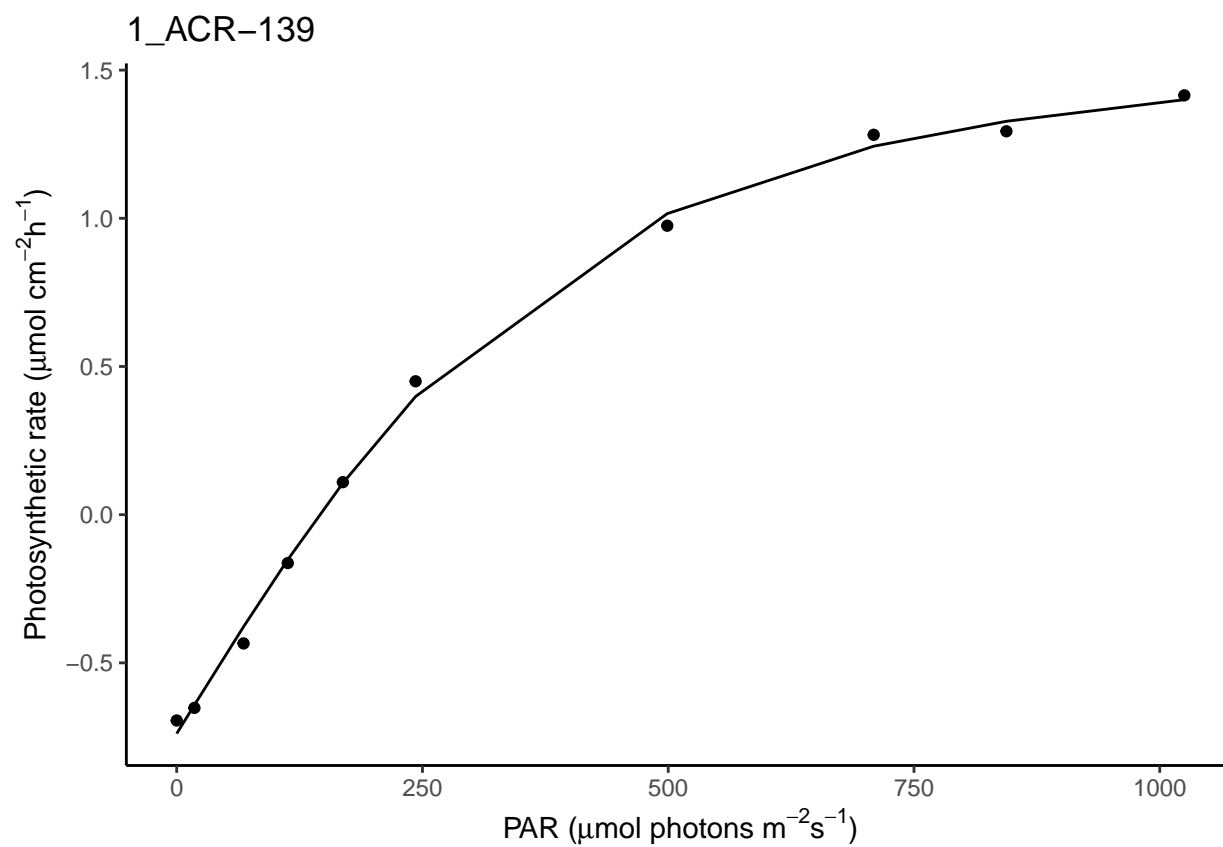
augmented\$colony_id: POR-80



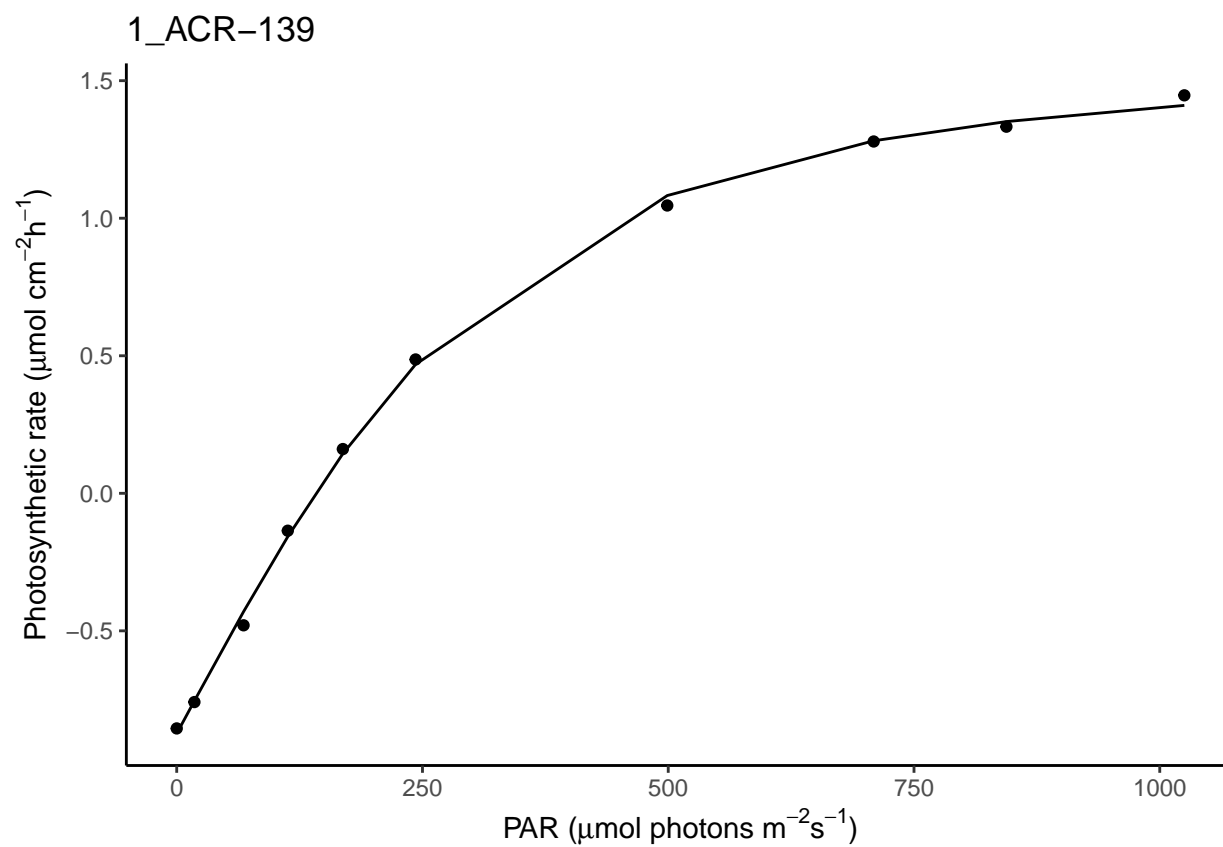
```
## -----  
## augmented$colony_id: POR-81
```

augmented\$colony_id: POR-82



augmented\$colony_id: POR-83



#NEED TO FIND A WAY TO SAVE INDIVIDUALS