Species sensitivity distributions

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Nov 3 2019

Example data

Data are 48- to 96-hour acute toxicity values (LC50 and EC50 values from dose-response analysis) for exposure of Australian and Non-Australian arthropod, nonarthropod invertebrate, fish, and amphibian to the pesticide endosulfan (Hose & Van den Brink, 2004)

Data retrieved like this:

```
library(fitdistrplus)  # to retrieve the data
data("endosulfan")
endosulfan.art <- subset(endosulfan,
                         group == "Arthropods" & Australian == "no")
```

(we only look at the non-Australian data)

Fitting an SSD model

Fitting a Burr type III distribution (a generalized log-logistic distribution), which is a special case of the built-in five-parameter log-logistic model function in *drc*:

```
library(drc)

endo.art.no <- drm(~ ATV, data = endosulfan.art,
                   fct = LL.5(fixed = c(NA, 0, 1, NA, NA)), type = "ssd")

summary(endo.art.no)
```

```
##
## Model fitted: Generalized log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##                Estimate Std. Error t-value   p-value
## b:(Intercept) -0.42124    0.10130 -4.1582 3.207e-05 ***
## e:(Intercept)  0.14826    0.82215  0.1803    0.8569
## f:(Intercept)  4.43626    7.86226  0.5642    0.5726
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Plotting the fitted curve (1)

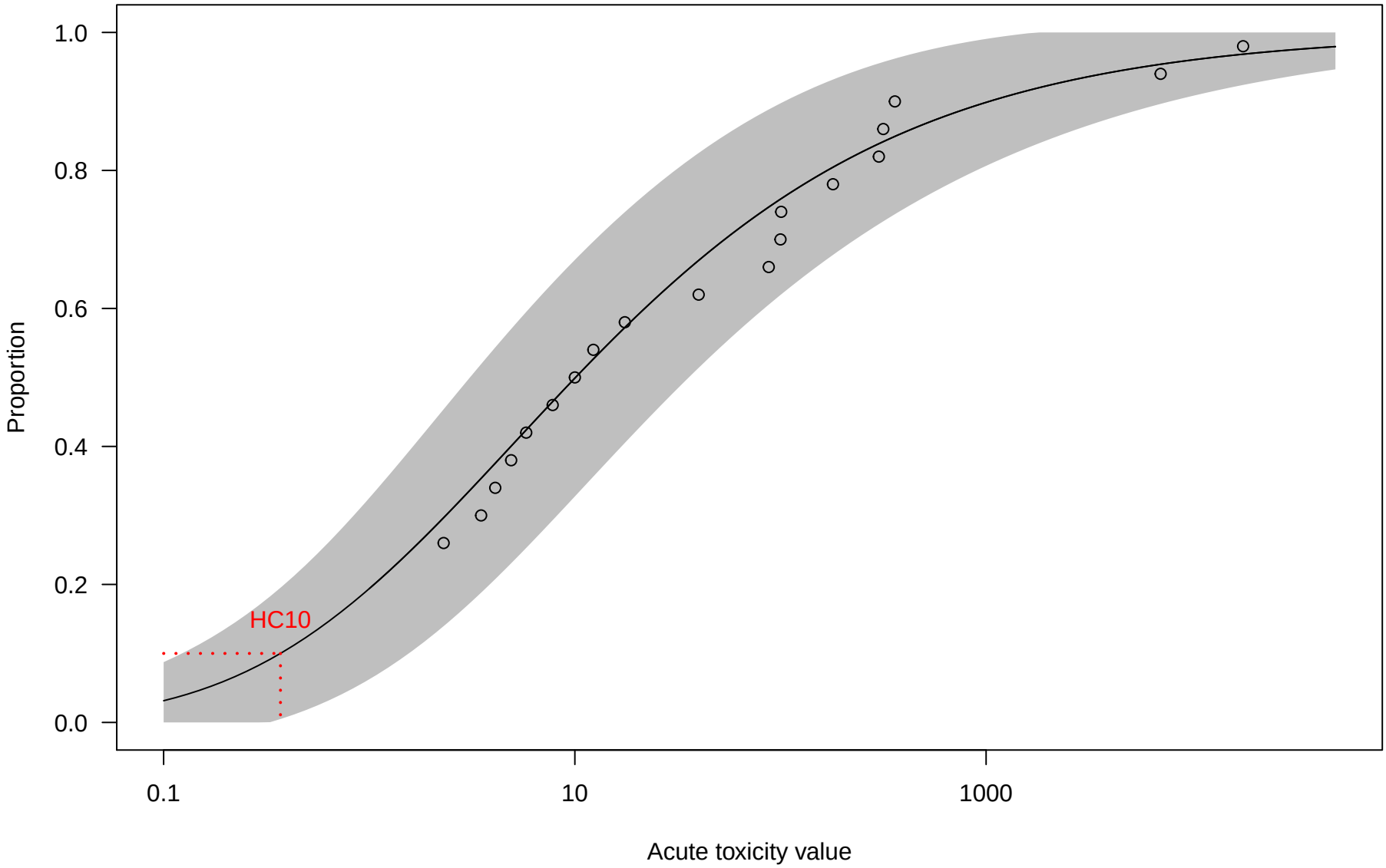
We use the function plot() twice to show both data, fitted SSD curve, and the corresponding 95% confidence band:

```
plot(endo.art.no,
     type = "confidence",
     xlim = c(0.1, 50000), ylim = c(0, 1),
     xlab = "Acute toxicity value", ylab = "Proportion")

plot(endo.art.no,
     xlim = c(1, 50000), ylim = c(0, 1), add = TRUE)

segments(0.1, 0.1, 0.37, 0.1, lty = 3, lwd = 2, col = 2)
segments(0.37, 0.1, 0.37, 0, lty = 3, lwd = 2, col = 2)
text(0.37, 0.15, "HC10", col = 2)
```

Plotting the fitted curve (2)



Estimating HC values

Hazard concentrations (HC) and confidence intervals estimated through inverse regression:

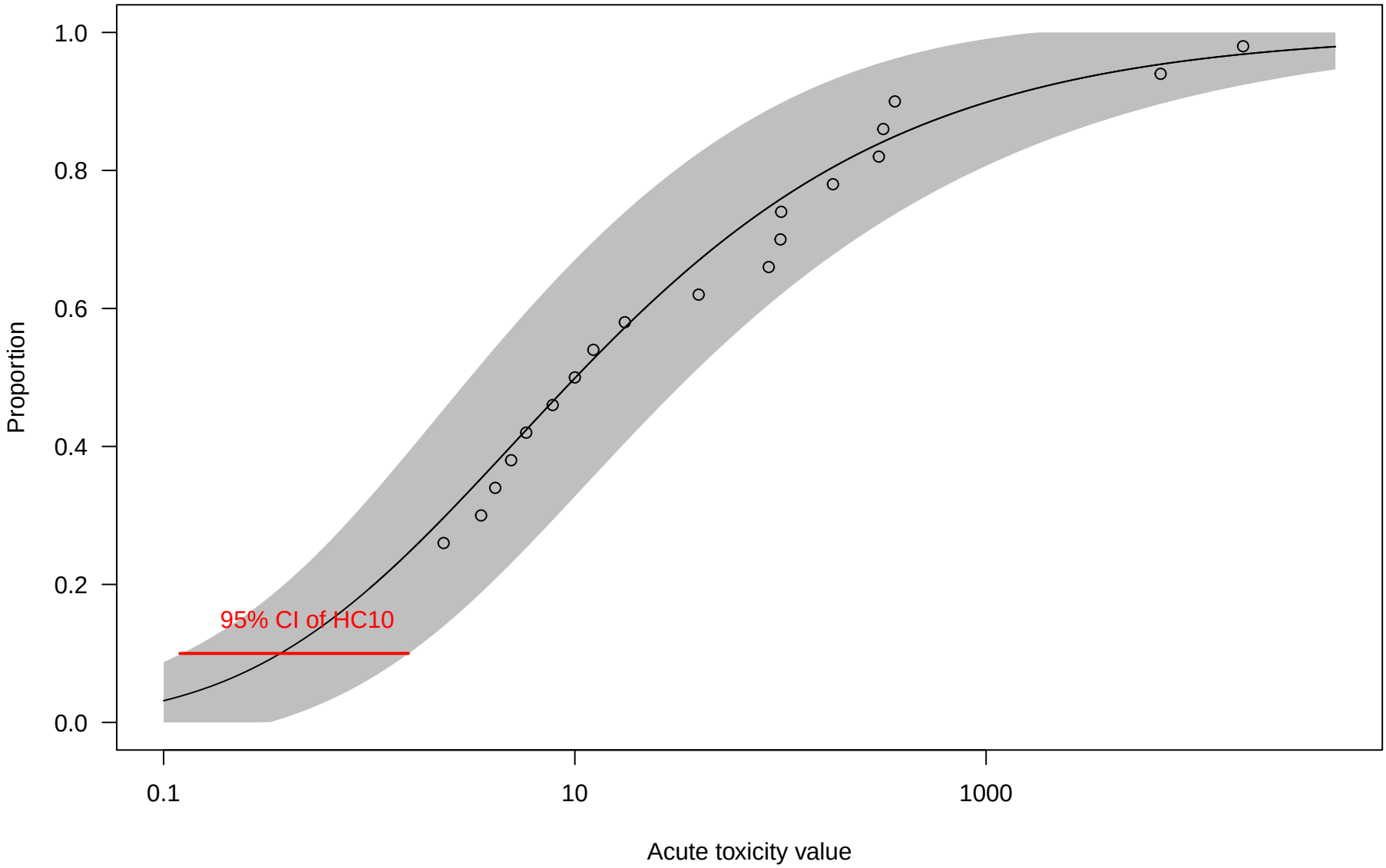
```
ED(endo.art.no, c(5, 10, 50))
```

```
##
## Estimated effective doses
##
##         Estimate Std. Error
## e:1:5    0.16151    0.12397
## e:1:10   0.36985    0.23723
## e:1:50  10.07614    6.52066
```

```
#ED(endo.art.no, c(5,10,50), interval = "delta")  # this you don't want to do
ED(endo.art.no, c(5, 10, 50), interval = "inv")
```

```
##
## Estimated effective doses
##
##          Estimate     Lower     Upper
## e:1:5    0.161510  0.045483  0.842860
## e:1:10   0.369848  0.122836  1.556769
## e:1:50  10.076144  3.088323 35.805902
```

Plotting the fitted curve (3)



References

- Hose, G. C., Van den Brink, P. (2004). Confirming the Species-Sensitivity Distribution concept for Endosulfan Using Laboratory, Mesocosm, and Field Data. *Archives of Environmental Contamination and Toxicology*, **45**, 511-520