Robustness

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Fake-dynamics

Simple topological dynamics are unrealistic, but help us understand how topology affects stability in a very visual way. Here we will play with two data sets in bipartite

Load data

```
#install.packages("bipartite")
library(bipartite)

#load data
?bipartite

olesen2002flores
olesen2002aigrettes
```

Compare two networks

```
#calculate size, conectance and nestedness
networklevel(web = olesen2002flores, index = c("number of species",
                                               "connectance",
                                               "NODF"))
```

```
         connectance                NODF number.of.species.HL
             0.25000            35.96096             12.00000
number.of.species.LL
            10.00000
```

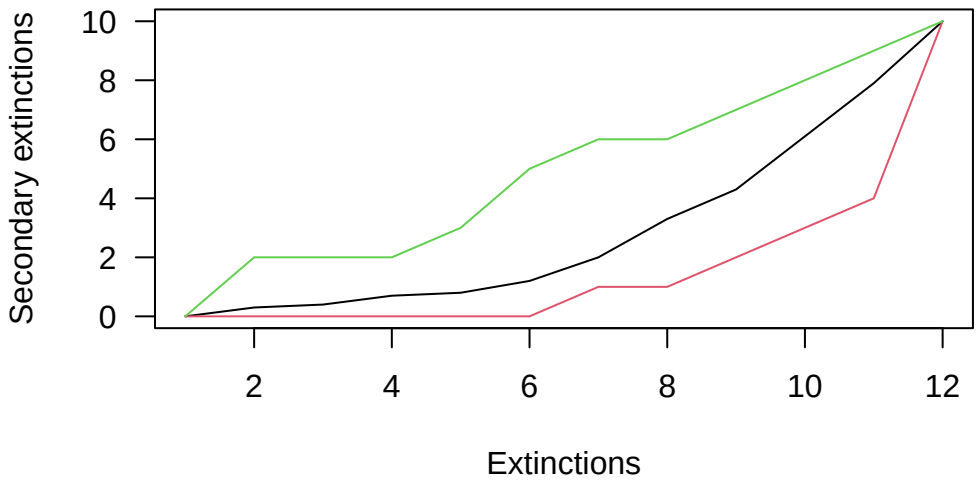
```
networklevel(web = olesen2002aigrettes, index = c("number of species",
                                                   "connectance",
                                                   "NODF"))
```

```
         connectance                NODF number.of.species.HL
           0.2857143           51.8737673           13.0000000
number.of.species.LL
          14.0000000
```

It looks like Aigrettes has higher C, N and M, indicating higher robustness. Let's check it.

```
#select how we lose species for flores.
r1f <- second.extinct(web = olesen2002flores,
                      method = "random") #random
r2f <- second.extinct(web = olesen2002flores,
                      method = "abundance") #less to more abundant
r3f <- second.extinct(web = olesen2002flores,
                      method = "degree") #more to less degree

#Plot it (a bit convoluted, because we need the cumulative sum)
plot(cumsum(r1f[,"ext.higher"]), cumsum(r1f[,"ext.lower"]),
     las = 1, t = "l",
     xlab = "Extinctions", ylab = "Secondary extinctions")
lines(cumsum(r2f[,"ext.higher"]), cumsum(r2f[,"ext.lower"]),
      las = 1, t = "l", col = 2)
lines(cumsum(r3f[,"ext.higher"]), cumsum(r3f[,"ext.lower"]),
      las = 1, t = "l", col = 3)
```




```
robustness(r1f)
```

```
[1] 0.6512729
```

```
robustness(r2f)
```

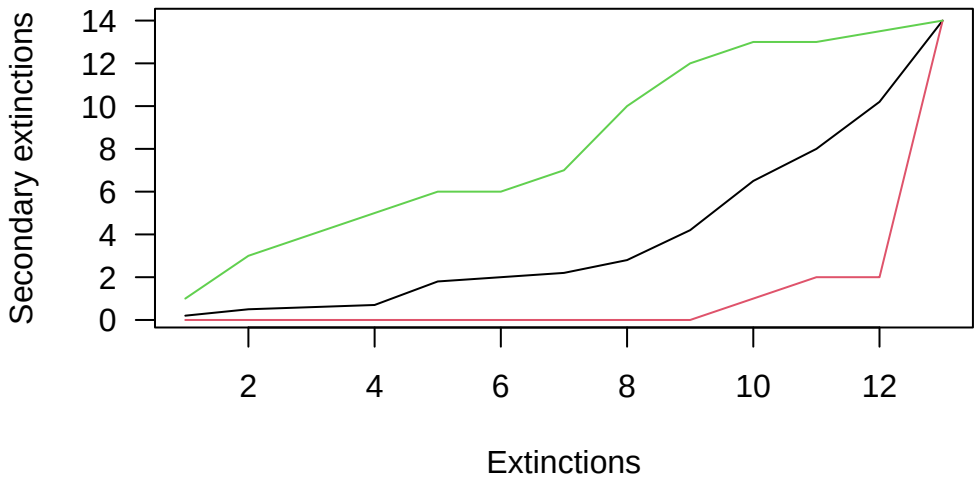
```
[1] 0.7904834
```

```
robustness(r3f)
```

```
[1] 0.4564537
```

```
#Same for Aigrettes
r1a <- second.extinct(web = olesen2002aigrettes,
                      method = "random") #random
r2a <- second.extinct(web = olesen2002aigrettes,
                      method = "abundance") #less to more abundant
r3a <- second.extinct(web = olesen2002aigrettes,
                      method = "degree") #more to less connected
```

```r
plot(cumsum(r1a[,"ext.higher"]), cumsum(r1a[,"ext.lower"]),
     las = 1, t = "l",
     xlab = "Extinctions", ylab = "Secondary extinctions")
lines(cumsum(r2a[,"ext.higher"]), cumsum(r2a[,"ext.lower"]),
      las = 1, t = "l", col = 2)
lines(cumsum(r3a[,"ext.higher"]), cumsum(r3a[,"ext.lower"]),
      las = 1, t = "l", col = 3)
```




```r
robustness(r1a)
```

```
[1] 0.6690681
```

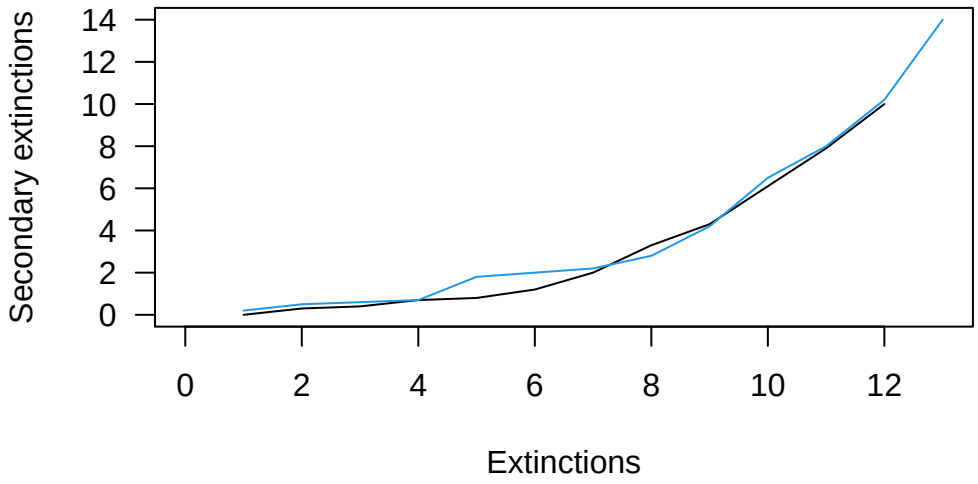
```r
robustness(r2a)
```

```
[1] 0.8675481
```

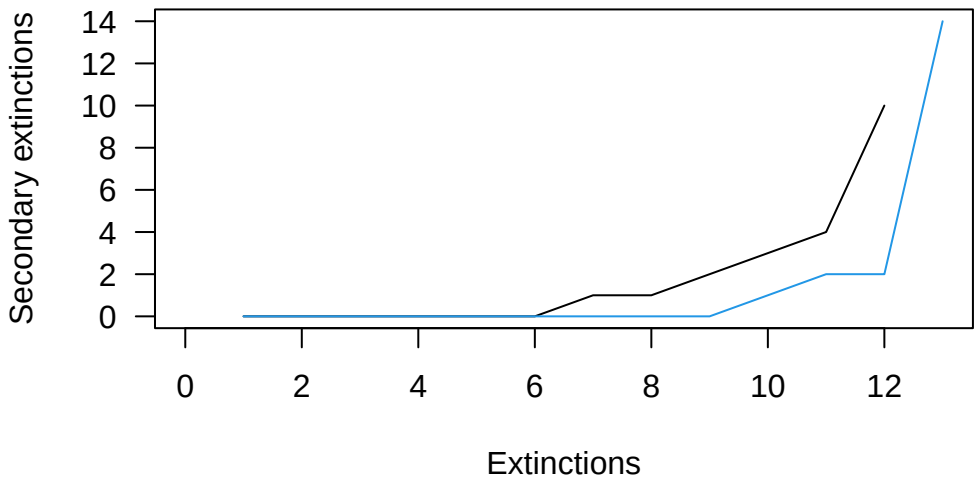
```r
robustness(r3a)
```

```
[1] 0.368982
```

```
#comparamos both
#random
plot(cumsum(r1f[,"ext.higher"]), cumsum(r1f[,"ext.lower"]),
     las = 1, t = "l", xlim = c(0,13), ylim = c(0,14),
     xlab = "Extinctions", ylab = "Secondary extinctions")
lines(cumsum(r1a[,"ext.higher"]), cumsum(r1a[,"ext.lower"]),
      las = 1, t = "l", col = 4)
```




```
#abundance
plot(cumsum(r2f[,"ext.higher"]), cumsum(r2f[,"ext.lower"]),
     las = 1, t = "l",  xlim = c(0,13), ylim = c(0,14),
     xlab = "Extinctions", ylab = "Secondary extinctions")
lines(cumsum(r2a[,"ext.higher"]), cumsum(r2a[,"ext.lower"]),
      las = 1, t = "l", col = 4)
```



Yes, it looks like Aigrettes is more robust to species loss. But note this models are extremely simplified, and in nature species do not get extinct one by one, they can rewire their interactions and many more mecanisms operate at once (e.g. immigration).