

# ANOSIM, PERMANOVA, SIMPER, Indicator Value

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```
libraries <- c("vegan", "ggplot2", "dplyr", "indicspecies", "labdsv", "MASS",  
              "labdsv", "cluster")  
lapply(libraries, require, character.only = TRUE)
```

```
## [[1]]  
## [1] TRUE  
##  
## [[2]]  
## [1] TRUE  
##  
## [[3]]  
## [1] TRUE  
##  
## [[4]]  
## [1] TRUE  
##  
## [[5]]  
## [1] TRUE  
##  
## [[6]]  
## [1] TRUE  
##  
## [[7]]  
## [1] TRUE  
##  
## [[8]]  
## [1] TRUE
```

Paso 1. LLamar de nuevo a las tablas.

```
Moth_full <- read.csv("data/fullmatrix.csv")  
head(Moth_full)
```

##	TimeCode	Year	Site	Habitat	Month	Period	Abundance	Richness	M1	M2
## 1	T1Apr17	2017	T1	Tabonuco	April	Pre-Hurricane	73	25	1	0
## 2	T1May17	2017	T1	Tabonuco	May	Pre-Hurricane	61	25	0	0
## 3	T1Jun17	2017	T1	Tabonuco	June	Pre-Hurricane	68	33	6	1
## 4	T1Jul17	2017	T1	Tabonuco	July	Pre-Hurricane	73	17	3	0
## 5	T1Aug17	2017	T1	Tabonuco	August	Pre-Hurricane	46	19	2	0
## 6	T1Oct17	2017	T1	Tabonuco	October	Post-Hurricane	124	15	0	0

##	M3	M5	M7	M8	M10	M13	M15	M17	M19	M25	M26	M29	M45	M48	M50	M52	M53	M54	M55	M66	
## 1	0	0	2	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	7	0	
## 2	0	0	4	0	0	1	2	0	0	0	1	1	0	1	0	2	0	0	1	0	
## 3	2	0	21	1	1	0	0	0	2	1	2	0	1	2	1	1	3	1	2	0	
## 4	0	0	5	0	0	1	0	1	0	0	9	0	0	0	0	1	0	0	0	1	
## 5	2	0	6	0	0	0	0	0	1	0	3	0	0	0	1	0	1	0	0	0	
## 6	0	0	78	0	0	0	0	0	0	0	14	0	0	0	0	1	0	0	0	0	
##	M70	M74	M77	M79	M80	M81	M85	M86	M87	M88	M89	M94	M95	M96	M100	M104	M105	M106			
## 1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0			
## 2	0	0	0	0	0	0	1	1	3	0	0	1	0	0	0	0	0	0			
## 3	0	0	0	1	0	0	0	1	2	0	0	3	1	1	1	0	0	1			
## 4	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			
## 5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0			
## 6	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0			
##	M109	M110	A1	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A14	A15	A16	A17	A19	A21	A22	A24
## 1	0	0	1	4	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1
## 2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	1	0	0
## 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
## 4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0
## 5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0
## 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	5	3	0
##	A25	A27	A28	A29	A30	A31	A32	A33	A34	A36	A37	A38	A39	A40	A41	A42	A43	A44	A45		
## 1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0		
## 2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
## 3	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0		
## 4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
## 5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		
## 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
##	A46	A47	A48	A49	A50	A51	A52	A53	A54	A55	A56	A58	A59	A60	A61	A65	A66	A67	A68		
## 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
## 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
## 3	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0		
## 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
## 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
## 6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0		
##	A69	A70	A71	A72	A73	A74	A75	A76	A77	A78	A79	A80	A81	A82	A83	A84	A86	A97	A99		
## 1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2		
## 2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2		
## 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
## 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
## 5	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
## 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
##	A101	A105	A111	A112	A115	A116	A117	A118	A119	A120	A121	A122	A123	A124	A125						
## 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 6	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0						
##	A126	A127	A128	A129	A130	A131	A132	A133	A134	A135	A136	A137	A138	A139	A140						
## 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0						
## 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
## 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						

```

## 5      0      0      0      0      0      0      0      0      0      0      0      1      0      0      0      0
## 6      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
##      A141 A142 A143 A144 A145 A147 A148 A149 A150 A151 A152 A153 A154 A155 A157
## 1      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      36
## 2      0      0      0      0      0      0      0      0      0      0      0      0      1      0      0      27
## 3      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 4      0      0      0      0      0      0      0      0      1      0      0      0      0      1      0      38
## 5      0      0      0      0      0      1      0      0      0      0      0      0      1      0      0      16
## 6      1      0      0      0      0      0      0      0      0      0      0      0      0      0      0      3
##      A158 A159 A160 A161 A162 A163 A164 A165 A166 A167 A168 A169 A170 A171 A172
## 1      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 2      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 3      0      0      0      0      0      0      0      0      0      1      0      0      0      0      0      0
## 4      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 5      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 6      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
##      A177 A178 A179 A182 A184 A185 A186 A188 A190 A191 A192 A193 A194 A196 A198
## 1      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 2      0      0      0      0      1      0      0      0      0      0      0      0      0      0      0
## 3      0      0      0      0      0      0      0      0      0      0      0      0      0      1      0
## 4      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 5      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 6      0      0      0      0      0      0      0      0      5      0      0      0      0      0      0
##      A199 A200 A201 A202 A203 A205 A206 A207 A208 A209 A210 A211 A212 A213 A214
## 1      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 2      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 3      0      0      0      0      0      0      0      0      0      0      1      0      0      0      0
## 4      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 5      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 6      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
##      A215 A216 A218 A219 A220 A222 A223 A225 A228 A230 A234 A235 A236 A237 A238
## 1      0      0      0      0      0      0      0      0      0      0      0      2      1      0      0
## 2      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 3      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 4      0      0      0      0      0      0      0      0      0      0      0      0      2      0      0
## 5      0      0      0      0      0      0      0      0      0      0      0      0      0      0      0
## 6      0      0      0      0      0      0      0      0      0      0      0      0      1      0      0
##      A239 A240 A241 A242 A243 A244 A245 A246 A247 A248 DAMAGED
## 1      0      0      0      0      0      0      0      0      0      0      9
## 2      0      0      0      0      0      0      0      0      0      0      2
## 3      0      0      0      0      0      0      0      0      0      0      1
## 4      0      0      0      0      0      0      0      0      0      0      6
## 5      0      0      0      0      0      0      0      0      0      0      2
## 6      0      0      0      0      0      0      0      0      0      0      4

```

```
moth_sp <- dplyr::select(Moth_full, M1:A248)
```

Paso 2. Vamos a comparar entre grupos. Son los grupos propuestos (e identificados en el nMDS) significativamente diferente? Vamos hacer un ANOSIM

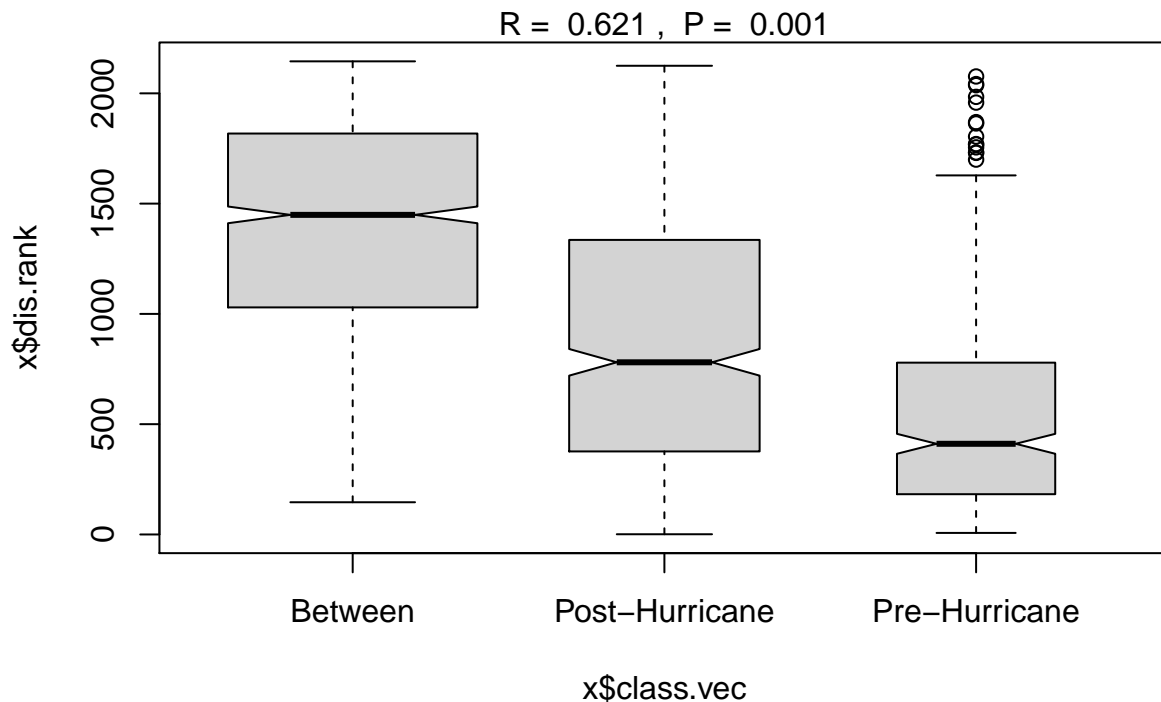
```
##### ANOSIM #####
```

```
moth.dist <- vegdist(moth_sp,method="bray")
```

```
moth.ano <- anosim(moth.dist, Moth_full$Period)
summary(moth.ano)
```

```
##
## Call:
## anosim(x = moth.dist, grouping = Moth_full$Period)
## Dissimilarity: bray
##
## ANOSIM statistic R: 0.6206
##      Significance: 0.001
##
## Permutation: free
## Number of permutations: 999
##
## Upper quantiles of permutations (null model):
##   90%   95%  97.5%   99%
## 0.0341 0.0466 0.0583 0.0744
##
## Dissimilarity ranks between and within classes:
##           0%   25%   50%   75%  100%   N
## Between      146 1029.75 1449.0 1817.375 2145.0 1080
## Post-Hurricane 1  376.50  780.5 1334.875 2125.0  630
## Pre-Hurricane  7  182.50  411.0  779.000 2076.5  435
```

```
plot(moth.ano)
```



Paso 3. Comprobar diferencias en los grupos.

```
dis_well <- betadisper(moth.dist, Moth_full$Period)
permutest(dis_well)
```

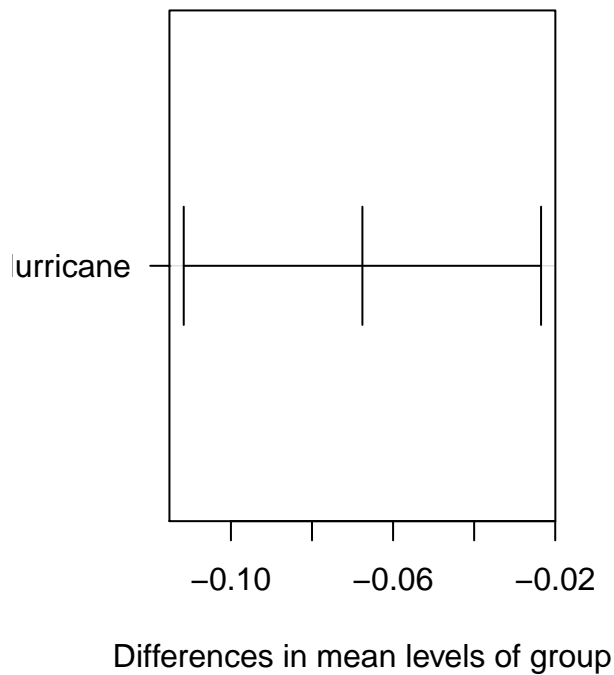
```
##
## Permutation test for homogeneity of multivariate dispersions
## Permutation: free
## Number of permutations: 999
##
## Response: Distances
##      Df Sum Sq Mean Sq      F N.Perm Pr(>F)
## Groups   1 0.07471 0.074710 9.3792   999 0.004 **
## Residuals 64 0.50979 0.007965
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
well.HSD <- TukeyHSD(dis_well)
well.HSD
```

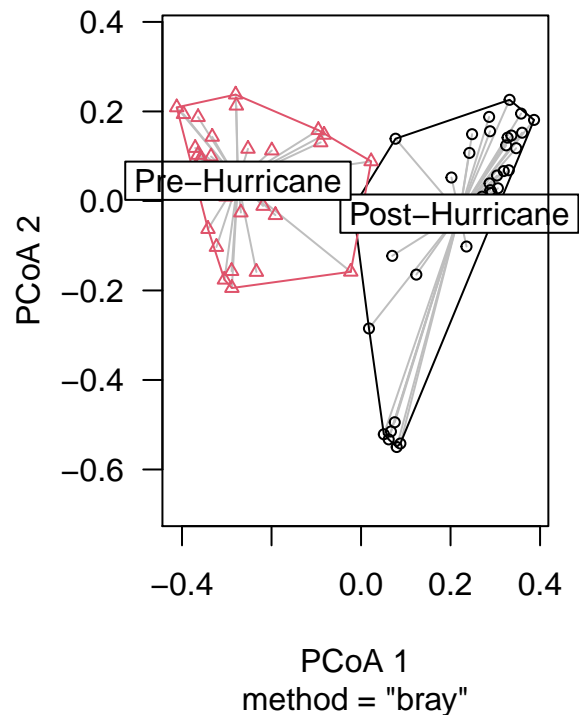
```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = distances ~ group, data = df)
##
## $group
##              diff              lwr              upr              p adj
## Pre-Hurricane-Post-Hurricane -0.06756914 -0.1116451 -0.02349315 0.0032081
```

```
par(mfrow=c(1,2))
plot(well.HSD, las=1)
plot(dis_well, las=1)
```

95% family-wise confidence level



dis\_well



Paso 4. Vamos a probar los grupos, pero ahora con un PERMANOVA.

```
adonis(moth_sp ~ Period, data = Moth_full, permutations = 999, method="bray")
```

```
##
## Call:
## adonis(formula = moth_sp ~ Period, data = Moth_full, permutations = 999, method = "bray")
##
## Permutation: free
## Number of permutations: 999
##
## Terms added sequentially (first to last)
##
##          Df SumsOfSqs MeanSqs F.Model    R2 Pr(>F)
## Period    1     3.9156  3.9156  17.813 0.21773 0.001 ***
## Residuals 64    14.0680  0.2198         0.78227
## Total    65    17.9836         1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Paso 5. Comparasion entre grupos.

```
library(devtools)
```

```
## Warning: package 'devtools' was built under R version 4.0.5
```

```
## Loading required package: usethis
```

```
## Warning: package 'usethis' was built under R version 4.0.5
```

```
##
```

```
## Attaching package: 'devtools'
```

```
## The following object is masked from 'package:permute':
```

```
##
```

```
##      check
```

```
install_github("pmartinezarbizu/pairwiseAdonis/pairwiseAdonis")
```

```
## Skipping install of 'pairwiseAdonis' from a github remote, the SHA1 (ece560d2) has not changed since
```

```
## Use `force = TRUE` to force installation
```

```
library(pairwiseAdonis)
```

```
pair.mod<-pairwise.adonis(moth_sp,factors=Moth_full$Period)
```

```
pair.mod
```

```
##              pairs Df SumsOfSqs F.Model      R2 p.value
## 1 Pre-Hurricane vs Post-Hurricane  1  3.915556 17.8131 0.2177292  0.001
##    p.adjusted sig
## 1      0.001  **
```

Paso 6. Vamos a ver quien cuales especies contribuyen a la disimilaridad entre esos grupos.

```
##### SIMPER #####
```

```
moth_simper <- with(Moth_full, simper(moth_sp, Moth_full$Period), permutations = 999)
summary(moth_simper, ordered = TRUE,
        digits = max(3,getOption("digits") - 3))
```

```
##
```

```
## Contrast: Pre-Hurricane_Post-Hurricane
```

```
##
```

```
##      average      sd  ratio      ava      avb cumsum
## A157 1.639e-01 0.1071130 1.5302 32.46667  3.94444 0.2029
## M7   1.136e-01 0.1310294 0.8671 11.93333 22.72222 0.3436
## A141 9.986e-02 0.1120347 0.8913  0.03333 21.69444 0.4672
## M94  1.895e-02 0.0156875 1.2078  1.33333  3.72222 0.4907
## M26  1.595e-02 0.0163408 0.9760  1.43333  2.86111 0.5104
## M87  1.385e-02 0.0115333 1.2010  2.03333  2.47222 0.5276
## M55  1.273e-02 0.0221916 0.5738  2.03333  0.11111 0.5433
## M104 1.227e-02 0.0223592 0.5485  2.20000  0.44444 0.5585
## A21  1.108e-02 0.0095103 1.1654  0.80000  2.27778 0.5723
## A25  8.939e-03 0.0104711 0.8537  1.46667  0.33333 0.5833
## A188 8.810e-03 0.0103498 0.8512  0.03333  1.77778 0.5942
## A123 8.695e-03 0.0156544 0.5554  0.16667  1.83333 0.6050
## A22  8.532e-03 0.0097545 0.8747  0.10000  1.52778 0.6156
```

##	A73	8.198e-03	0.0108273	0.7571	0.06667	1.66667	0.6257
##	M52	7.996e-03	0.0164520	0.4860	1.30000	0.50000	0.6356
##	A139	7.992e-03	0.0112553	0.7100	0.06667	1.41667	0.6455
##	M1	7.338e-03	0.0106460	0.6893	1.16667	0.02778	0.6546
##	A203	6.934e-03	0.0129661	0.5348	0.00000	0.91667	0.6632
##	A58	6.736e-03	0.0087274	0.7718	1.16667	0.16667	0.6715
##	A236	6.502e-03	0.0067682	0.9607	0.76667	0.86111	0.6796
##	A19	6.492e-03	0.0080278	0.8087	0.63333	0.86111	0.6876
##	A99	6.116e-03	0.0102138	0.5988	0.86667	0.00000	0.6952
##	A86	6.102e-03	0.0099287	0.6145	0.86667	0.30556	0.7027
##	M45	6.049e-03	0.0079997	0.7561	0.66667	0.61111	0.7102
##	M3	5.948e-03	0.0069256	0.8589	0.80000	0.61111	0.7176
##	A125	5.682e-03	0.0124889	0.4550	0.23333	0.91667	0.7246
##	A163	5.482e-03	0.0066479	0.8247	0.23333	0.97222	0.7314
##	A153	5.386e-03	0.0069346	0.7767	0.76667	0.44444	0.7381
##	M79	5.170e-03	0.0060920	0.8486	0.40000	0.80556	0.7445
##	A17	5.168e-03	0.0095796	0.5395	0.06667	0.83333	0.7509
##	M48	5.134e-03	0.0077485	0.6626	0.73333	0.27778	0.7572
##	M50	4.917e-03	0.0063888	0.7697	0.76667	0.19444	0.7633
##	A79	4.728e-03	0.0079849	0.5921	0.73333	0.13889	0.7692
##	A60	4.706e-03	0.0054927	0.8567	0.20000	0.77778	0.7750
##	A40	4.681e-03	0.0061086	0.7663	0.06667	0.77778	0.7808
##	M53	4.607e-03	0.0062412	0.7382	0.73333	0.05556	0.7865
##	A200	4.409e-03	0.0055058	0.8008	0.23333	0.72222	0.7920
##	M8	4.381e-03	0.0072714	0.6025	0.13333	0.88889	0.7974
##	A3	4.325e-03	0.0064252	0.6732	0.23333	0.63889	0.8027
##	M13	4.306e-03	0.0055121	0.7811	0.66667	0.00000	0.8081
##	M66	4.010e-03	0.0057964	0.6918	0.50000	0.33333	0.8130
##	M10	3.948e-03	0.0055742	0.7083	0.63333	0.08333	0.8179
##	A192	3.759e-03	0.0057529	0.6533	0.00000	0.63889	0.8226
##	M77	3.540e-03	0.0083397	0.4244	0.46667	0.11111	0.8270
##	A41	3.524e-03	0.0057052	0.6178	0.43333	0.25000	0.8313
##	A15	3.420e-03	0.0053573	0.6383	0.40000	0.33333	0.8355
##	A150	3.143e-03	0.0063736	0.4931	0.00000	0.52778	0.8394
##	A239	3.020e-03	0.0047332	0.6379	0.10000	0.52778	0.8432
##	A32	2.787e-03	0.0047516	0.5865	0.23333	0.27778	0.8466
##	A11	2.763e-03	0.0039073	0.7070	0.40000	0.19444	0.8500
##	M80	2.745e-03	0.0056451	0.4863	0.40000	0.00000	0.8534
##	A186	2.527e-03	0.0057717	0.4378	0.03333	0.44444	0.8566
##	A36	2.424e-03	0.0037284	0.6501	0.36667	0.08333	0.8596
##	A80	2.355e-03	0.0059924	0.3929	0.03333	0.58333	0.8625
##	M19	2.336e-03	0.0042497	0.5497	0.40000	0.00000	0.8654
##	A5	2.175e-03	0.0046809	0.4648	0.03333	0.30556	0.8681
##	A216	1.945e-03	0.0041023	0.4742	0.03333	0.38889	0.8705
##	M29	1.925e-03	0.0036106	0.5331	0.33333	0.00000	0.8729
##	A134	1.821e-03	0.0033783	0.5389	0.33333	0.00000	0.8751
##	M86	1.803e-03	0.0034797	0.5183	0.23333	0.05556	0.8774
##	M96	1.749e-03	0.0039201	0.4461	0.13333	0.19444	0.8795
##	A154	1.712e-03	0.0038382	0.4460	0.30000	0.00000	0.8816
##	M85	1.650e-03	0.0038896	0.4243	0.23333	0.02778	0.8837
##	A7	1.636e-03	0.0040174	0.4072	0.23333	0.00000	0.8857
##	A6	1.626e-03	0.0034751	0.4679	0.20000	0.11111	0.8877
##	A207	1.616e-03	0.0031801	0.5082	0.10000	0.19444	0.8897
##	M106	1.593e-03	0.0041172	0.3870	0.26667	0.00000	0.8917



##	A162	1.577e-03	0.0042160	0.3740	0.23333	0.05556	0.8936
##	A168	1.523e-03	0.0030447	0.5004	0.23333	0.00000	0.8955
##	M95	1.520e-03	0.0029500	0.5154	0.13333	0.16667	0.8974
##	A51	1.492e-03	0.0028353	0.5262	0.06667	0.25000	0.8993
##	M15	1.487e-03	0.0037777	0.3936	0.23333	0.00000	0.9011
##	A33	1.439e-03	0.0028652	0.5021	0.23333	0.00000	0.9029
##	A82	1.389e-03	0.0034971	0.3972	0.06667	0.22222	0.9046
##	A185	1.372e-03	0.0033002	0.4157	0.13333	0.16667	0.9063
##	A30	1.368e-03	0.0033083	0.4135	0.06667	0.25000	0.9080
##	A178	1.345e-03	0.0034425	0.3907	0.26667	0.00000	0.9097
##	A14	1.335e-03	0.0031203	0.4277	0.20000	0.05556	0.9113
##	A138	1.319e-03	0.0036980	0.3567	0.00000	0.22222	0.9130
##	A201	1.304e-03	0.0038866	0.3355	0.20000	0.00000	0.9146
##	A167	1.284e-03	0.0031907	0.4025	0.16667	0.02778	0.9162
##	A179	1.212e-03	0.0035034	0.3459	0.06667	0.13889	0.9177
##	A83	1.205e-03	0.0033145	0.3636	0.00000	0.27778	0.9191
##	A244	1.184e-03	0.0025924	0.4567	0.03333	0.22222	0.9206
##	M105	1.183e-03	0.0049062	0.2411	0.03333	0.11111	0.9221
##	A149	1.169e-03	0.0036708	0.3185	0.13333	0.02778	0.9235
##	M70	1.143e-03	0.0028682	0.3986	0.13333	0.02778	0.9249
##	A9	1.132e-03	0.0026436	0.4282	0.10000	0.11111	0.9263
##	A208	1.088e-03	0.0025764	0.4223	0.13333	0.05556	0.9277
##	A194	1.076e-03	0.0026228	0.4101	0.06667	0.11111	0.9290
##	A38	1.061e-03	0.0023351	0.4542	0.16667	0.02778	0.9303
##	A193	1.059e-03	0.0026641	0.3974	0.16667	0.05556	0.9316
##	M81	1.053e-03	0.0028777	0.3661	0.13333	0.00000	0.9329
##	A67	1.029e-03	0.0021588	0.4768	0.20000	0.00000	0.9342
##	A76	1.027e-03	0.0031214	0.3291	0.16667	0.00000	0.9355
##	M88	1.024e-03	0.0040235	0.2545	0.16667	0.00000	0.9368
##	M17	1.015e-03	0.0024039	0.4224	0.16667	0.00000	0.9380
##	A235	9.952e-04	0.0039701	0.2507	0.13333	0.00000	0.9393
##	A209	9.825e-04	0.0023584	0.4166	0.16667	0.00000	0.9405
##	A28	9.682e-04	0.0027311	0.3545	0.16667	0.00000	0.9417
##	A71	9.483e-04	0.0024407	0.3885	0.13333	0.02778	0.9428
##	M5	8.693e-04	0.0024407	0.3562	0.13333	0.00000	0.9439
##	A196	8.515e-04	0.0022978	0.3706	0.06667	0.08333	0.9450
##	A31	8.434e-04	0.0023308	0.3618	0.13333	0.00000	0.9460
##	M89	8.099e-04	0.0022537	0.3594	0.13333	0.00000	0.9470
##	A105	8.037e-04	0.0030572	0.2629	0.13333	0.00000	0.9480
##	M2	8.030e-04	0.0023242	0.3455	0.10000	0.02778	0.9490
##	A56	7.922e-04	0.0023043	0.3438	0.10000	0.02778	0.9500
##	M25	7.876e-04	0.0021373	0.3685	0.03333	0.11111	0.9510
##	A130	7.785e-04	0.0024274	0.3207	0.00000	0.11111	0.9519
##	A118	7.712e-04	0.0018620	0.4142	0.03333	0.13889	0.9529
##	A55	7.389e-04	0.0021778	0.3393	0.00000	0.11111	0.9538
##	A116	7.323e-04	0.0028005	0.2615	0.00000	0.25000	0.9547
##	A184	7.030e-04	0.0023297	0.3018	0.13333	0.00000	0.9556
##	A1	6.842e-04	0.0022091	0.3097	0.10000	0.00000	0.9564
##	A78	6.797e-04	0.0019966	0.3404	0.06667	0.05556	0.9573
##	A164	6.659e-04	0.0022808	0.2919	0.03333	0.05556	0.9581
##	M110	6.628e-04	0.0031251	0.2121	0.06667	0.02778	0.9589
##	A8	6.502e-04	0.0028173	0.2308	0.10000	0.00000	0.9597
##	A145	6.442e-04	0.0023479	0.2744	0.00000	0.22222	0.9605
##	A119	6.378e-04	0.0019624	0.3250	0.06667	0.05556	0.9613

##	A59	6.312e-04	0.0016588	0.3805	0.00000	0.16667	0.9621
##	A159	6.308e-04	0.0020006	0.3153	0.10000	0.00000	0.9629
##	M54	6.299e-04	0.0020775	0.3032	0.10000	0.00000	0.9636
##	A39	6.295e-04	0.0018148	0.3468	0.10000	0.02778	0.9644
##	A27	6.250e-04	0.0020559	0.3040	0.10000	0.00000	0.9652
##	A66	6.111e-04	0.0019498	0.3134	0.10000	0.00000	0.9660
##	A61	5.848e-04	0.0019283	0.3033	0.10000	0.00000	0.9667
##	A81	5.775e-04	0.0018627	0.3100	0.00000	0.11111	0.9674
##	A117	5.638e-04	0.0017029	0.3311	0.03333	0.08333	0.9681
##	A136	5.564e-04	0.0022254	0.2500	0.06667	0.00000	0.9688
##	A49	5.498e-04	0.0016363	0.3360	0.03333	0.08333	0.9695
##	A44	5.074e-04	0.0020553	0.2469	0.10000	0.00000	0.9701
##	A37	5.065e-04	0.0028852	0.1756	0.06667	0.00000	0.9707
##	A29	4.944e-04	0.0019732	0.2506	0.06667	0.00000	0.9713
##	A34	4.931e-04	0.0019845	0.2485	0.06667	0.00000	0.9719
##	A111	4.812e-04	0.0016805	0.2863	0.03333	0.05556	0.9725
##	A52	4.743e-04	0.0014812	0.3202	0.10000	0.00000	0.9731
##	A43	4.699e-04	0.0014640	0.3210	0.10000	0.00000	0.9737
##	A198	4.609e-04	0.0018706	0.2464	0.06667	0.00000	0.9743
##	A206	4.461e-04	0.0015135	0.2947	0.00000	0.08333	0.9748
##	A121	4.323e-04	0.0014510	0.2980	0.00000	0.11111	0.9754
##	A171	4.311e-04	0.0018288	0.2357	0.00000	0.05556	0.9759
##	M74	4.303e-04	0.0017508	0.2458	0.06667	0.00000	0.9764
##	A84	4.167e-04	0.0014994	0.2779	0.00000	0.08333	0.9769
##	A135	4.165e-04	0.0017358	0.2399	0.03333	0.02778	0.9775
##	A72	3.895e-04	0.0016786	0.2320	0.00000	0.05556	0.9779
##	A170	3.854e-04	0.0016170	0.2383	0.03333	0.02778	0.9784
##	A133	3.835e-04	0.0011278	0.3401	0.00000	0.11111	0.9789
##	A191	3.591e-04	0.0015734	0.2282	0.00000	0.05556	0.9793
##	A45	3.506e-04	0.0019492	0.1799	0.06667	0.00000	0.9798
##	A77	3.469e-04	0.0014642	0.2369	0.00000	0.05556	0.9802
##	A218	3.312e-04	0.0013911	0.2381	0.00000	0.05556	0.9806
##	A74	3.280e-04	0.0013935	0.2354	0.00000	0.05556	0.9810
##	A222	3.258e-04	0.0013926	0.2340	0.00000	0.05556	0.9814
##	A237	3.236e-04	0.0013489	0.2399	0.00000	0.08333	0.9818
##	A54	2.972e-04	0.0011504	0.2583	0.06667	0.00000	0.9822
##	A213	2.849e-04	0.0016405	0.1737	0.03333	0.00000	0.9825
##	A4	2.795e-04	0.0016063	0.1740	0.03333	0.00000	0.9829
##	A12	2.795e-04	0.0016063	0.1740	0.03333	0.00000	0.9832
##	A16	2.795e-04	0.0016063	0.1740	0.03333	0.00000	0.9836
##	A147	2.795e-04	0.0016063	0.1740	0.03333	0.00000	0.9839
##	A211	2.743e-04	0.0015736	0.1743	0.03333	0.00000	0.9843
##	A214	2.743e-04	0.0015736	0.1743	0.03333	0.00000	0.9846
##	M109	2.669e-04	0.0015271	0.1748	0.03333	0.00000	0.9849
##	A142	2.659e-04	0.0016364	0.1625	0.00000	0.02778	0.9853
##	A240	2.659e-04	0.0016364	0.1625	0.00000	0.02778	0.9856
##	A205	2.554e-04	0.0015675	0.1629	0.00000	0.02778	0.9859
##	A131	2.354e-04	0.0013332	0.1766	0.03333	0.00000	0.9862
##	M100	2.318e-04	0.0013113	0.1768	0.03333	0.00000	0.9865
##	A53	2.318e-04	0.0013113	0.1768	0.03333	0.00000	0.9868
##	A166	2.318e-04	0.0013113	0.1768	0.03333	0.00000	0.9871
##	A225	2.305e-04	0.0014064	0.1639	0.00000	0.02778	0.9873
##	A234	2.305e-04	0.0014064	0.1639	0.00000	0.02778	0.9876
##	A169	2.265e-04	0.0013808	0.1641	0.00000	0.02778	0.9879

##	A10	2.233e-04	0.0012598	0.1773	0.03333	0.00000	0.9882
##	A24	2.233e-04	0.0012598	0.1773	0.03333	0.00000	0.9885
##	A144	2.227e-04	0.0013562	0.1642	0.00000	0.02778	0.9887
##	A230	2.208e-04	0.0013442	0.1643	0.00000	0.02778	0.9890
##	A143	2.190e-04	0.0013325	0.1643	0.00000	0.02778	0.9893
##	A152	2.190e-04	0.0013325	0.1643	0.00000	0.02778	0.9896
##	A161	2.190e-04	0.0013325	0.1643	0.00000	0.02778	0.9898
##	A115	2.162e-04	0.0009270	0.2332	0.00000	0.05556	0.9901
##	A97	2.082e-04	0.0011686	0.1781	0.03333	0.00000	0.9904
##	A132	2.082e-04	0.0011686	0.1781	0.03333	0.00000	0.9906
##	A177	2.082e-04	0.0011686	0.1781	0.03333	0.00000	0.9909
##	A50	2.027e-04	0.0011360	0.1784	0.03333	0.00000	0.9911
##	A137	2.027e-04	0.0011360	0.1784	0.03333	0.00000	0.9914
##	A210	2.027e-04	0.0011360	0.1784	0.03333	0.00000	0.9916
##	A212	2.027e-04	0.0011360	0.1784	0.03333	0.00000	0.9919
##	A47	1.948e-04	0.0011792	0.1652	0.00000	0.02778	0.9921
##	A172	1.920e-04	0.0011615	0.1653	0.00000	0.02778	0.9924
##	A190	1.902e-04	0.0007974	0.2386	0.00000	0.05556	0.9926
##	A124	1.879e-04	0.0011360	0.1654	0.00000	0.02778	0.9928
##	A122	1.868e-04	0.0010421	0.1793	0.03333	0.00000	0.9931
##	A165	1.868e-04	0.0010421	0.1793	0.03333	0.00000	0.9933
##	A202	1.868e-04	0.0010421	0.1793	0.03333	0.00000	0.9935
##	A69	1.814e-04	0.0010102	0.1795	0.03333	0.00000	0.9937
##	A70	1.814e-04	0.0010102	0.1795	0.03333	0.00000	0.9940
##	A75	1.814e-04	0.0010102	0.1795	0.03333	0.00000	0.9942
##	A158	1.783e-04	0.0009921	0.1797	0.03333	0.00000	0.9944
##	A46	1.753e-04	0.0009746	0.1799	0.03333	0.00000	0.9946
##	A155	1.753e-04	0.0009746	0.1799	0.03333	0.00000	0.9948
##	A241	1.753e-04	0.0009746	0.1799	0.03333	0.00000	0.9951
##	A220	1.722e-04	0.0010377	0.1659	0.00000	0.02778	0.9953
##	A223	1.722e-04	0.0010377	0.1659	0.00000	0.02778	0.9955
##	A68	1.711e-04	0.0010309	0.1660	0.00000	0.02778	0.9957
##	A247	1.711e-04	0.0010309	0.1660	0.00000	0.02778	0.9959
##	A48	1.660e-04	0.0009207	0.1803	0.03333	0.00000	0.9961
##	A65	1.660e-04	0.0009207	0.1803	0.03333	0.00000	0.9963
##	A120	1.590e-04	0.0009556	0.1664	0.00000	0.02778	0.9965
##	A228	1.590e-04	0.0009556	0.1664	0.00000	0.02778	0.9967
##	A243	1.590e-04	0.0009556	0.1664	0.00000	0.02778	0.9969
##	A140	1.570e-04	0.0008683	0.1808	0.03333	0.00000	0.9971
##	A199	1.570e-04	0.0008683	0.1808	0.03333	0.00000	0.9973
##	A246	1.570e-04	0.0008683	0.1808	0.03333	0.00000	0.9975
##	A219	1.453e-04	0.0008713	0.1667	0.00000	0.02778	0.9977
##	A160	1.441e-04	0.0007947	0.1814	0.03333	0.00000	0.9979
##	A245	1.400e-04	0.0008391	0.1669	0.00000	0.02778	0.9980
##	A127	1.338e-04	0.0008011	0.1671	0.00000	0.02778	0.9982
##	A128	1.338e-04	0.0008011	0.1671	0.00000	0.02778	0.9984
##	A238	1.338e-04	0.0008011	0.1671	0.00000	0.02778	0.9985
##	A148	1.325e-04	0.0007931	0.1671	0.00000	0.02778	0.9987
##	A151	1.312e-04	0.0007853	0.1671	0.00000	0.02778	0.9989
##	A248	1.312e-04	0.0007853	0.1671	0.00000	0.02778	0.9990
##	A42	1.311e-04	0.0007206	0.1820	0.03333	0.00000	0.9992
##	A101	1.311e-04	0.0007206	0.1820	0.03333	0.00000	0.9993
##	A182	1.311e-04	0.0007206	0.1820	0.03333	0.00000	0.9995
##	A112	9.076e-05	0.0005401	0.1680	0.00000	0.02778	0.9996

```
## A242 8.234e-05 0.0004896 0.1682 0.00000 0.02778 0.9997
## A126 7.661e-05 0.0004553 0.1683 0.00000 0.02778 0.9998
## A129 7.661e-05 0.0004553 0.1683 0.00000 0.02778 0.9999
## A215 7.661e-05 0.0004553 0.1683 0.00000 0.02778 1.0000
## Permutation: free
## Number of permutations: 0
```

Paso 7. Vamos a determinar las especies que son indecadoras de cada periodo.

max.order = 1 (which is equal to duleg=TRUE) -> singletons #Unicas en un sitio max.order = 2 -> singletons and pairs # Unicas y comparitdas max.order = 3 -> singletons, pairs and triplets

```
##### Indicator Value #####
```

```
ind_species<-multipatt(moth_sp, Moth_full$Period, max.order=1,
                      func="IndVal",control=how(nperm=999))
summary(ind_species)
```

```
##
## Multilevel pattern analysis
## -----
##
## Association function: IndVal
## Significance level (alpha): 0.05
##
## Total number of species: 233
## Selected number of species: 62
## Number of species associated to 1 group: 62
##
## List of species associated to each combination:
##
## Group Post-Hurricane #sps. 26
##      stat p.value
## A141 0.942 0.001 ***
## M7   0.834 0.037 *
## M94  0.814 0.001 ***
## A188 0.793 0.001 ***
## A22  0.761 0.001 ***
## A21  0.747 0.003 **
## A60  0.709 0.002 **
## A203 0.707 0.001 ***
## A73  0.696 0.001 ***
## A139 0.694 0.001 ***
## A17  0.685 0.001 ***
## A40  0.683 0.001 ***
## A163 0.645 0.006 **
## A192 0.601 0.002 **
## A123 0.579 0.013 *
## A200 0.573 0.029 *
## A125 0.566 0.048 *
## A150 0.553 0.004 **
## A239 0.537 0.006 **
## A3   0.526 0.032 *
```

```

## M8 0.497 0.045 *
## A186 0.457 0.030 *
## A5 0.451 0.029 *
## A80 0.431 0.037 *
## A216 0.426 0.042 *
## A59 0.373 0.050 *
##
## Group Pre-Hurricane #sps. 36
##      stat p.value
## A157 0.903 0.001 ***
## A25 0.742 0.001 ***
## M55 0.729 0.001 ***
## M13 0.707 0.001 ***
## M1 0.697 0.001 ***
## A58 0.675 0.001 ***
## A99 0.658 0.001 ***
## M10 0.635 0.001 ***
## M104 0.634 0.016 *
## M53 0.630 0.002 **
## M50 0.619 0.005 **
## A86 0.593 0.021 *
## M19 0.548 0.001 ***
## A79 0.547 0.016 *
## M29 0.516 0.002 **
## A134 0.516 0.002 **
## A36 0.512 0.023 *
## M80 0.483 0.003 **
## A33 0.483 0.007 **
## A168 0.483 0.004 **
## A7 0.447 0.012 *
## A67 0.447 0.002 **
## A154 0.447 0.010 **
## M85 0.418 0.032 *
## M15 0.408 0.014 *
## M17 0.408 0.022 *
## M106 0.408 0.015 *
## A178 0.408 0.022 *
## A209 0.408 0.019 *
## M5 0.365 0.046 *
## M81 0.365 0.029 *
## M89 0.365 0.029 *
## A28 0.365 0.046 *
## A31 0.365 0.043 *
## A76 0.365 0.044 *
## A201 0.365 0.037 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```