

# Structure of tenebrionid assemblages on islands of the Aegean archipelago

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## Aims

Investigate changes in the structure of tenebrionid assemblages among different habitat types on 12 islands of the central Aegean Archipelago

Determine the main ecological and geographical factors that explain them

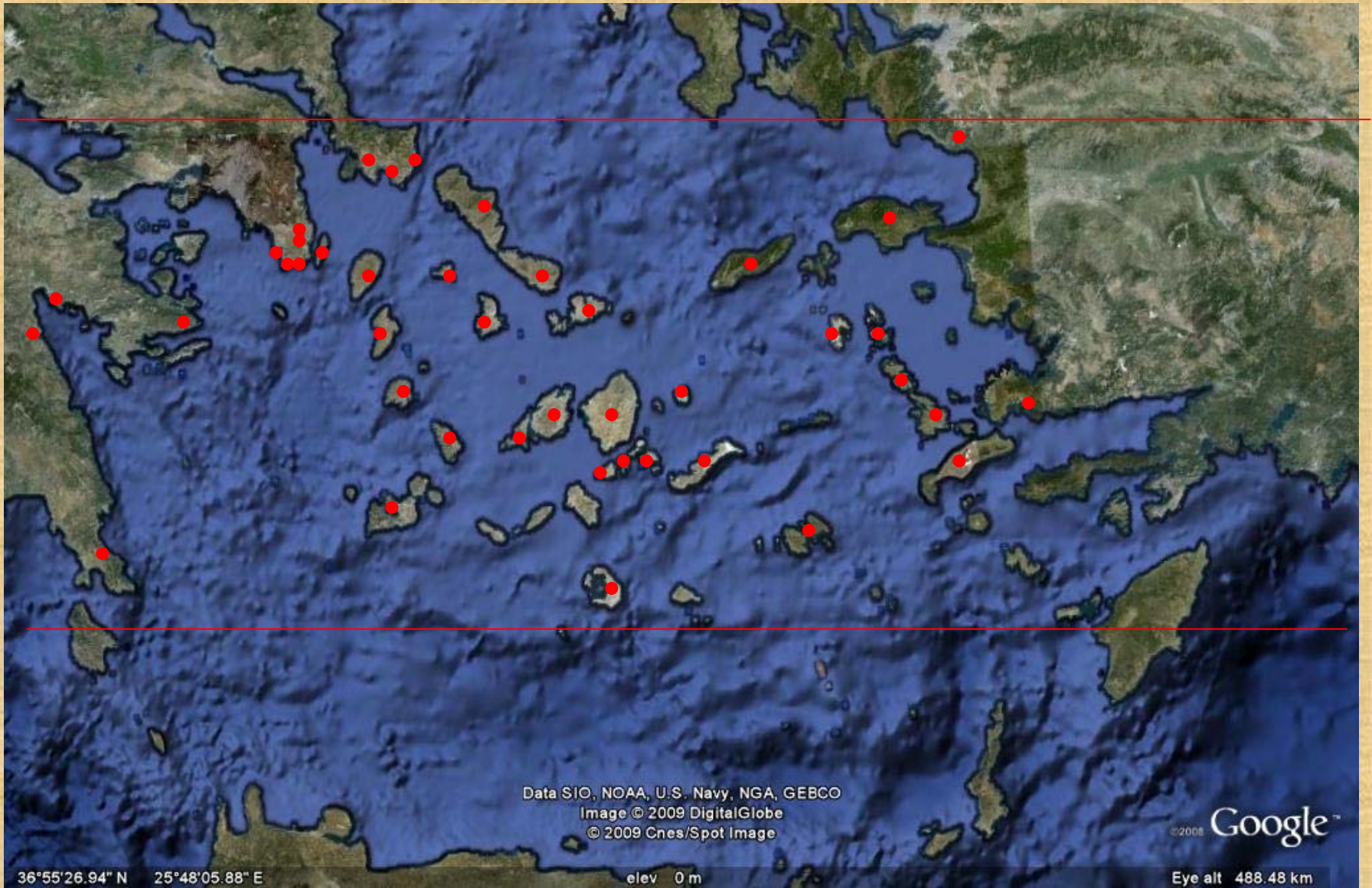
This study is part of a wider study on the biogeography of the *Aegean Sea* islands

### Study sites

28 islands

14 mainland locations in *Greece* and *Asia Minor*





## Methods

Tenebrionids were collected using in general 24 pitfall traps (diameter 7cm and depth 10cm) per site.

The 24 traps were placed 10m apart in three line transects of 8 traps each. The 3 transects were placed >50m apart.

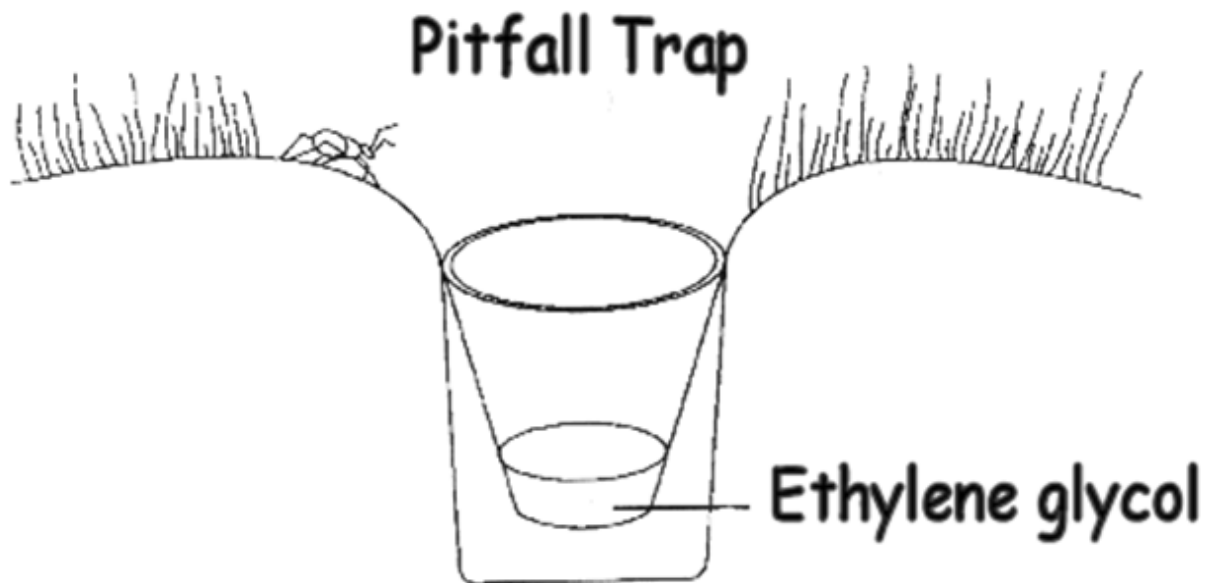
The traps were partly filled with ethylene glycol and were covered with 17cm diameter plastic roofs to protect them from litter and rain.



# Methods

In each island:

- Several different habitat types
- Pitfall traps
- Tenebrionidae



# Study area

12 islands of the central Aegean Sea



# Habitat types

## *Dominant*

Phrygana	phr
<i>Juniperus phoenicea</i>	jnp
<i>Juniperus oxycedrus</i> on sand	jnt
Sand dune	thn
Sand dune with phrygana	pht
Meadows	med



*Less common*

Salt pans

ali

Streams

riv

Mixed maquis

mak

Maquis with phrygana

phm

*Quercus ithaburensis* stands

que

Sandy meadow

met

*Juniperus oxycedrus* on soil

jno

*Cupressus* sp.

cpf

*Pinus brutia*

pnf



A total of 170 transects of 8 traps each were placed in the study areas

The number of stations in each island ranged from 8 to 21

Of the seven continuous months (April-October 2006), only the results of June are presented here



## Results

A total of 68.108 individuals belonging to 54 species were collected in all islands and habitats

The most common species were:

<i>Eutagenia smyrnensis</i>	38.6%
<i>Eutagenia minutissima</i>	24.8%
<i>Zophosis punctata</i>	10.0%
<i>Dailognatha</i> spp.	8.7%



DNA analysis of *Dailognatha* spp. has shown the presence of 4 species which have not yet been distinguished morphologically

Some species were identified only to genus level, while 3 species were not identified even at genus level



<b>Species</b>	<b>Code</b>	<b>Percentage</b>
<i>Akis elongata</i>	Akel	0.001
<i>Alphitobius diaperinus</i>	Aldi	0.002
<i>Ammobius rufus</i>	Amru	0.206
<i>Asida sp.</i>	Assp	0.021
<i>Cataphronetis reitteri</i>	Ctre	0.001
<i>Catomus consentaneus</i>	Cmco	0.001
<i>Cephalostenus orbicollis</i>	Ceor	0.454
<i>Cheirodes sardoa</i>	Chsa	0.003
<i>Cnemeplatia atropos</i>	Cnat	0.002
<i>Crypticus cf castaneus</i>	Crca	0.063
<i>Colpotus sulcatus</i>	Cosu	0.157
<i>Dailognatha spp</i>	Dasp	8.652
<i>Dendarus anguilitibia</i>	Dean	0.063
<i>Dendarus dentitibia</i>	Dede	0.107
<i>Dendarus messenius</i>	Deme	0.014



<i>Dendarus moesiacus</i>	Demo	0.003
<i>Dendarus rhodius</i>	Derh	0.008
<i>Dendarus schatzmayri</i>	Desc	0.024
<i>Dendarus sinuatus</i>	Desi	0.055
<i>Dendarus stygius</i>	Dest	0.006
<i>Dendarus weneri</i>	Dewe	0.026
<i>Dichillus pertusus</i>	Dipe	0.013
<i>Dichillus sp.</i>	Disp	0.005
<i>Dichomma dardanum</i>	Dmda	2.867
<i>Erodium orientale</i>	Erer	0.624
<i>Eutagenia minutissima</i>	Eumi	24.770
<i>Eutagenia smyrnensis</i>	Eusm	38.599
<i>Gonocephalum costatum</i>	Goco	0.003
<i>Gonocephalum rusticum</i>	Goru	0.065
<i>Graecopachys quadricollis</i>	Grqu	1.797
<i>Idastrandiella mucoreus</i>	Idmu	3.992

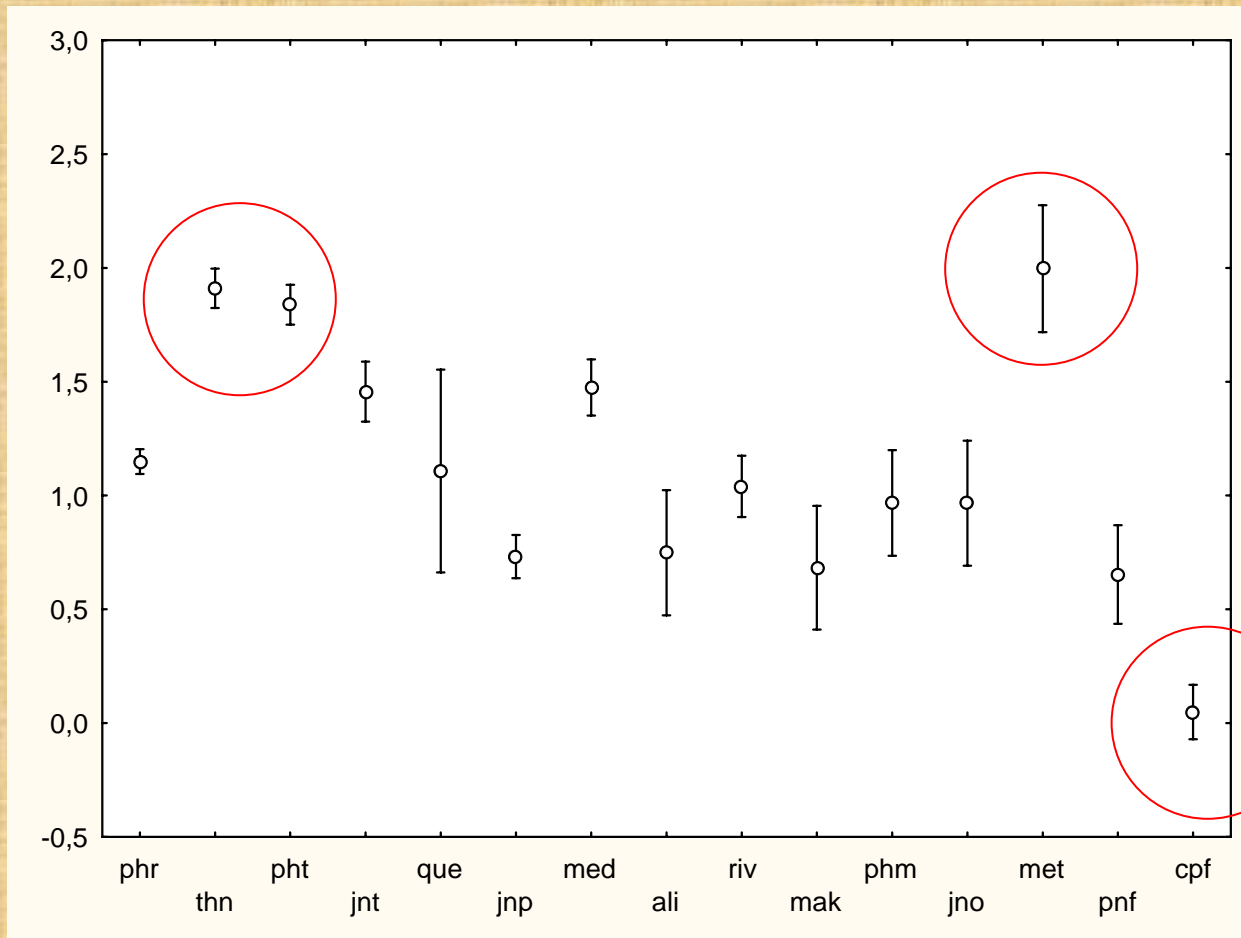
<i>Laena apfelbecki</i>	Laap	0.004
<i>Micrositus orbicularis</i>	Msor	0.119
<i>Microtelus asiaticus</i>	Mtas	0.009
<i>Opatroides punctulatus</i>	Otpu	0.224
<i>Opatrum obesum</i>	Omob	0.080
<i>Pachyscelis villosa</i>	Pavi	0.253
<i>Pedinus quadratus</i>	Pequ	0.545
<i>Pimelia subglobosa</i>	Pisu	0.055
<i>Probaticus tenebricosus</i>	Prsp	0.082
<i>Raiboscelis azureus</i>	Raaz	0.433
<i>Raiboscelis coelestinus</i>	Raco	0.059
<i>Scleron multistriatum</i>	Scmu	0.050
<i>Stenosis milosana</i>	Stmi	0.002
<i>Stenosis naxiana</i>	Stna	0.249
<i>Stenosis rhodica</i>	Strh	0.006
<i>Stenosis syrensis</i>	Stsy	0.108
<i>Stenosis sp.</i>	Stsp	0.925

<i>Tentyria rotundata</i>	Tero	4.184
<i>Trachyscelis aphodioides</i>	Trap	0.009
<i>Zophosis punctata</i>	Zopu	9.994
Ten 1	Ten1	0.005
Ten 2	Ten2	0.001
Ten 3	Ten3	0.001

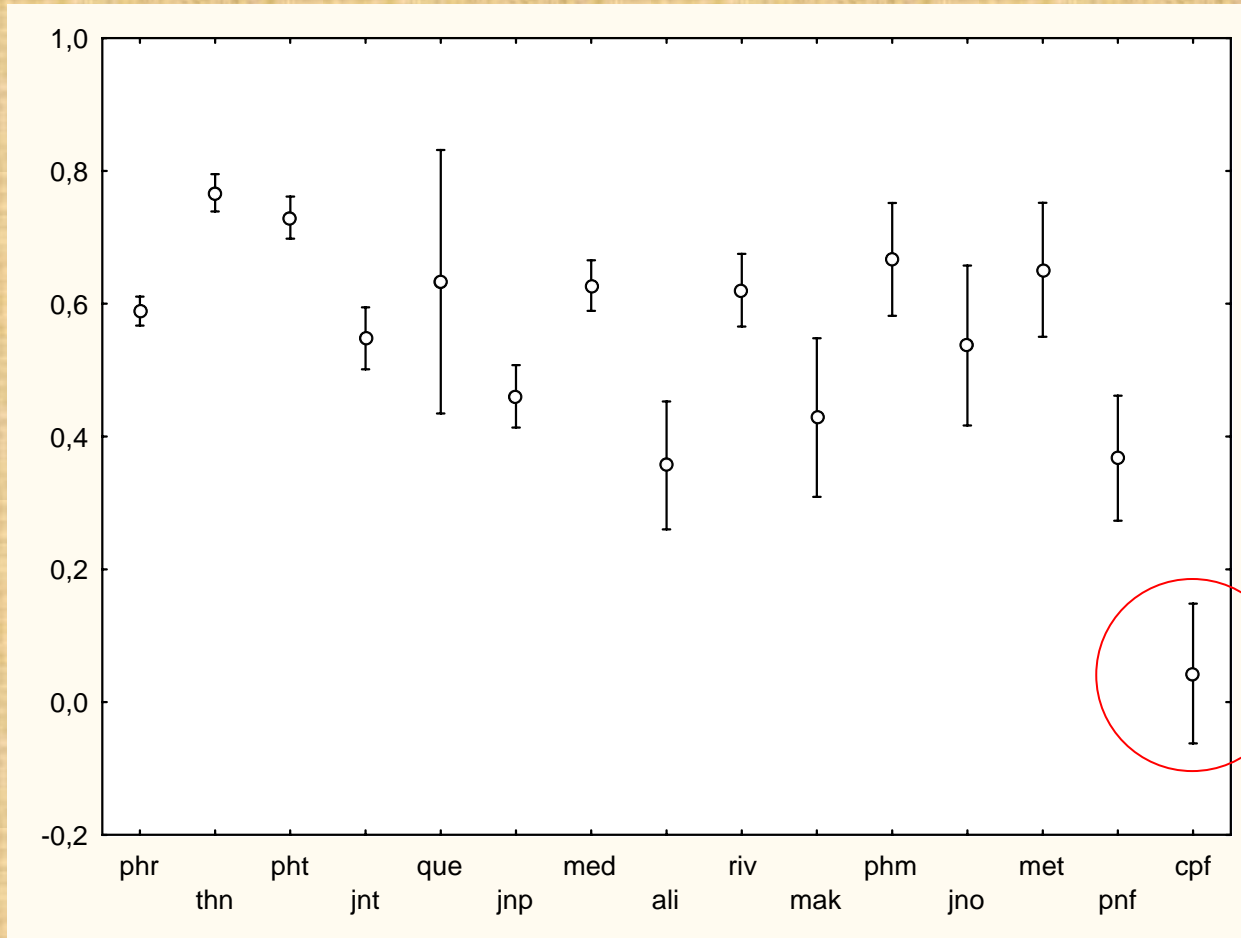


## Numbers of individuals and numbers of species in each island

Islands	no of indiv	no of spec
Naxos	5,769	30
Paros	2,544	22
Antiparos	1,516	15
Andros	11,090	28
Tinos	15,230	29
Mykonos	6,790	22
Milos	3,312	21
Serifos	11,116	20
Sifnos	5,198	17
Kos	3,946	16
Patmos	1,250	12
Kalymnos	347	12
<b>TOTAL</b>	<b>68,108</b>	<b>54</b>

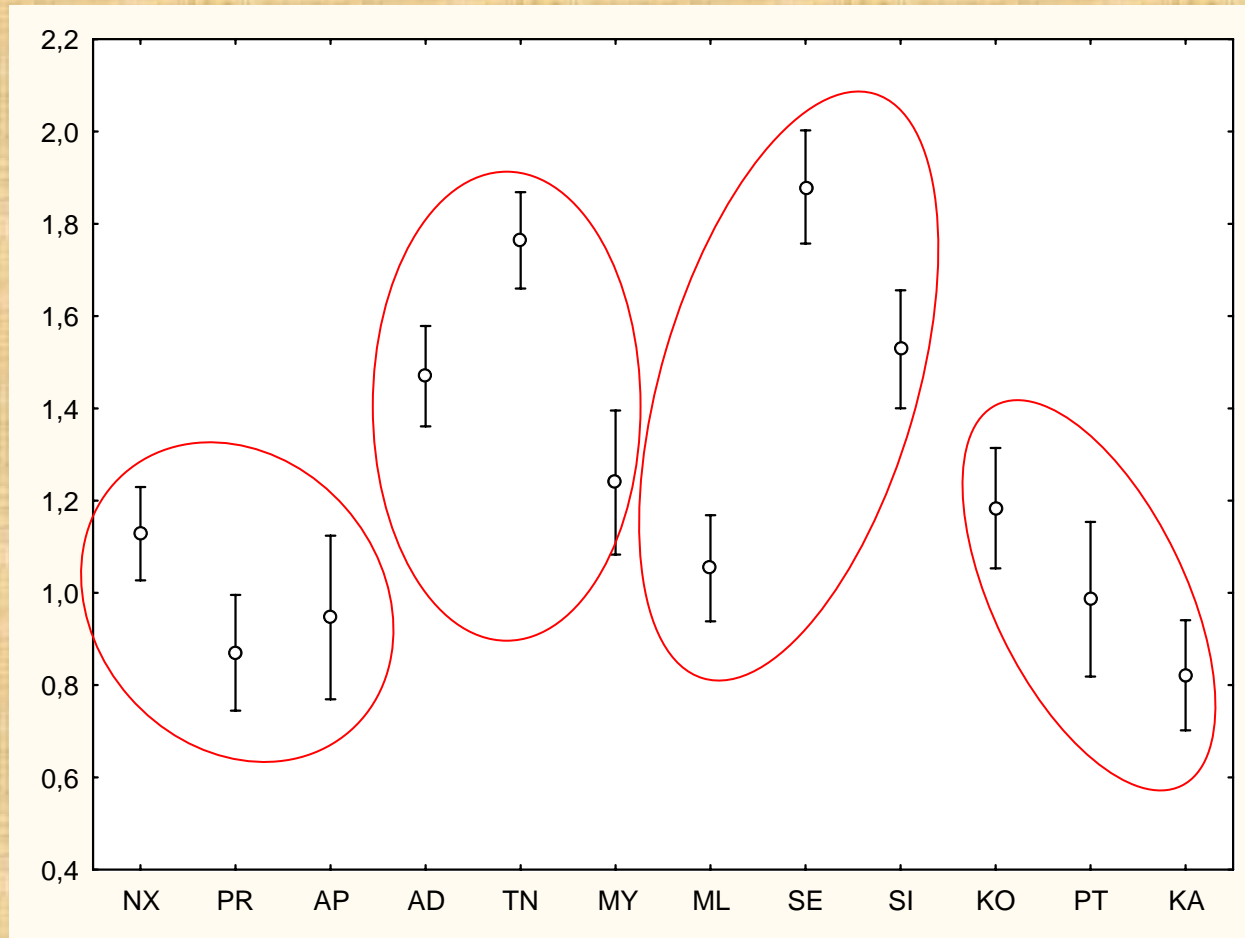


Log number of ind./trap in the various habitats

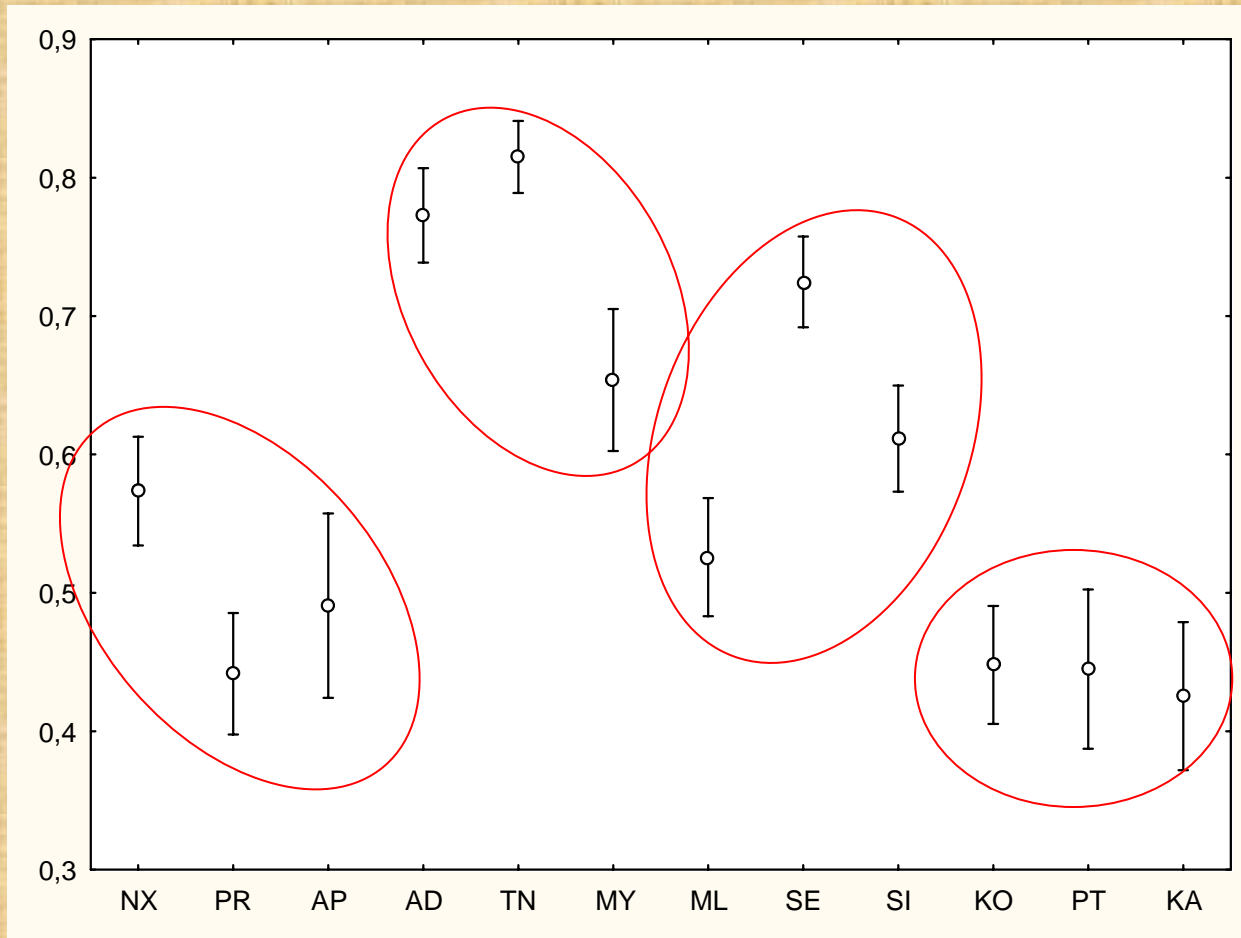


Log number of species/trap in the various habitats

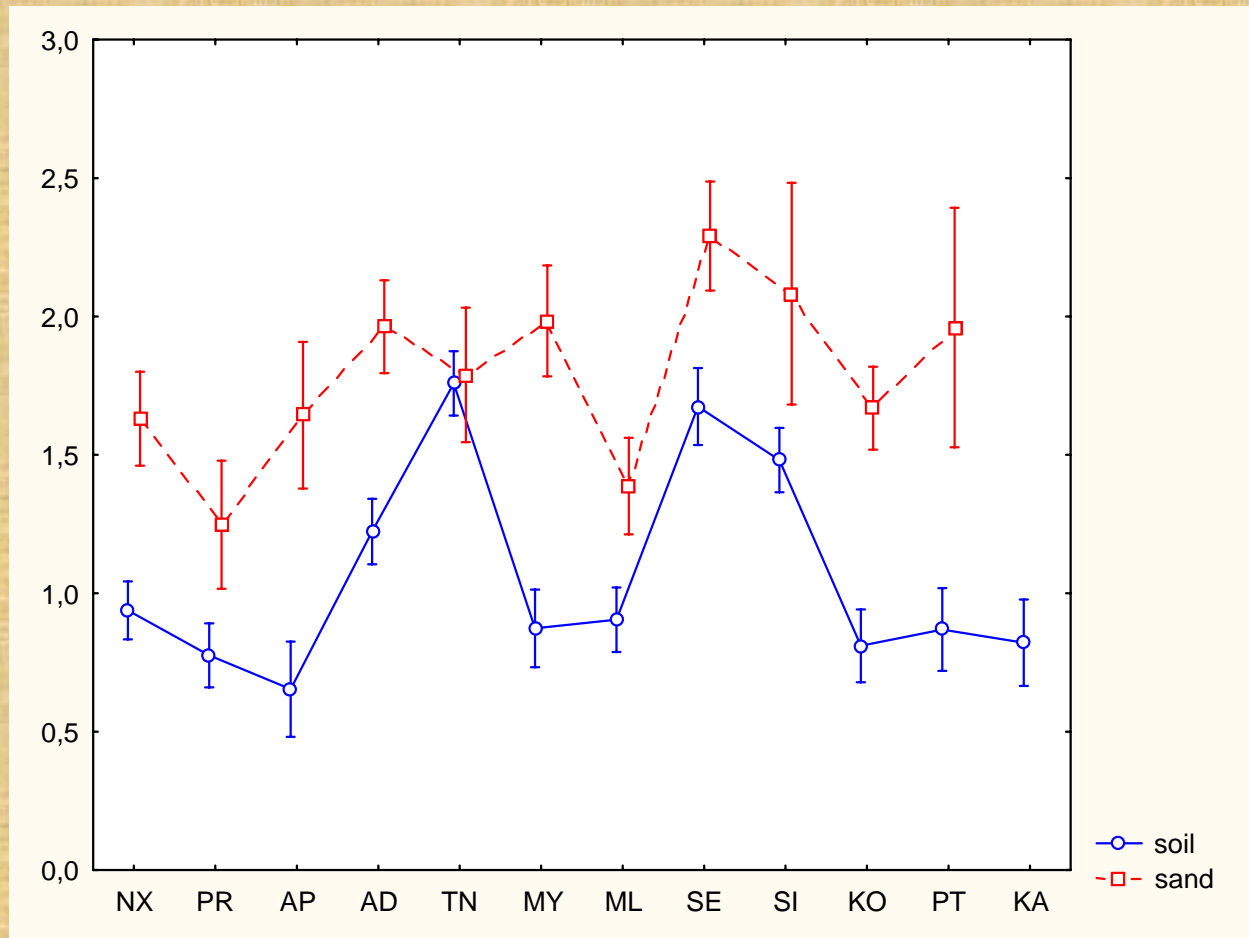




Log number of ind./trap in the various islands

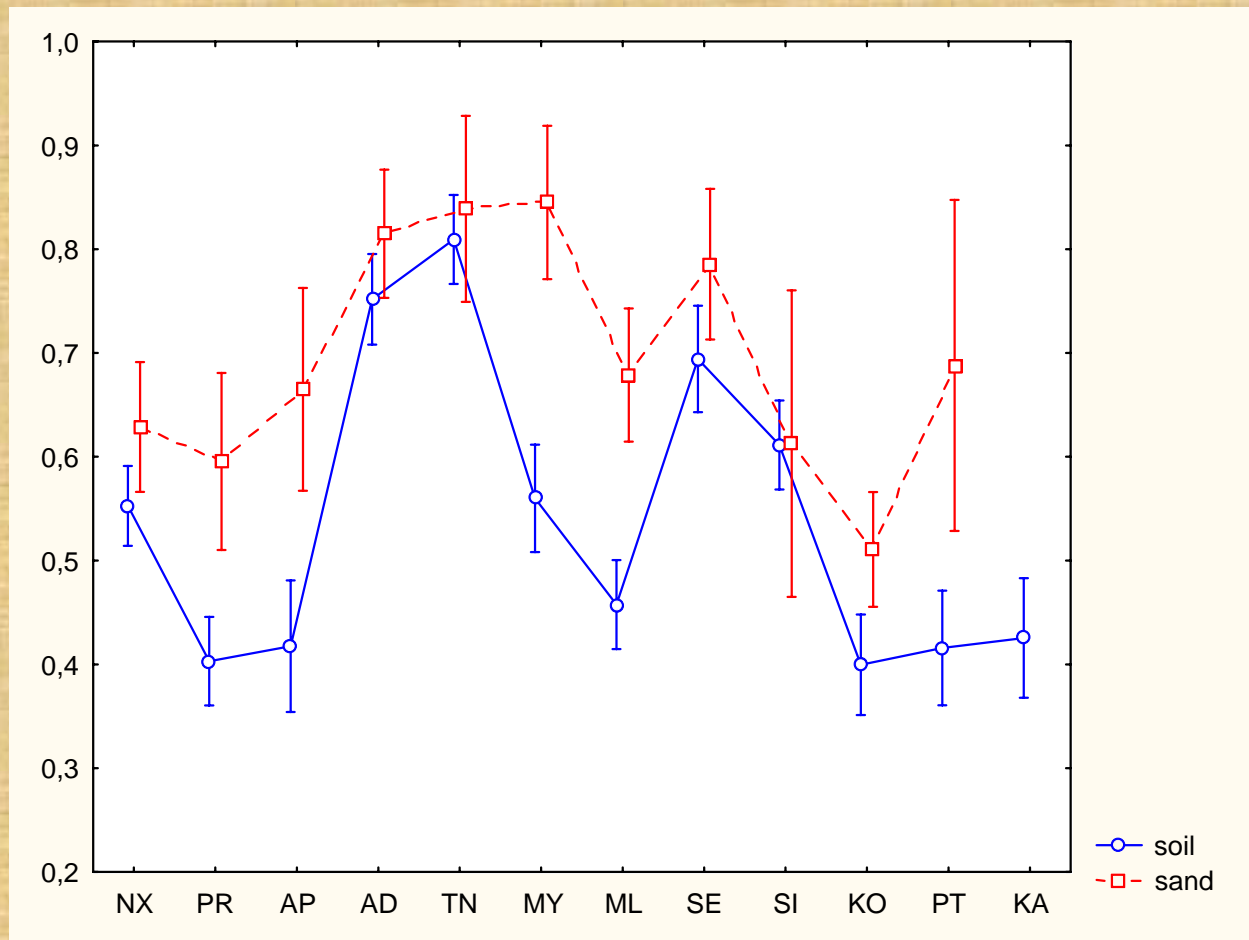


Log number of species/trap in the various islands

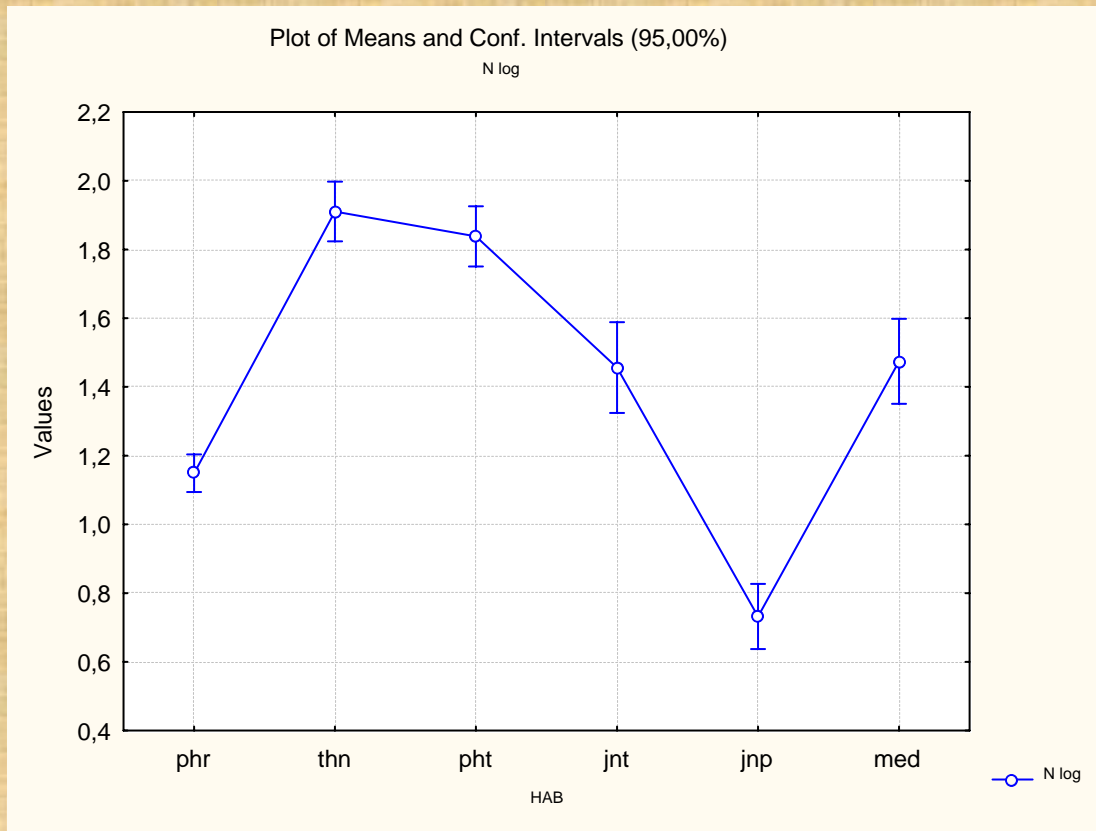


Log number of ind./trap in soil and sandy habitats

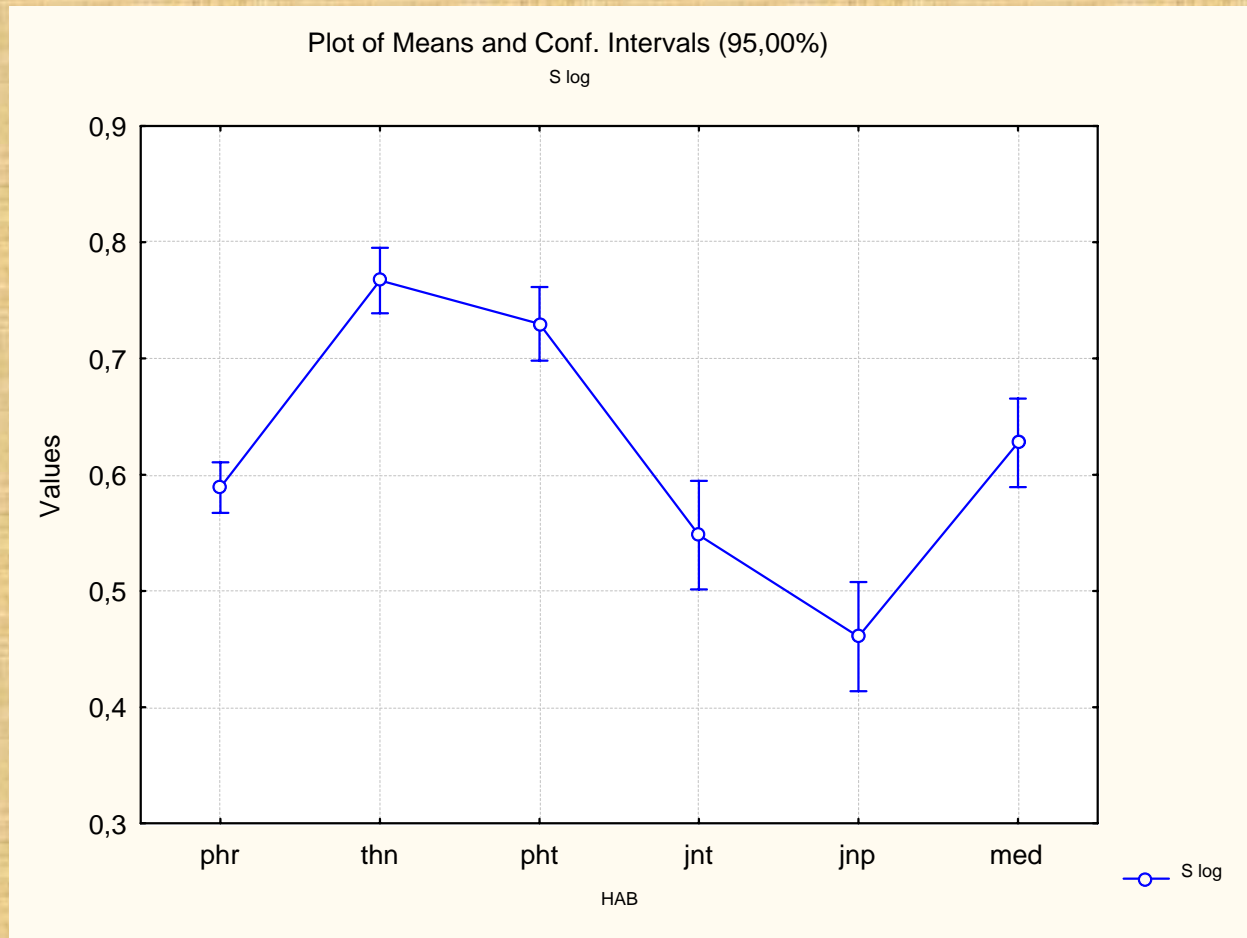




Log number of species/trap in soil and sandy habitats



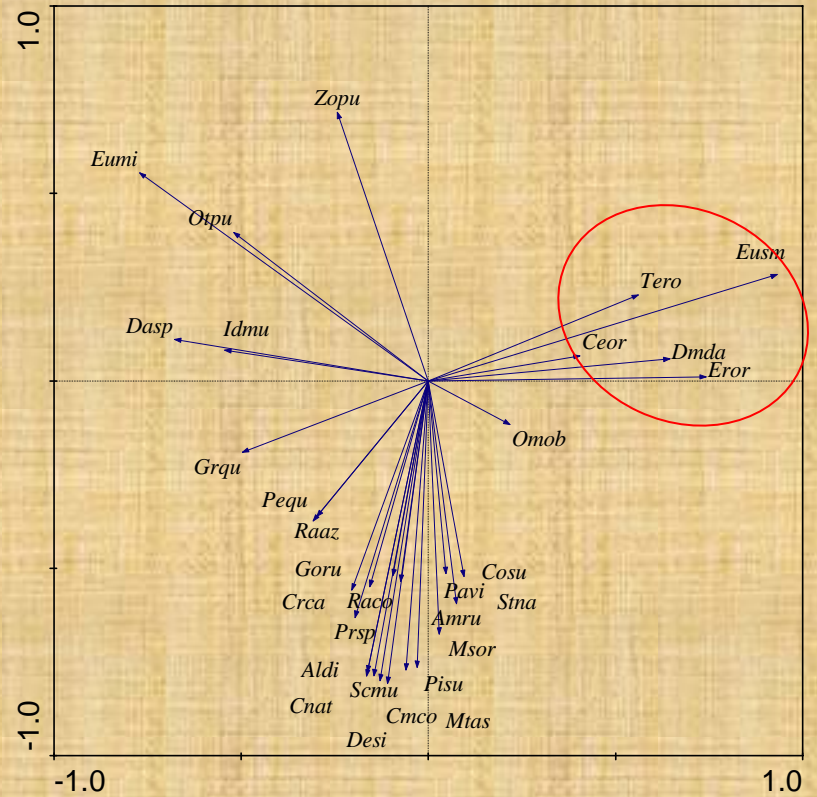
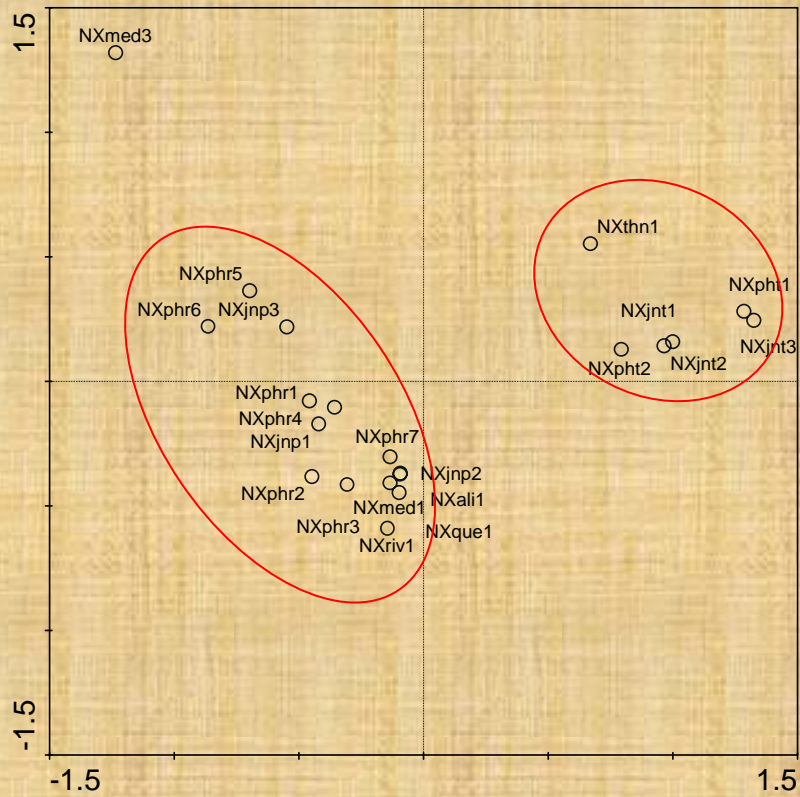
Log number of ind./trap in the dominant habitats



Log number of species/trap in the dominant habitats



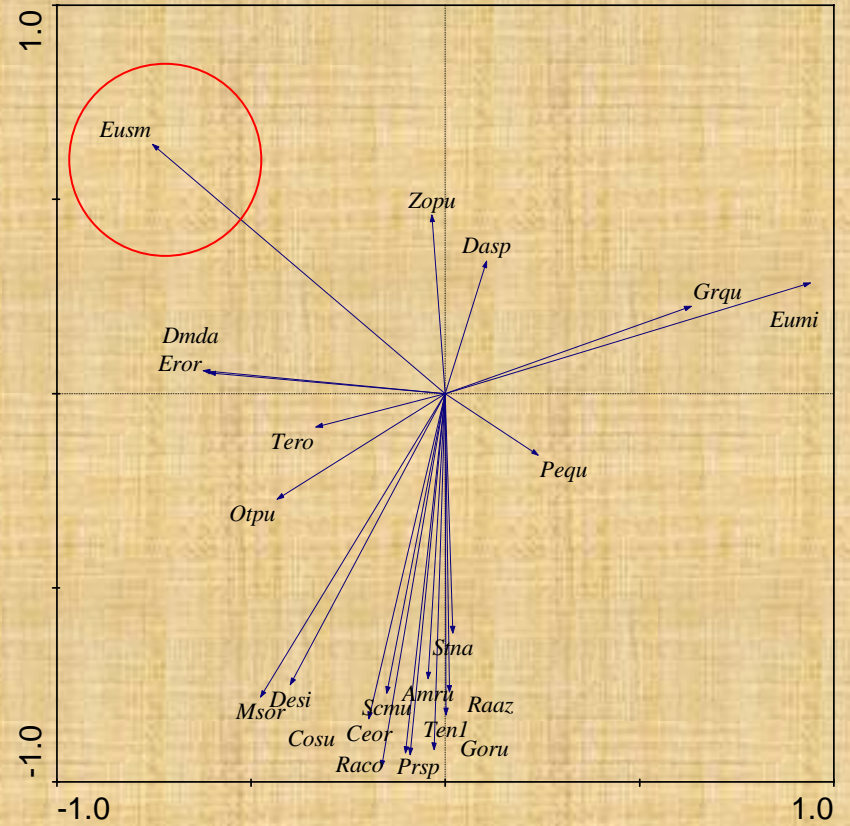
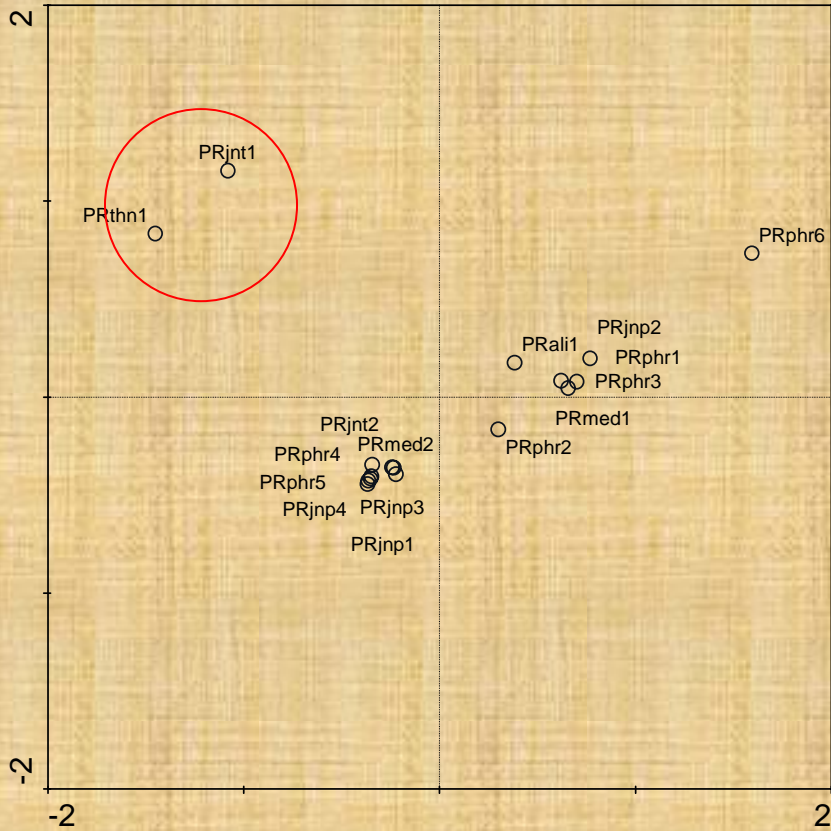
# Naxos



Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
49.4	68.1	80.1	84.8

# Paros



Axes

Cumulative percentage variance  
of species data :

1

2

3

4

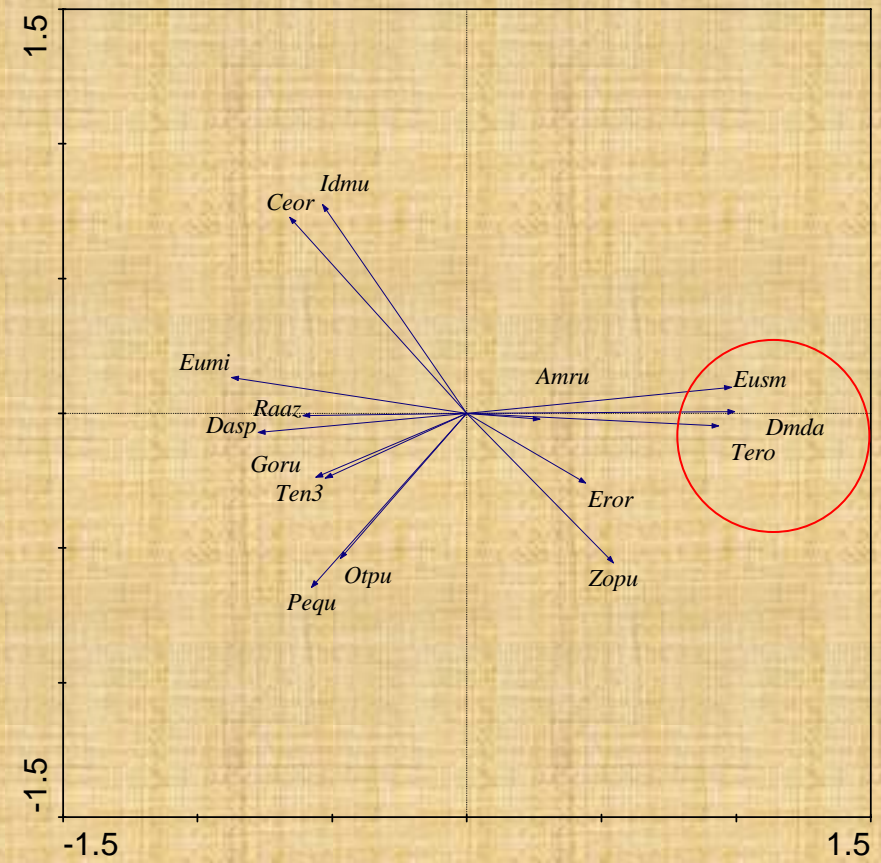
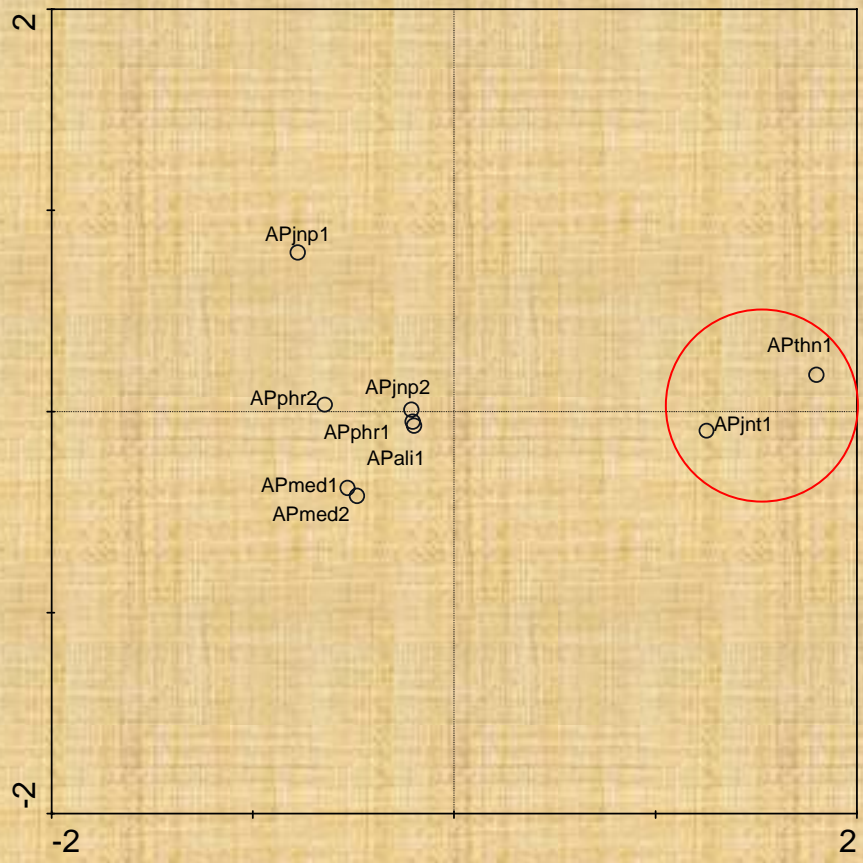
52.7

73.6

86.4

95.5

# Antiparos

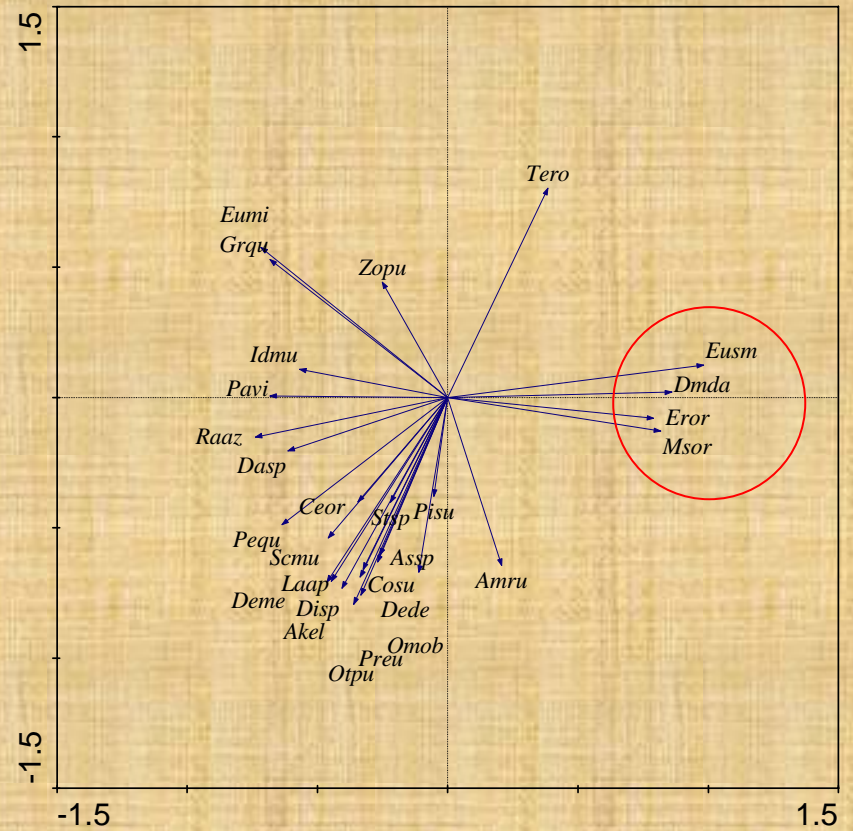
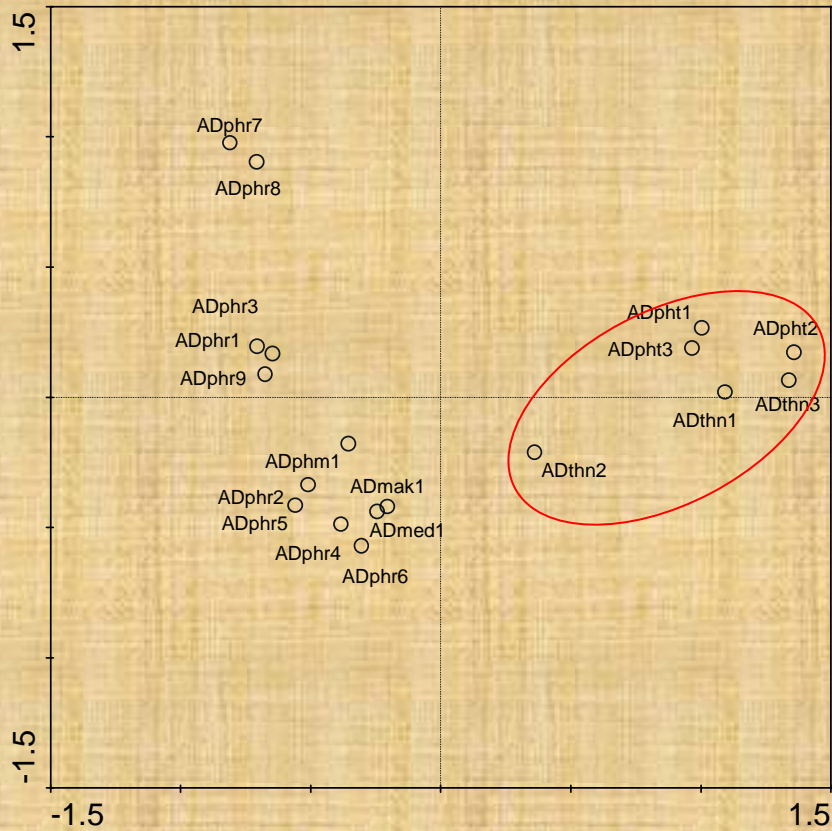


Axes  
Cumulative percentage variance  
of species data :

1	2	3	4
71.8	82.9	88.6	93.6



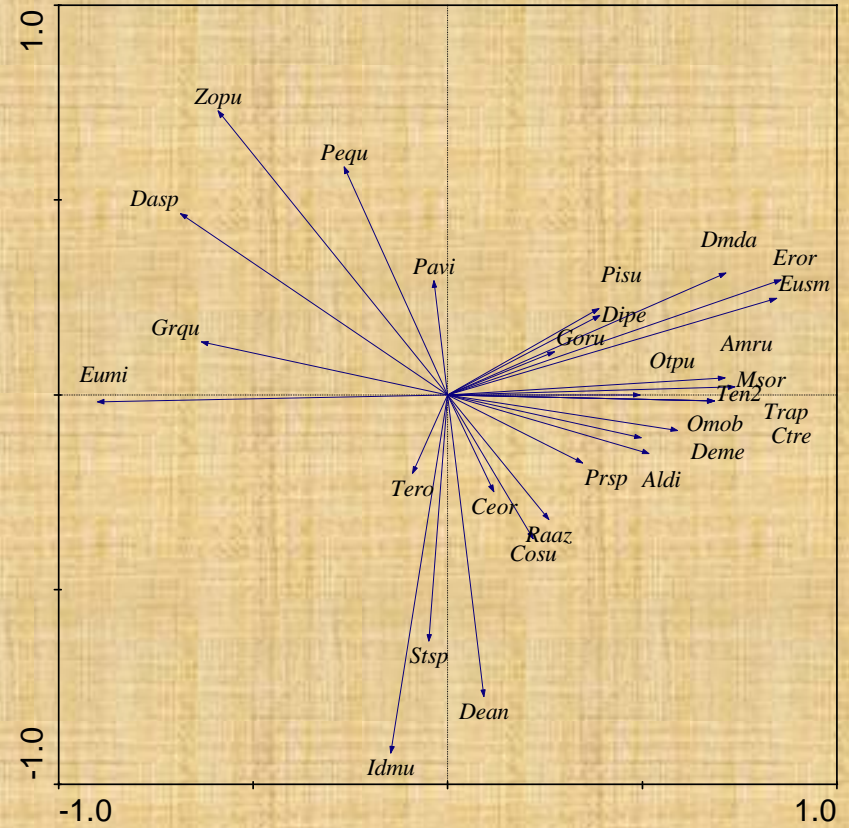
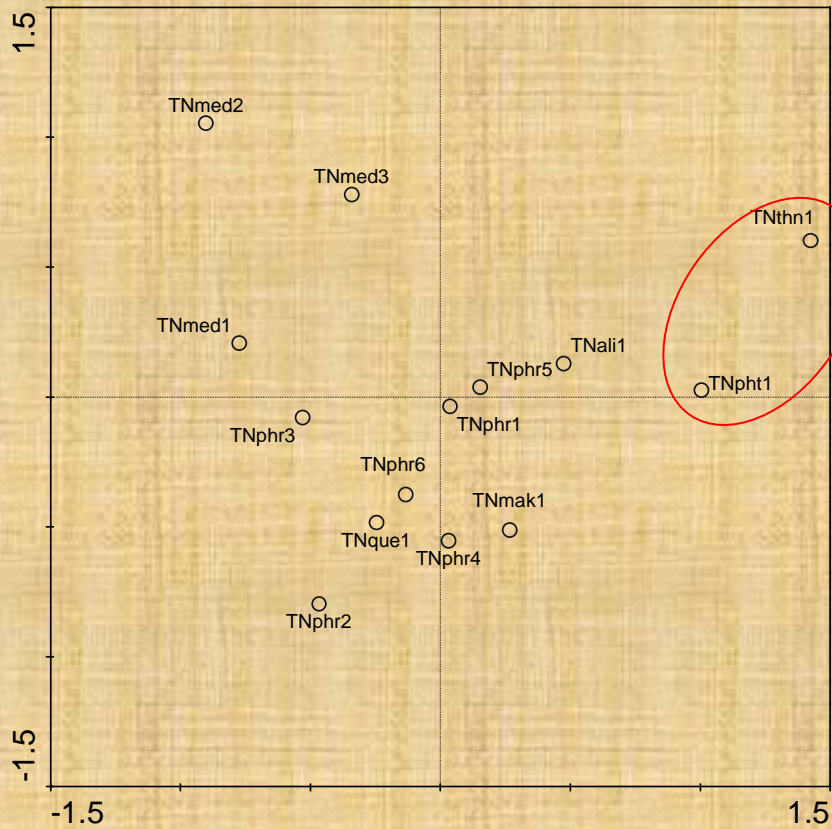
# Andros



Axes  
 Cumulative percentage variance  
 of species data :

Axes	1	2	3	4
Cumulative percentage variance of species data	58.2	76.4	84.2	89.2

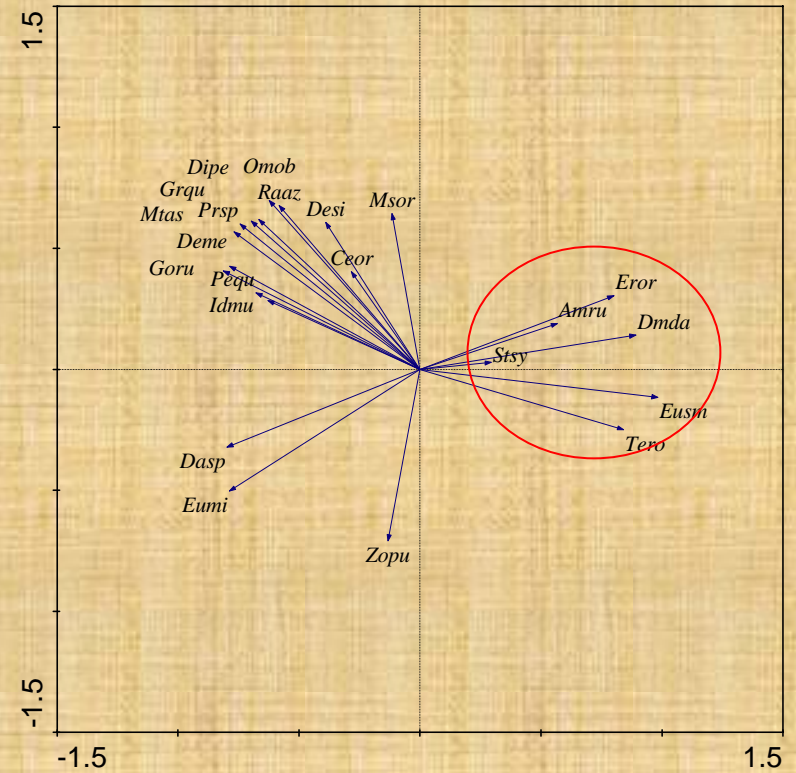
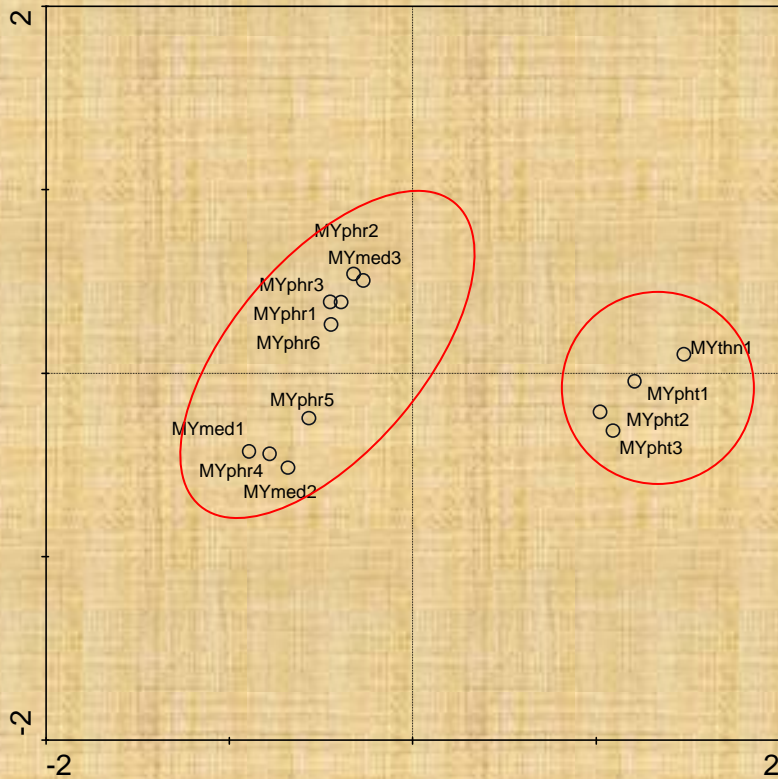
# Tinos



Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
39.0	65.7	81.7	88.2

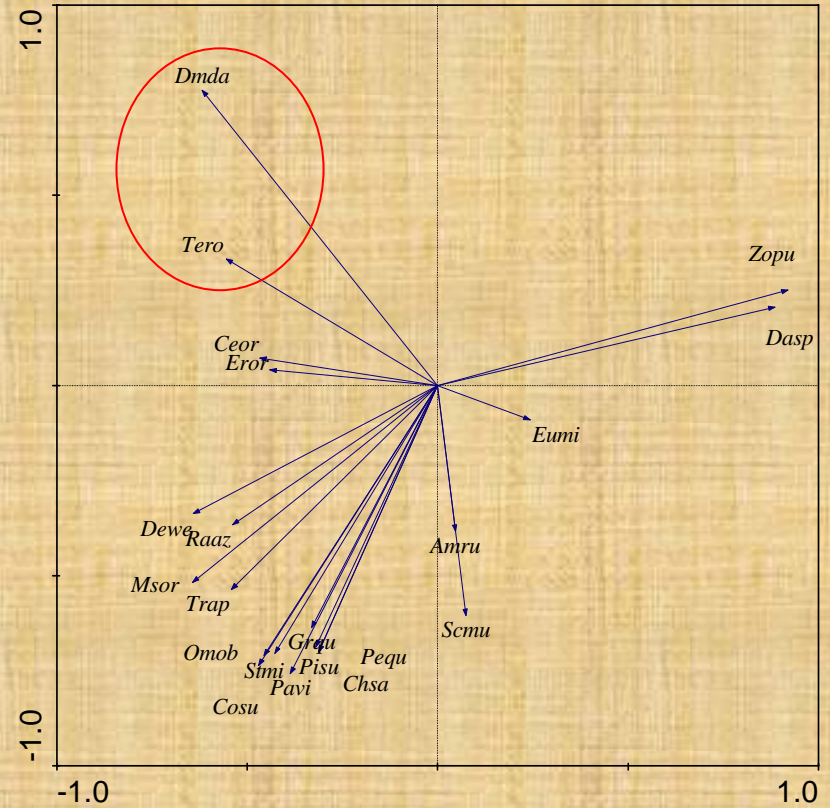
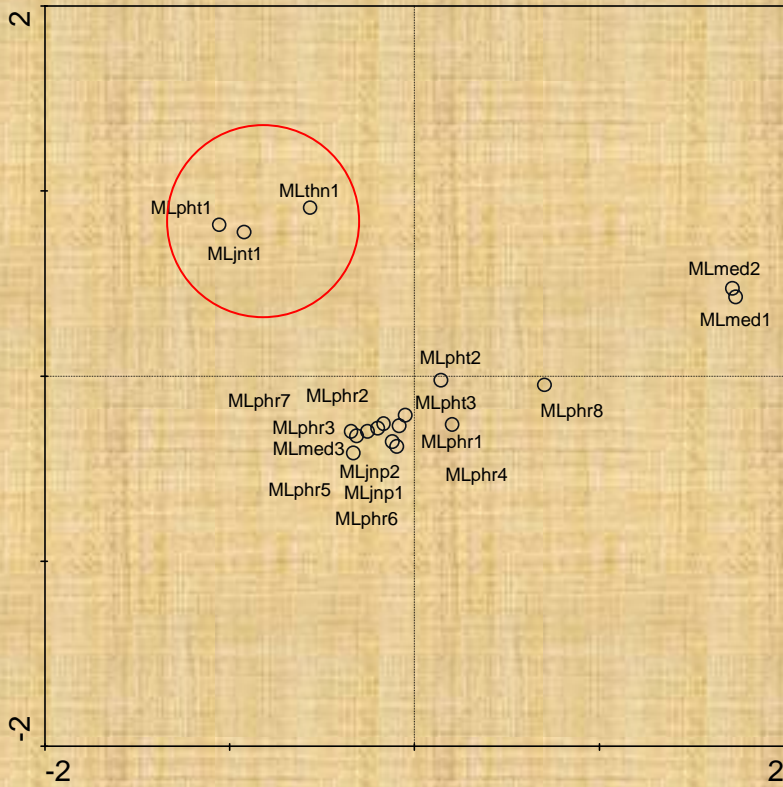
# Mykonos



Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
67.7	81.3	89.5	94.8

# Milos

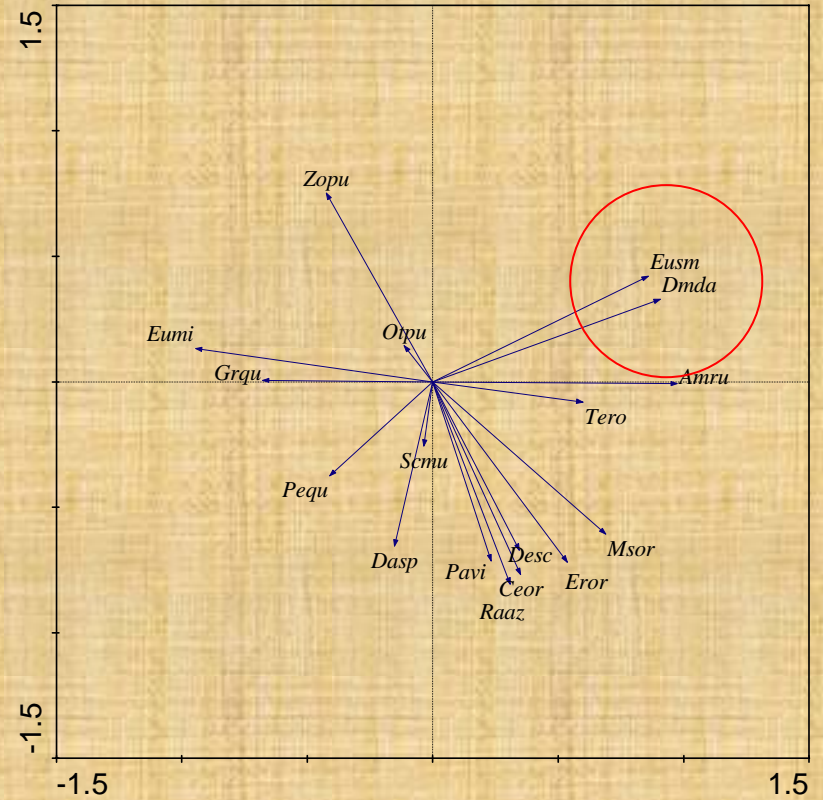
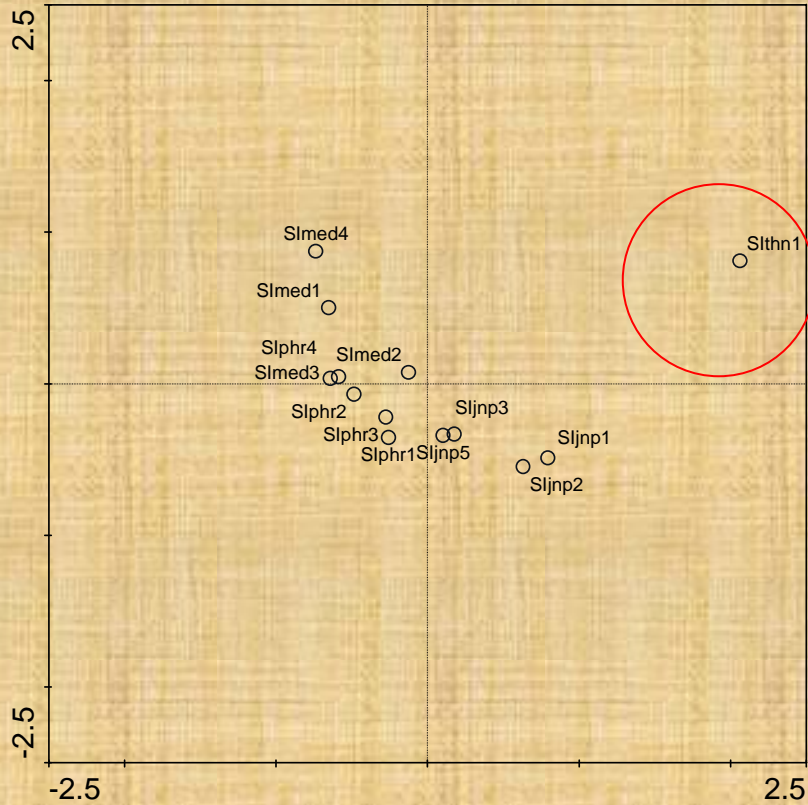


Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
51.7	71.5	85.6	92.1



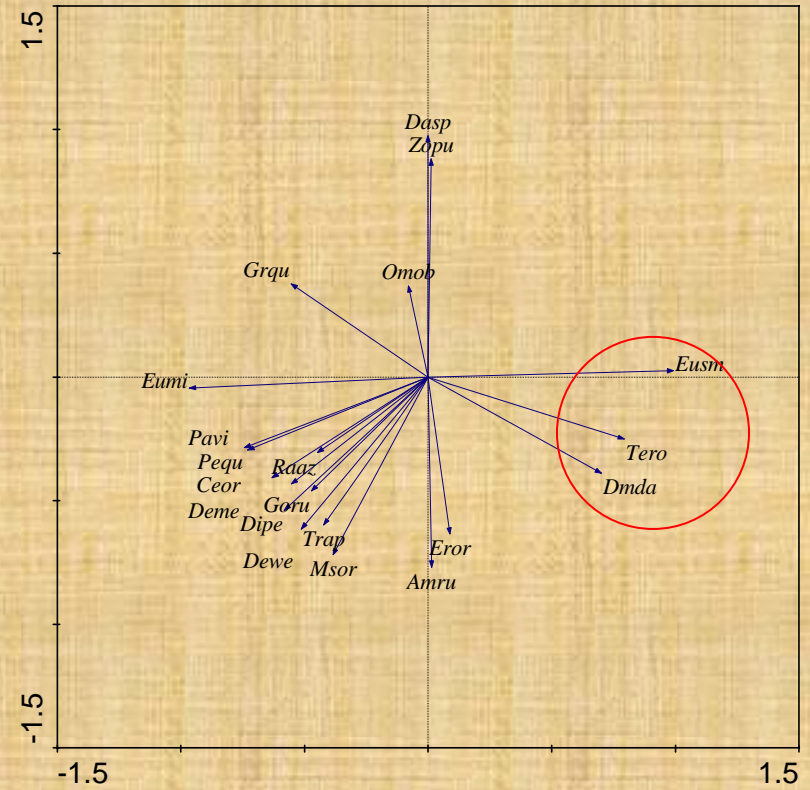
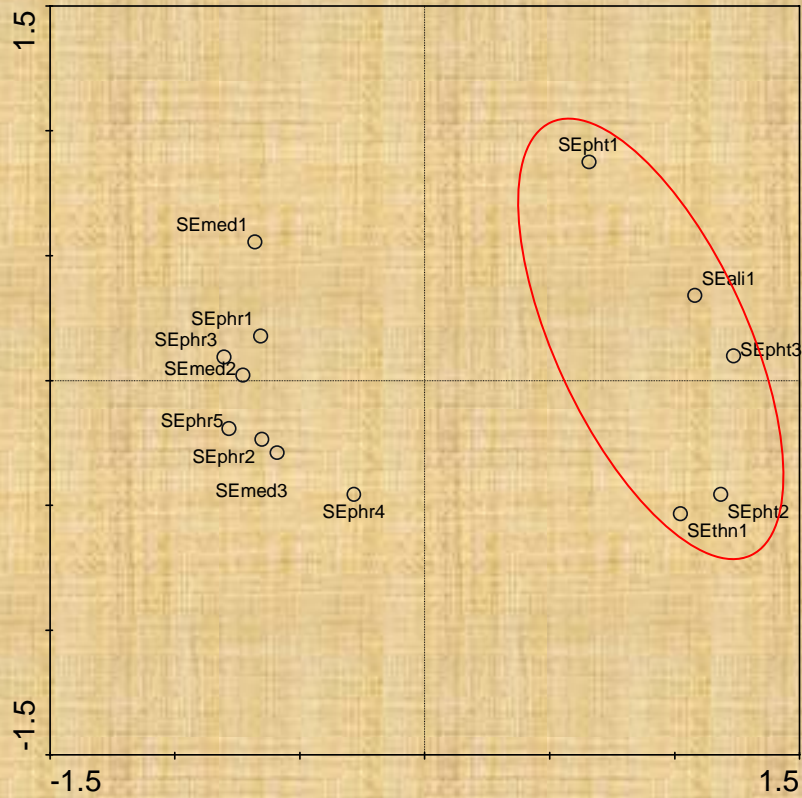
# Sifnos



Axes  
Cumulative percentage variance  
of species data :

1	2	3	4
57.2	77.4	88.8	94.6

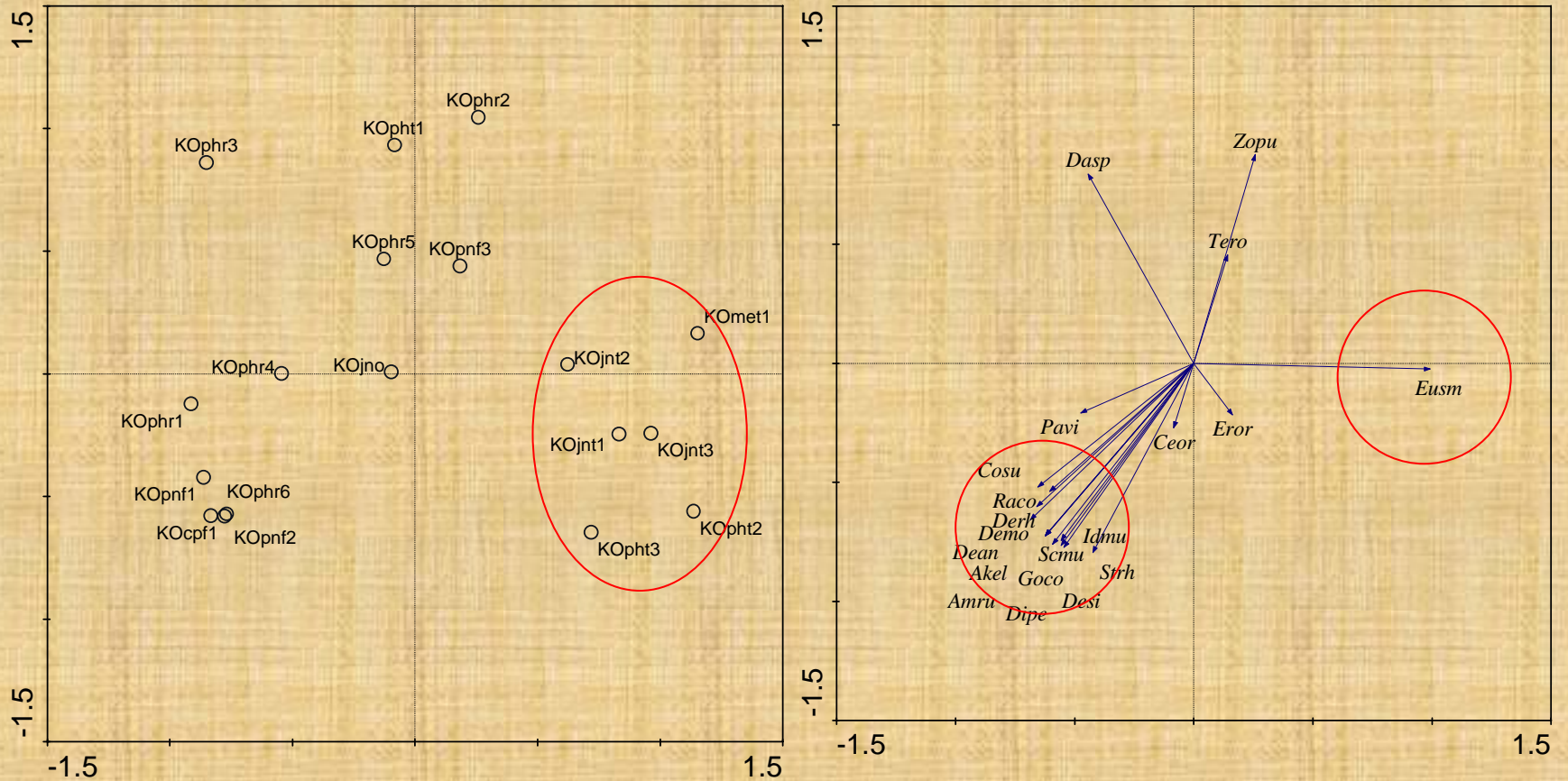
# Serifos



Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
70.1	86.4	91.4	94.4

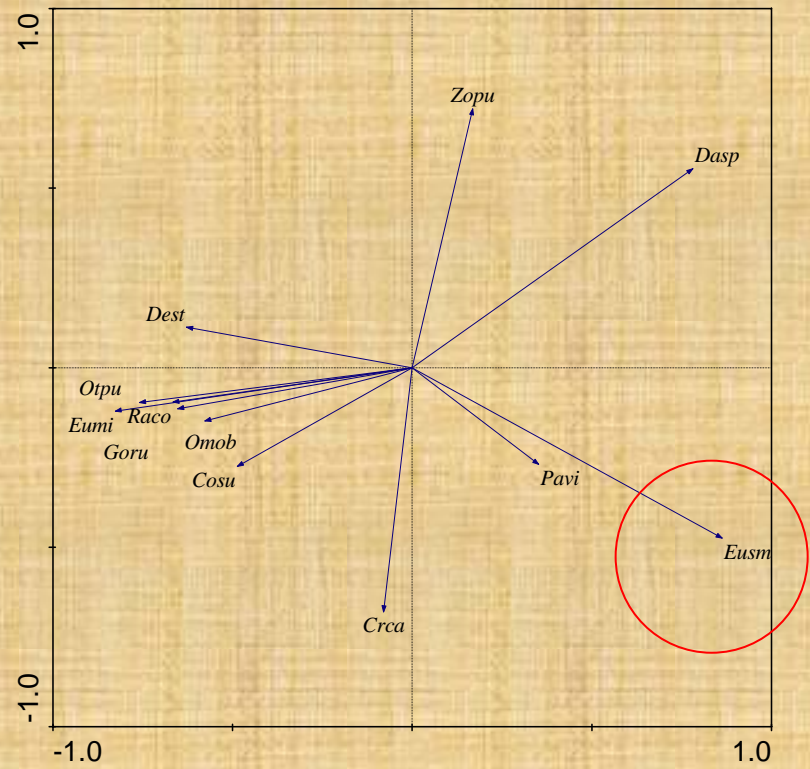
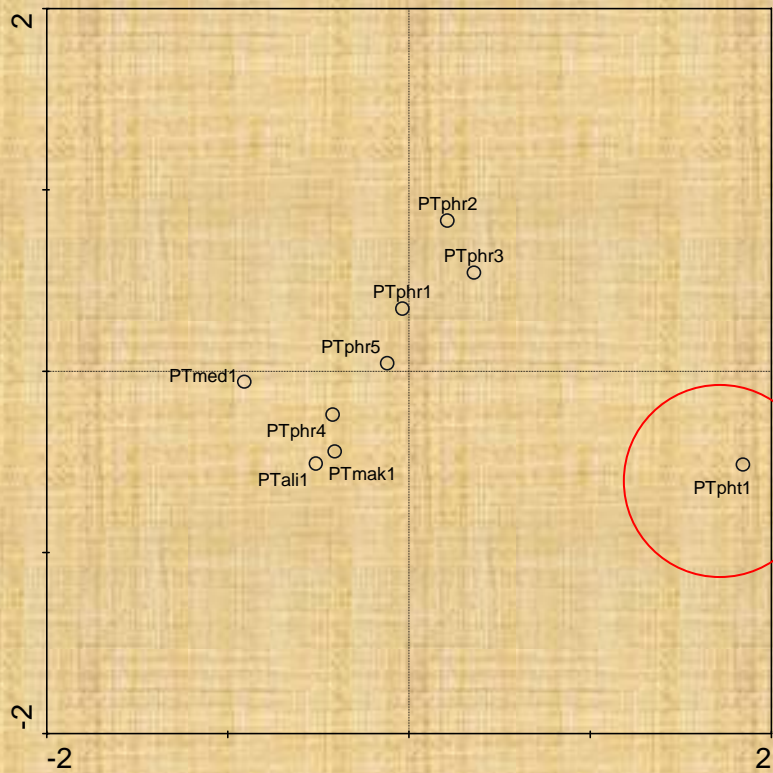
# Kos



Axes  
 Cumulative percentage variance  
 of species data :

1	2	3	4
54.2	83.0	90.5	95.2

# Patmos

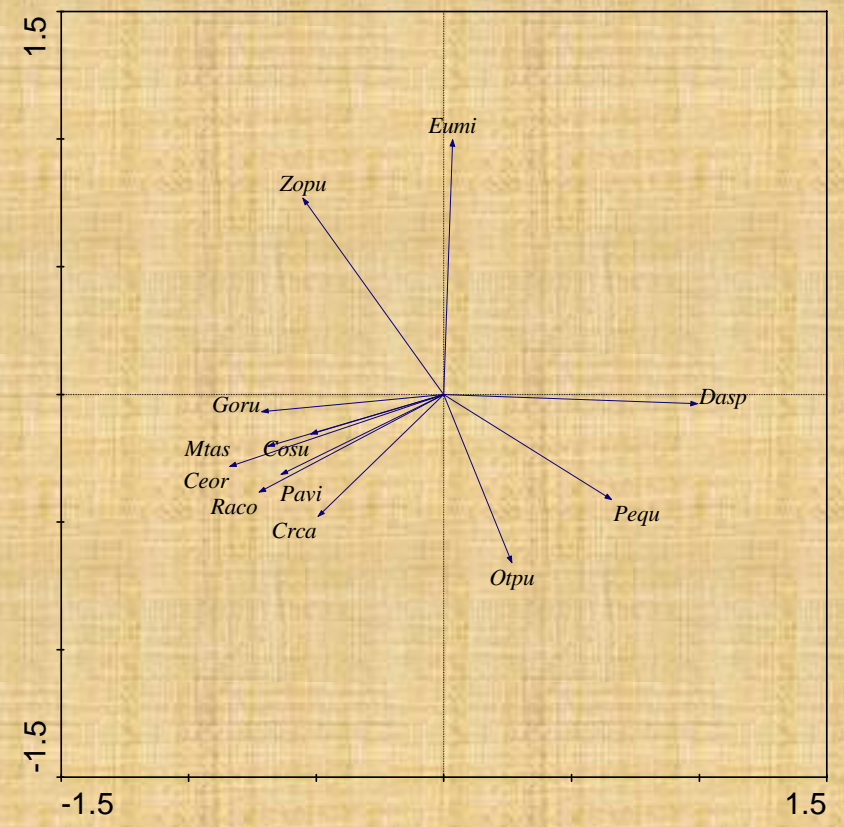
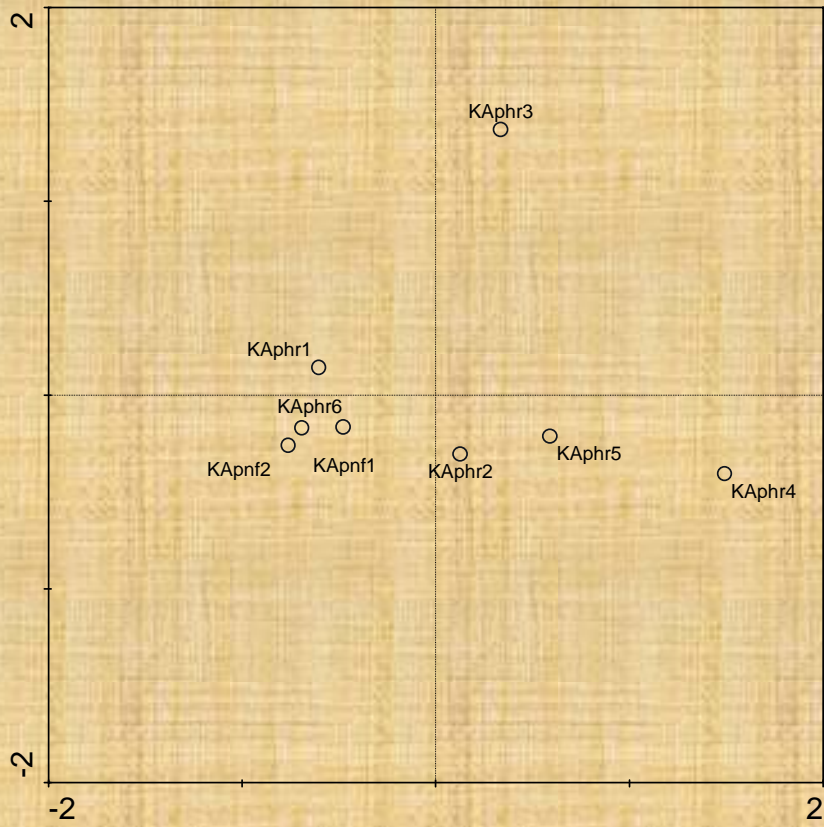


Axes  
Cumulative percentage variance  
of species data :

Axis	1	2	3	4
Cumulative percentage variance of species data	55.8	76.7	91.1	97.2



# Kalymnos



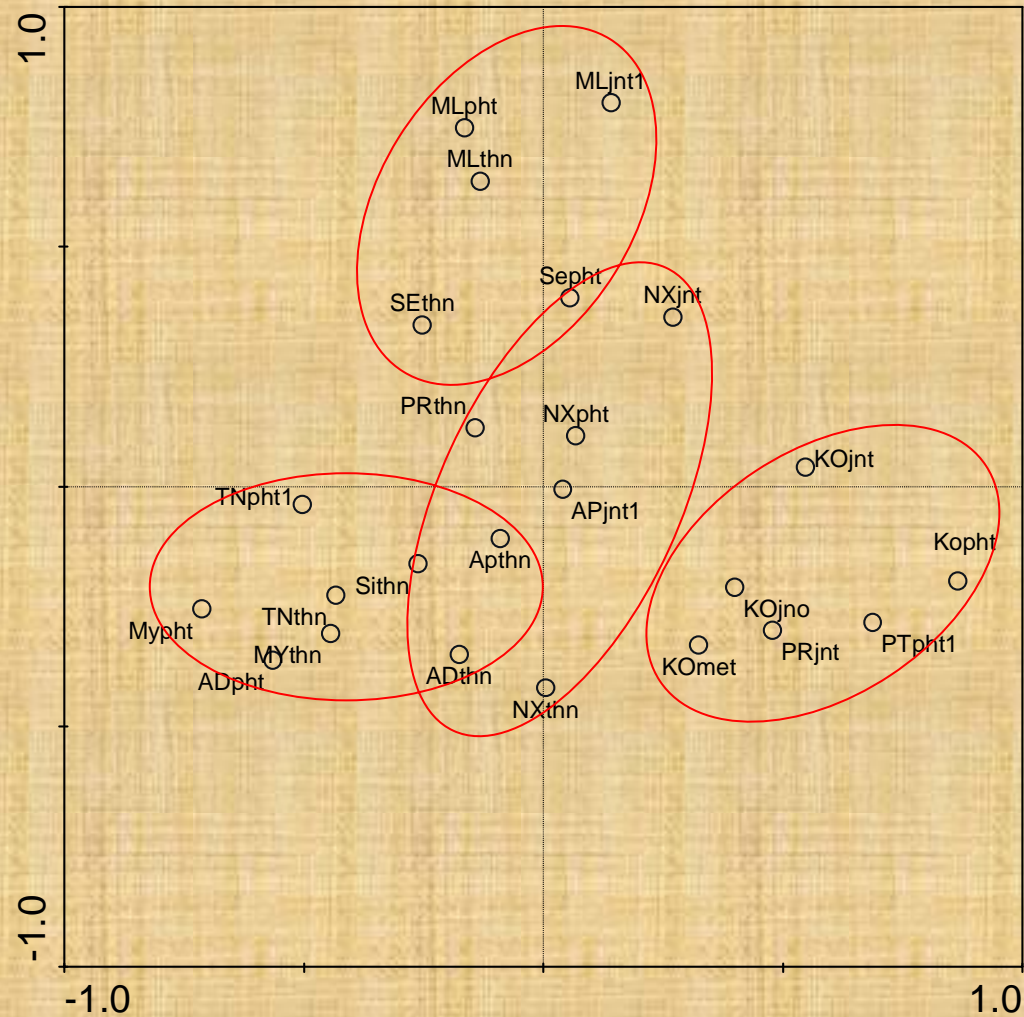
Axes	1	2	3	4
Cumulative percentage variance of species data :	54.4	83.4	89.0	93.6

All islands and soil habitats



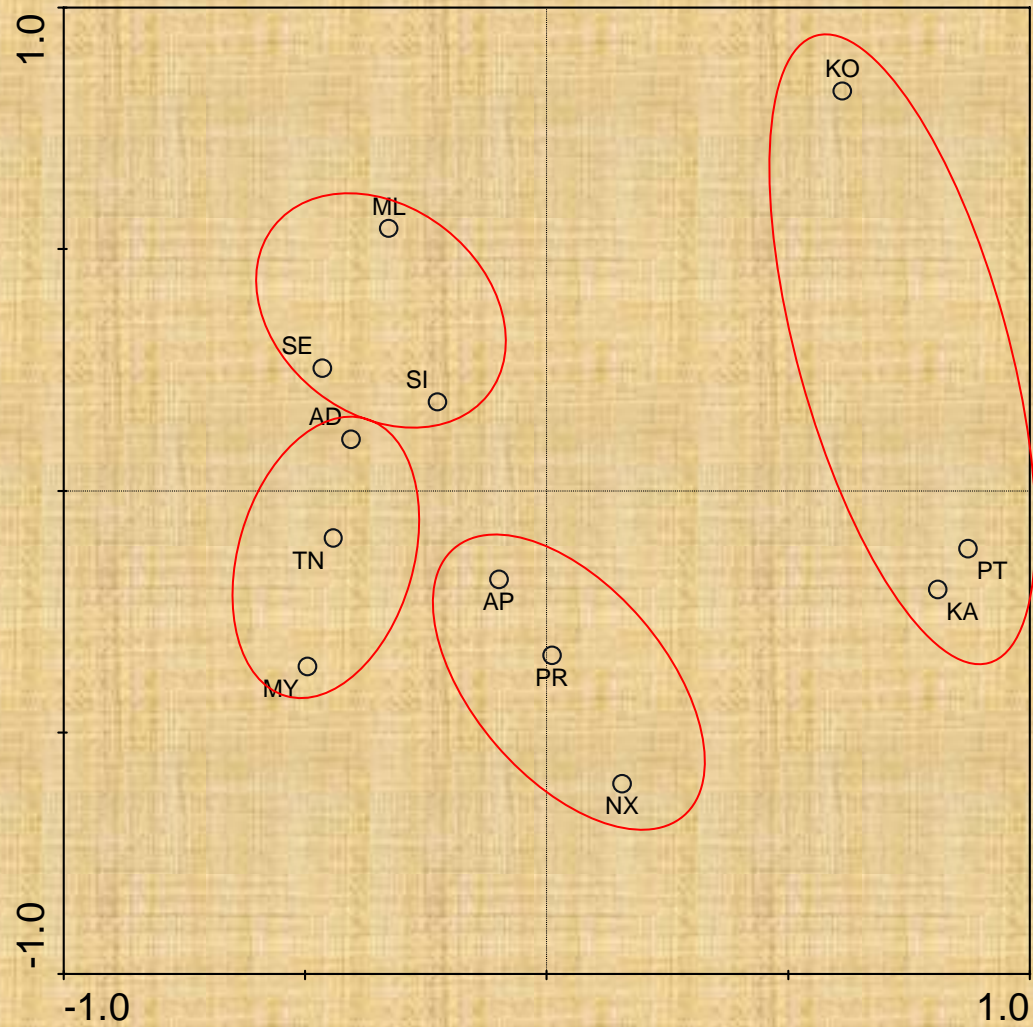
Axes	1	2	3	4
Cumulative percentage variance of species data	14.4	28.1	38.6	46.8

All islands  
and sandy  
habitats



Axes	1	2	3	4
Cumulative percentage variance of species data	15.9	28.7	39.9	48.1

All islands



Axes

Cumulative percentage variance  
of species data :

1

23.3

2

38.4

3

50.9

4

62.6



## Conclusions

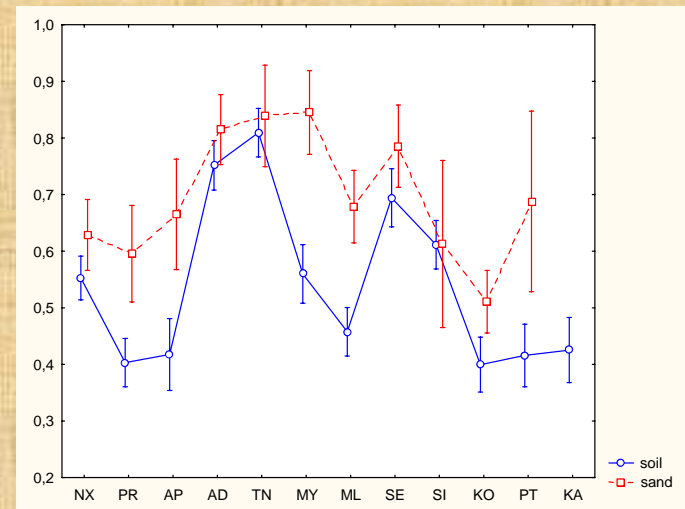
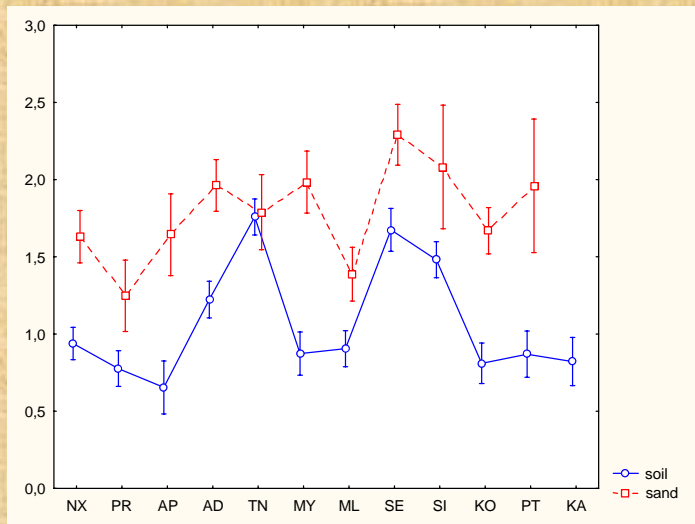
In general, the islands with the greatest surface area had the highest number of species, with the exception of Kos that had fewer species than expected

This conclusion might change when the samples from all months have been examined

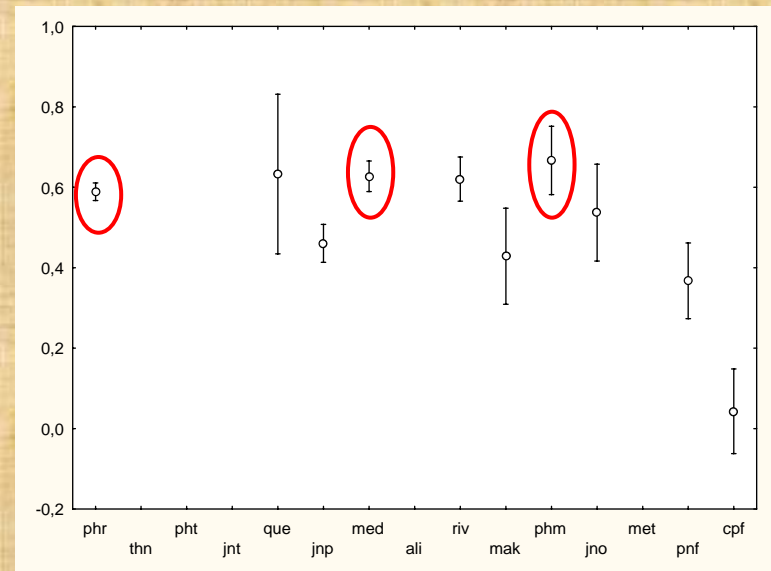
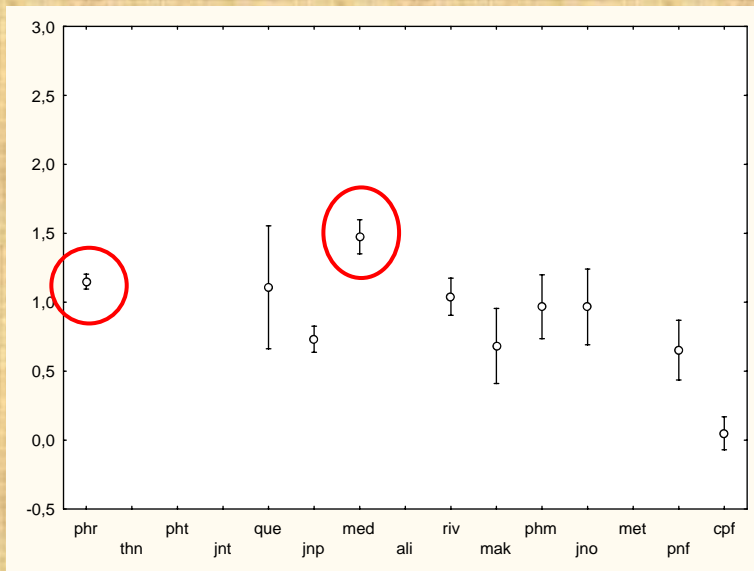
Islands	Area (sq. km.)	no of spec
Naxos	389.4	30
Paros	196.8	22
Antiparos	35.1	15
Andros	383.0	28
Tinos	197.0	29
Mykonos	86.1	22
Milos	158.4	21
Serifos	74.3	20
Sifnos	77.4	17
Kos	287.6	16
Patmos	34.1	12
Kalymnos	110.6	12
<b>TOTAL</b>		<b>54</b>

In all the islands, with the exception of Tinos, the highest abundances were observed in sandy habitats

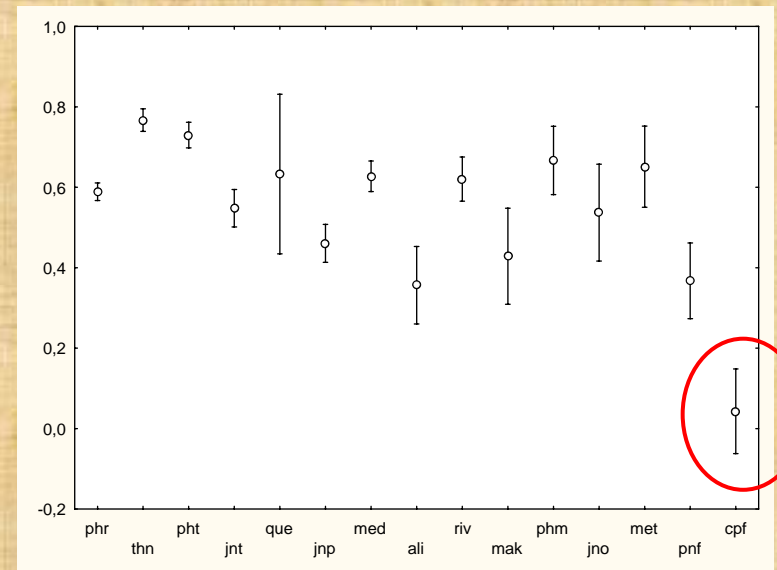
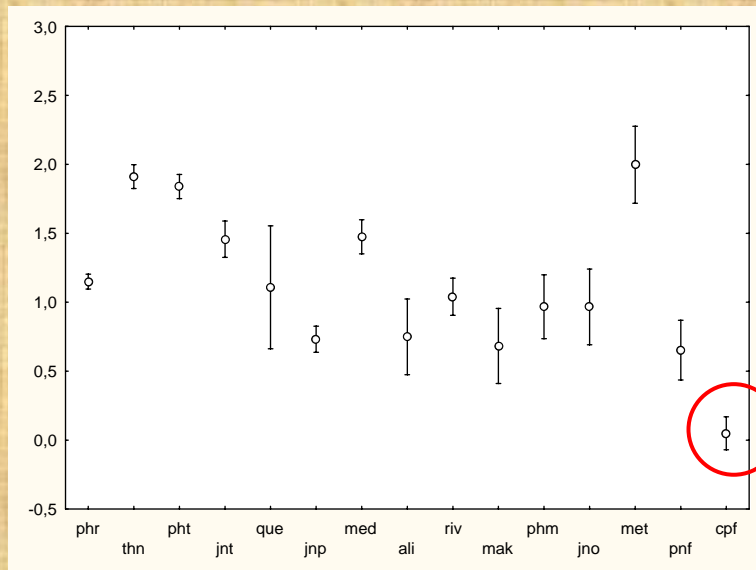
The same pattern was observed for the number of species



Among the soil habitats, high abundances were observed in meadows and phrygana



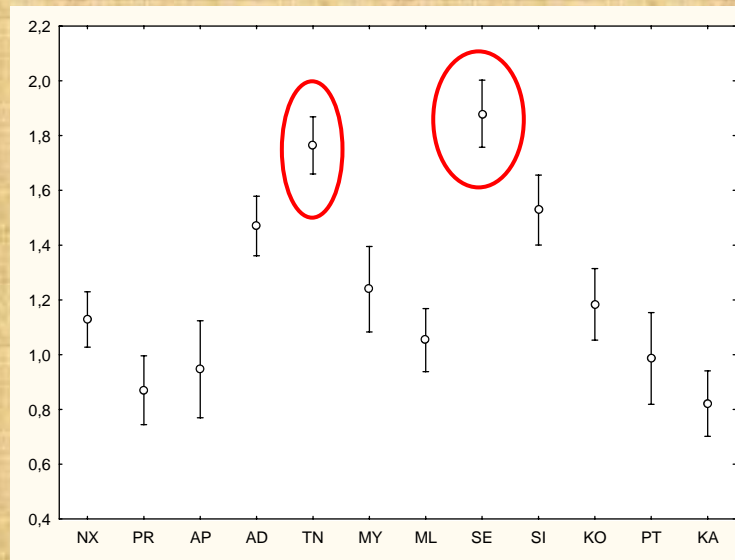
Tenebrionidae is a xerophilous family that prefers alkaline pH, and therefore, both number of individuals and number of species are low in conifer forests.





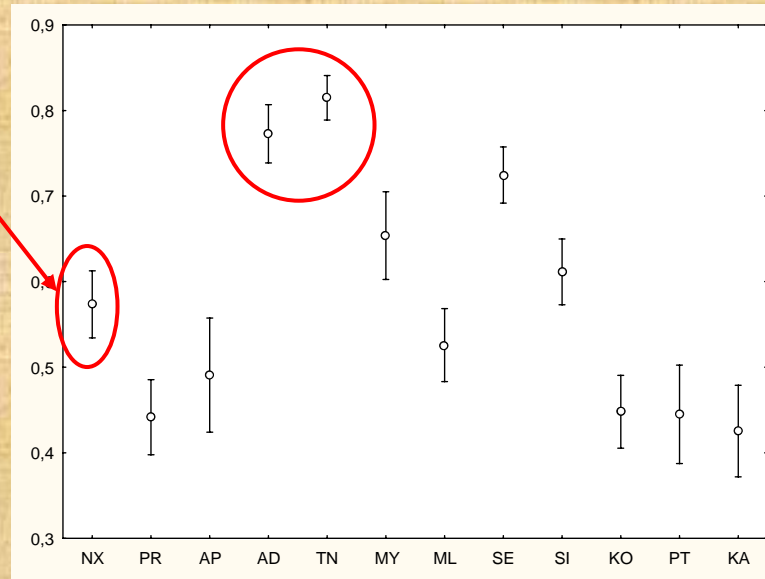
The highest values in numbers of individuals per trap were observed in Tinos and Serifos

In both cases this was due to the high number of individuals caught in meadows



The highest number of species per trap were observed in Andros and Tinos

Although Naxos had the total highest number of species, the number of species per trap was lower than in Andros and Tinos



The most important ecological factor that affects the composition of the tenebrionid fauna is the type of soil

In all cases, the sandy habitats were clearly distinguished from soil habitats

Sand dunes had the most characteristic species, while no apparent pattern was evident in soil habitats

*Eutagenia smyrnensis*

*Eutagenia minutissima*

*Dichomma dardanum*

*Erodius orientalis*

*Tentyria rotundata*

*Cephalostenus orbicollis*

*Micrositus orbicularis*



Sandy habitats contain species that are widely distributed

*Eutagenia smyrnensis*: Greece, Asia Minor, Syria

*Eutagenia minutissima*: Ionian, Aegean, Crete, Asia Minor

*Dichomma dardanum*: Mainland Greece, Aegean, Crete, Asia Minor,  
Syria

*Erodium orientale*: Mainland Greece, Aegean, Crete



Soil habitats contain species that have both wide and narrow distributions

Wide

*Opatroides punctulatus*: Palearctic

Narrow

*Dendarus*: More than 25 taxa in the Aegean

*Stenosis*: More than 5 taxa in the Aegean

*Dailognatha*: More than 10 taxa in the Aegean

Sandy habitats in the Aegean are always near the coast

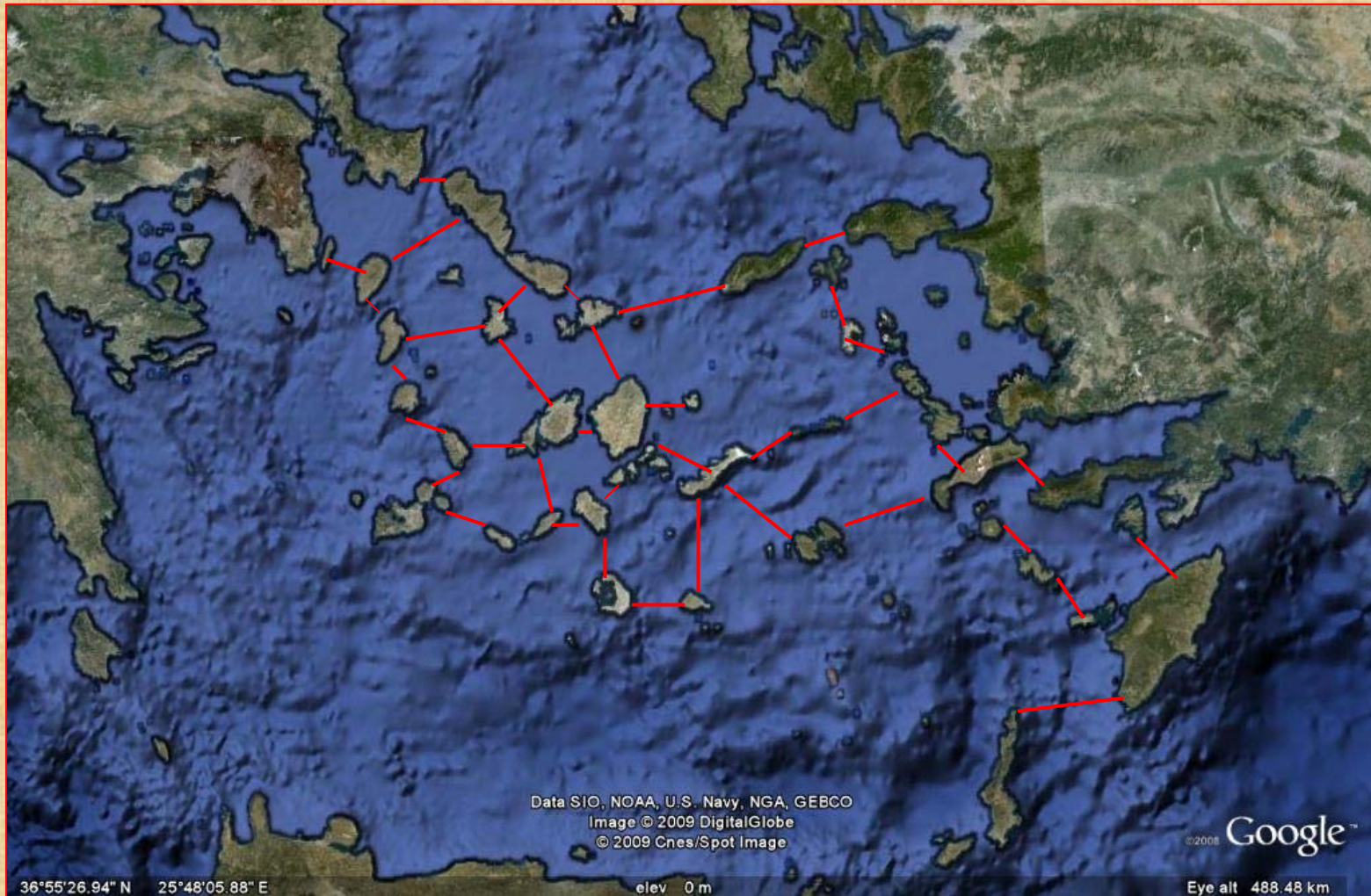
Their vegetation is very stable

Tenebrionids use the vegetation and especially the root system that reaches the water table, to hide, feed and raise their larvae

They form very large populations

Milos sand dunes: 7.546 ind. caught in 20 traps at 19 monthly intervals, an average of 400 ind/month in an area of 1500 sq. meters

The distance between the islands is relatively small and there is a constant rate of immigration of individuals on flotsam, especially during the summer with its strong winds





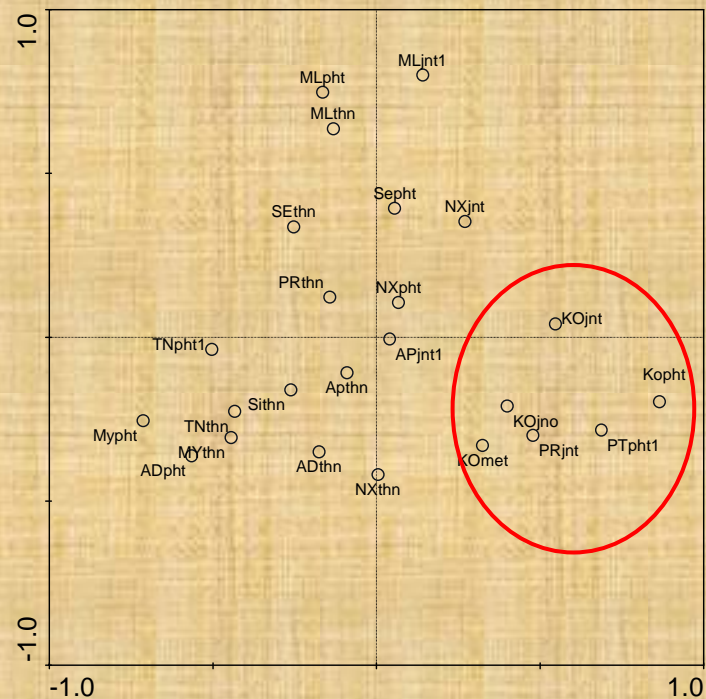
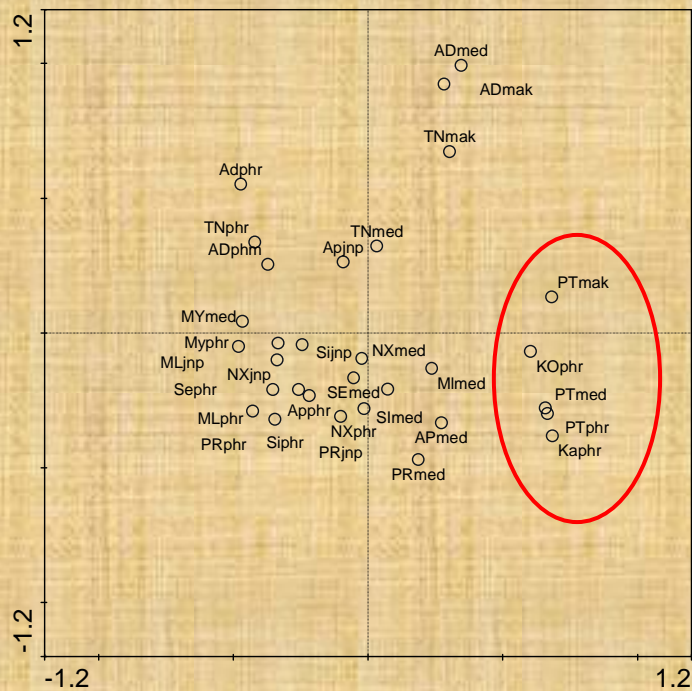
The species living in in the internal part of the islands have a smaller chance of emigration

The sandy areas and the rocky coasts that are sprayed by sea water are unfavourable habitats for them

These are good prerequisites for speciation



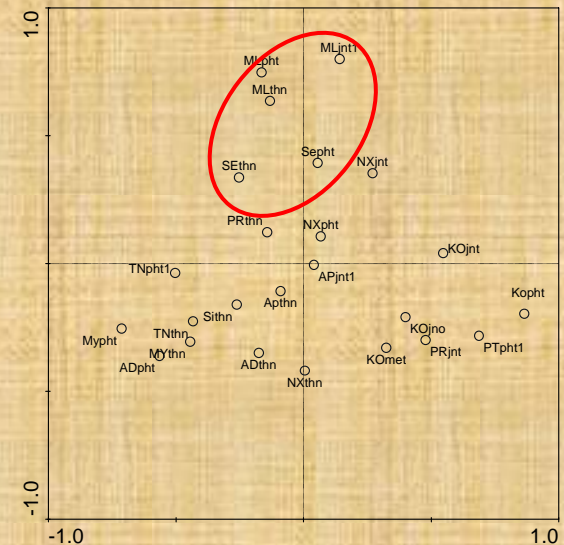
Looking at the analysis of presence-absence in sandy and soil habitats, the assemblages of Tenebrionidae from the eastern islands are distinctly separated from the other islands according to the first axis



In soil habitats, Andros and Tinos were separated according to the second axis



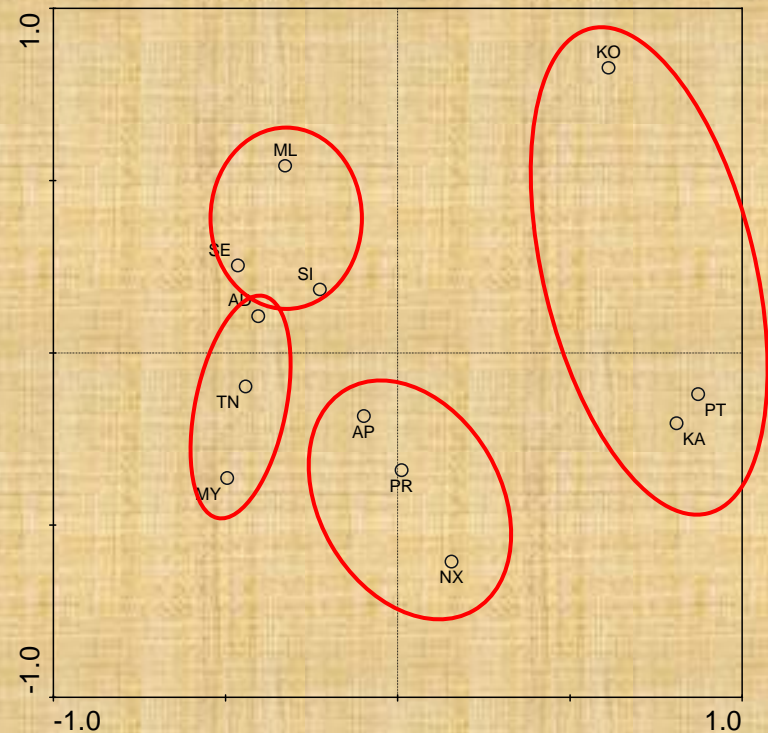
In sandy habitats, Milos and Serifos were separated according to the second axis



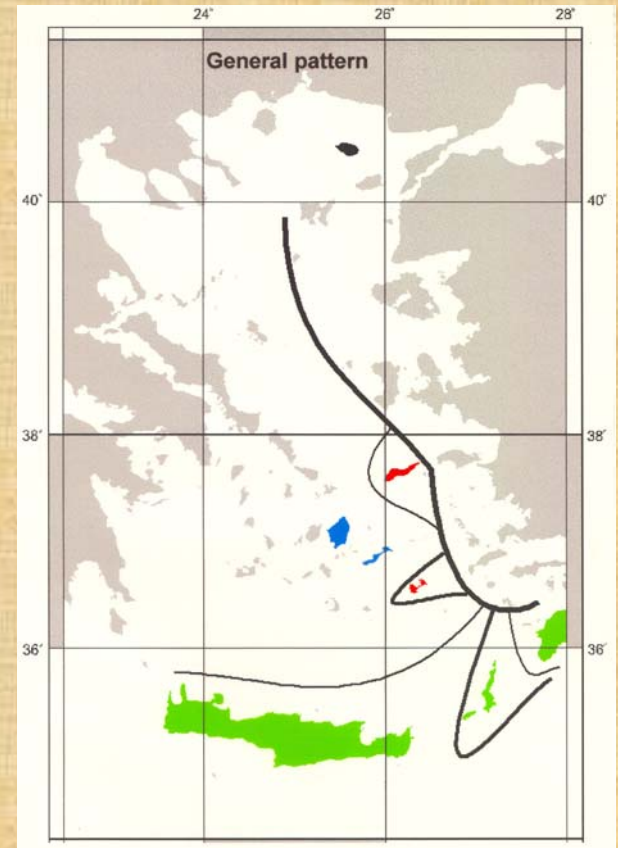
Looking at presence-absence in all habitat types, the eastern islands are again clearly separated

In the second axis, Milos, Serifos and Sifnos were separated from Naxos, Paros and Antiparos

The second axis reflects the differences in habitat composition of the various islands



The results show that the presence of eastern species such as *Dendarus stygius*, *D. rhodius*, *D. moesiacus* and *Stenosis rhodica*, characterize the eastern islands, in connection with the low number of species that were recorded there





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