Evolution underground: a case of tuco-tuco.

MACN

CONICET

Order Rodentia

- Подотряд белкообразные (Sciuromorpha)
- Подотряд боброобразные (Castorimorpha)
- Подотряд дикобразообразные(Hystricomorpha)
  - надсемейство свинкообразные (Cavioidea)
  - надсемейство нутриеобразные (Octodontoidea)
  - надсемейство шиншиллобразные (Chinchilloidea)
  - семейство гребнепалые (Ctenodactylidae)
  - семейство гребнемышиные (Ctenomyidae) 
- Подотряд мышеобразные (Myomorpha)

Genus: Ctenomys – > 60 species

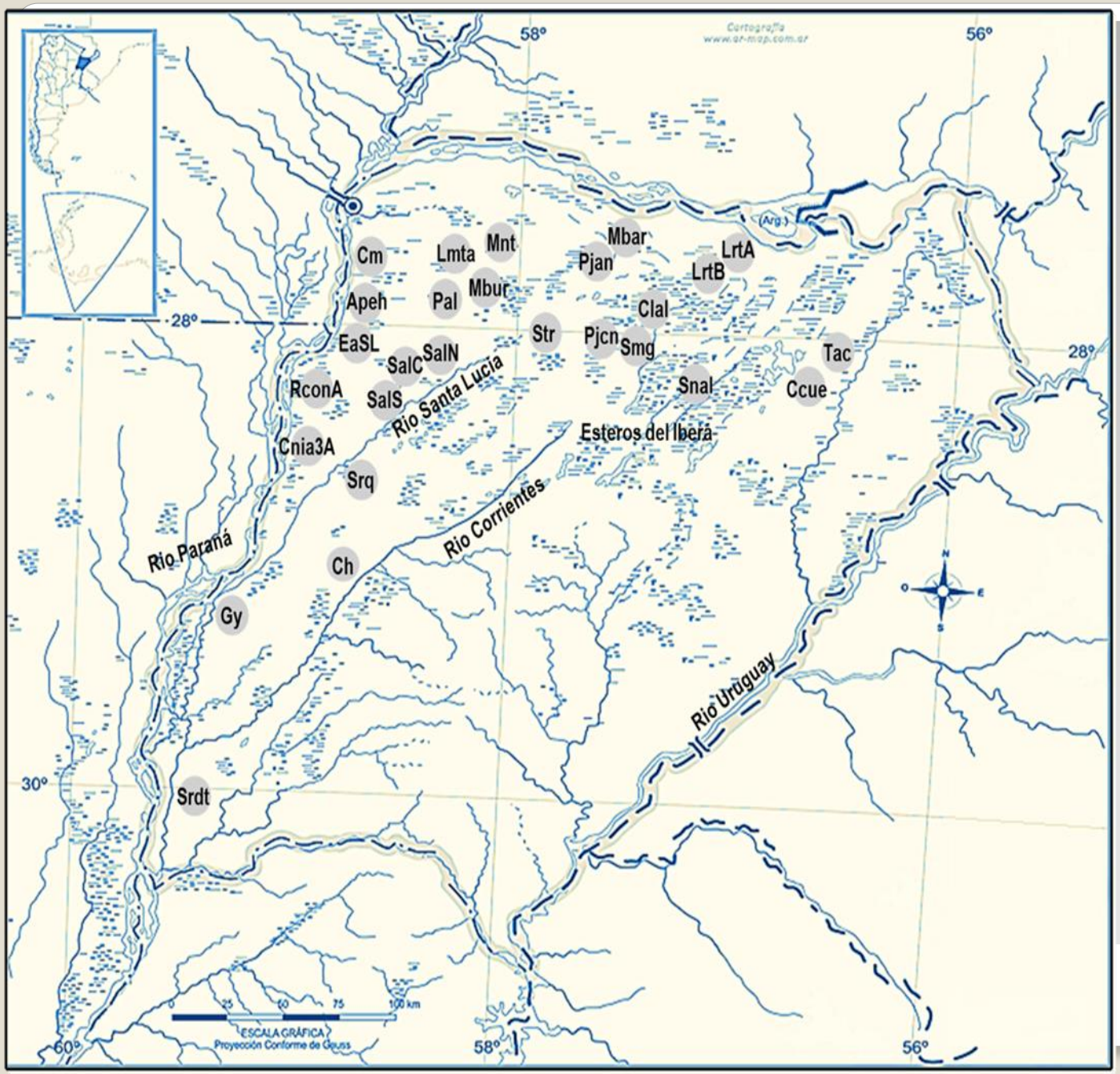
Family: Ctenomyidae

Order: Rodentia

The "perrensi group” belongs to the lineage torquatus, one of the major lineages, and consists of three named species (C. roigi, C. perrensi and C. dorbignyi) and a group of forms (Ctenomys sp) whose taxonomic status has not been completely resolved.


Chile
Paraguay
Asunción
Mato Grosso do Sul
Belo Horizonte
Espírito Santo
São Paulo
Rio de Janeiro
Paraná
Curitiba
Santa Catarina
Grande do Sul
Uruguay
Santiago
Buenos Aires
Argentina
Montevideo

58°
Upper Paraná River
Ibera wetland
Santa Lucía River
Corrientes River
Middle Parana River
Uruguay River
28°
ESCALA GRÁFICA
Proyección Conforme de Gauss
58°



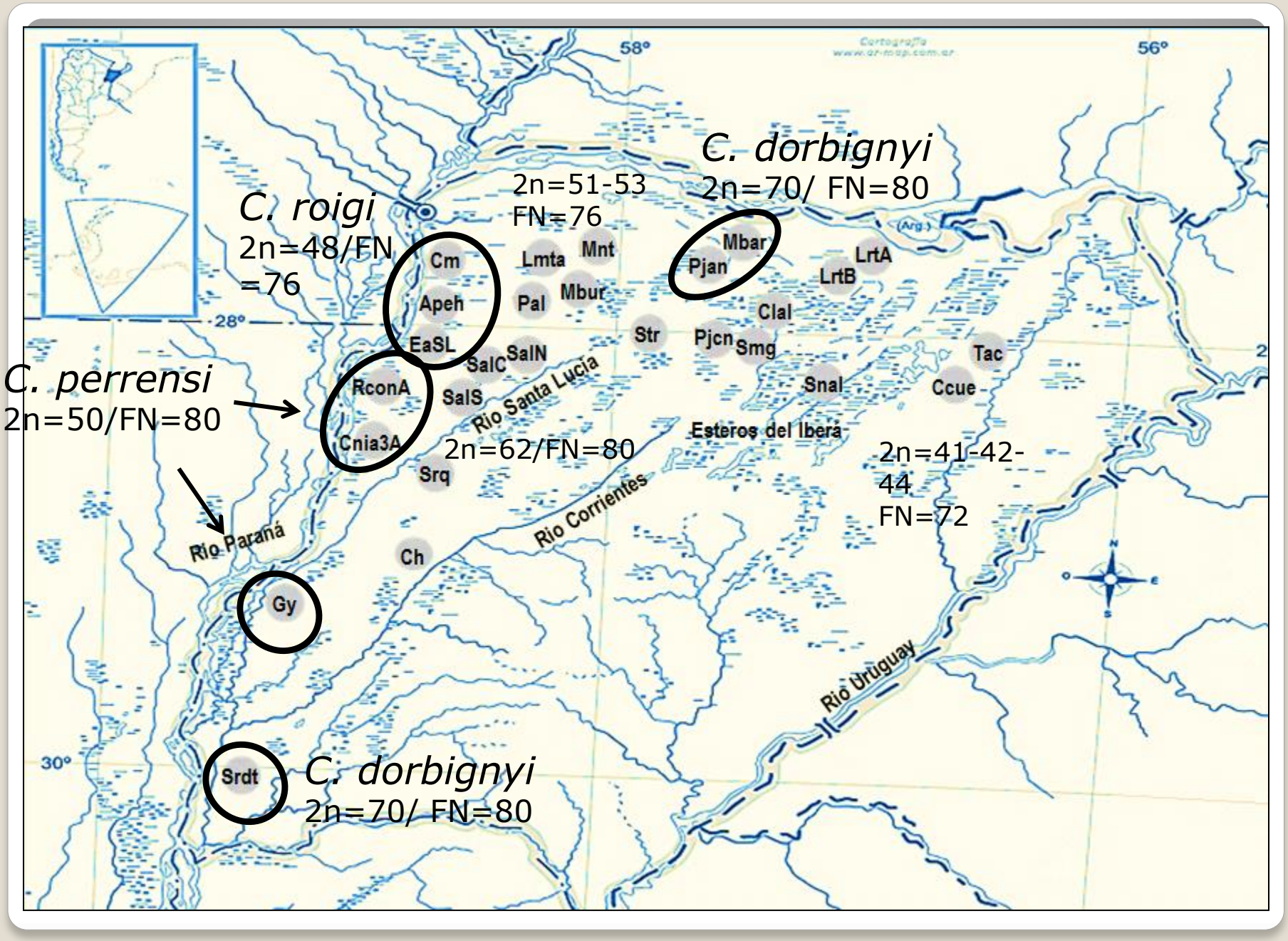
Sample collection in two time periods:

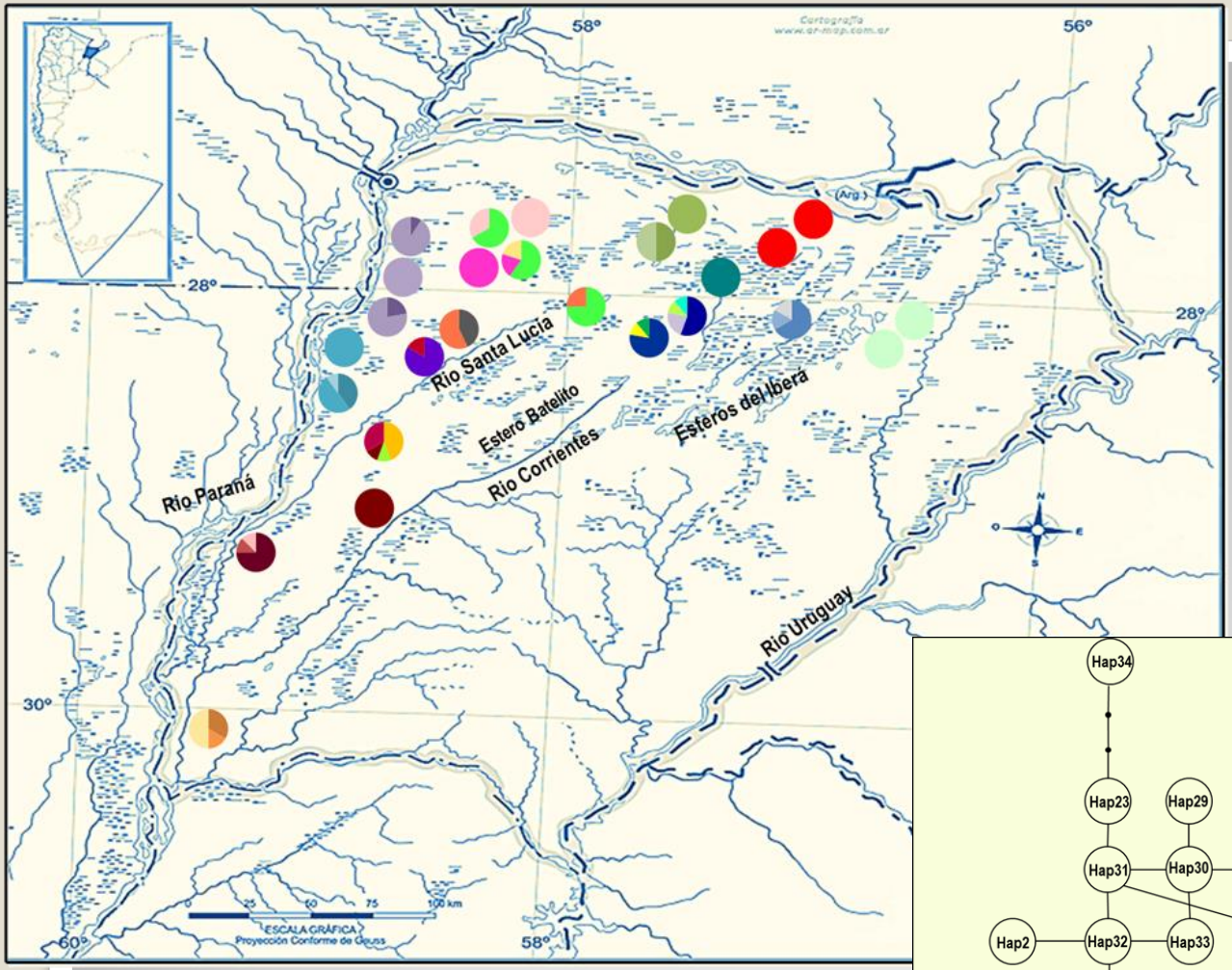
- 1993-2003
- 2007-2010

N=354

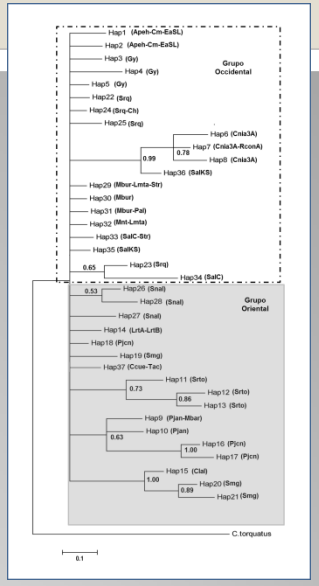
A fragment of the mitochondrial control region of 411 bp

12 microsatellite loci.

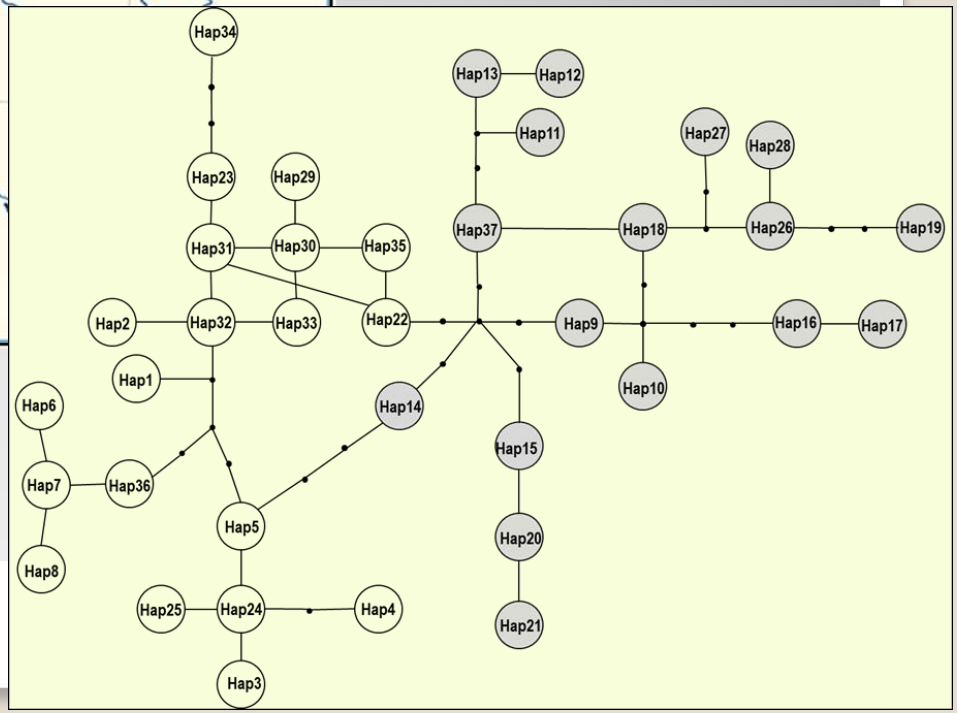

C. roigi
2n=48/FN=76
2n=51-53
FN=76
C. dorbignyi
2n=70/ FN=80
C. perrensi
2n=50/FN=80
2n=62/FN=80
2n=41-42-44
FN=72
C. dorbignyi
2n=70/ FN=80
Cm
Lmta
Mnt
Mbar
Pjan
LrtA
LrtB
Apeh
Pal
Mbur
Clal
Str
Pjcn
Smg
Tac
EaSL
SalC
SalN
RconA
SalS
Snal
Ccue
Cnia3A
Srq
Esteros del Iberá
Ch
Gy
Srdt
Río Santa Lucía
Río Corrientes
Río Paraná
Río Uruguay
58°
56°
28°
30°

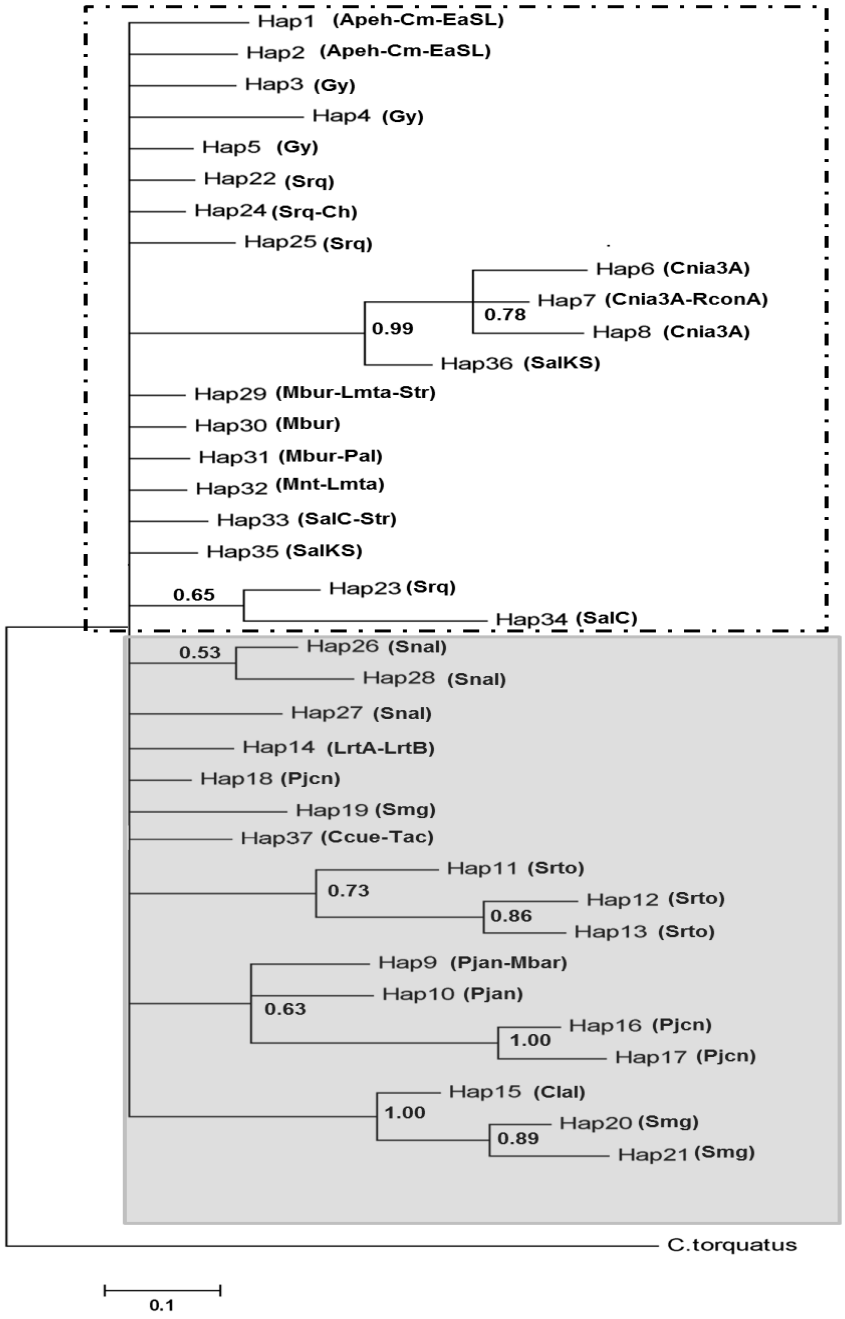


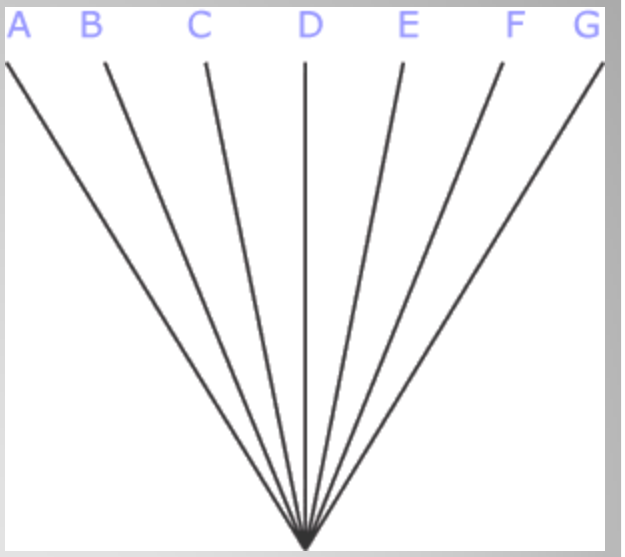
Geographical distribution of haplotypes

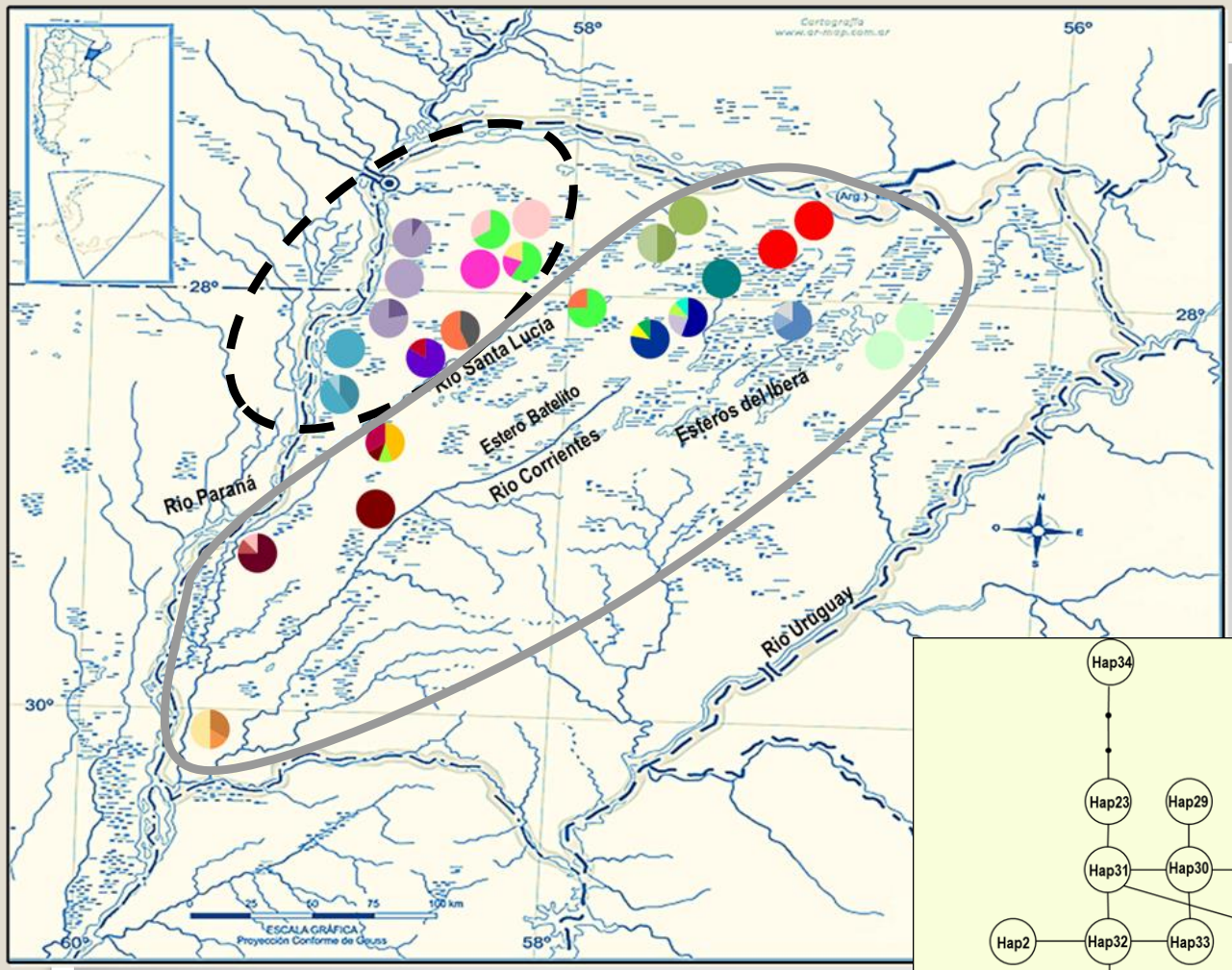


Haplotypes network

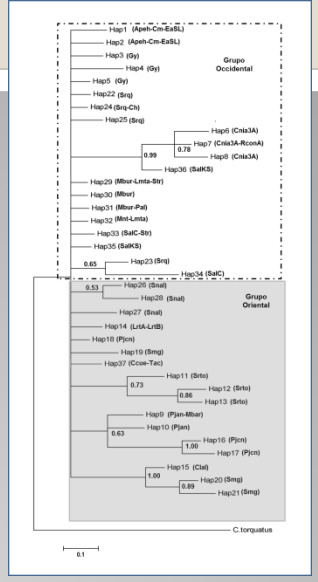



Hap1 (Apeh-Cm-EaSL)
Hap2 (Apeh-Cm-EaSL)
Hap3 (Gy)
Hap4 (Gy)
Hap5 (Gy)
Hap22 (Srq)
Hap24 (Srq-Ch)
Hap25 (Srq)
Hap6 (Cnia3A)
Hap7 (Cnia3A-RconA)
0.78
0.99
Hap8 (Cnia3A)
Hap36 (SalKS)
Hap29 (Mbur-Lmta-Str)
Hap30 (Mbur)
Hap31 (Mbur-Pal)
Hap32 (Mnt-Lmta)
Hap33 (SalC-Str)
Hap35 (SalKS)
0.65
Hap23 (Srq)
Hap34 (SalC)
0.53
Hap26 (Snal)
Hap28 (Snal)
Hap27 (Snal)
Hap14 (LrtA-LrtB)
Hap18 (Pjcn)
Hap19 (Smg)
Hap37 (Ccue-Tac)
Hap11 (Srto)
0.73
Hap12 (Srto)
0.86
Hap13 (Srto)
Hap9 (Pjan-Mbar)
Hap10 (Pjan)
0.63
Hap16 (Pjcn)
1.00
Hap17 (Pjcn)
Hap15 (Clal)
1.00
Hap20 (Smg)
0.89
Hap21 (Smg)
C.torquatus
0.1

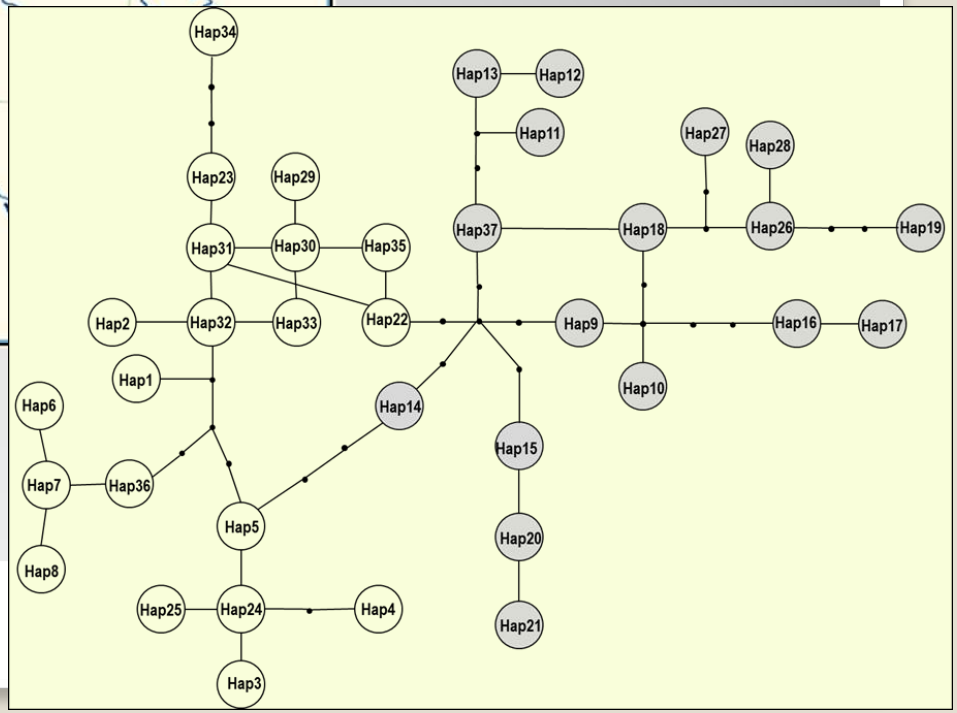

A
B
C
D
E
F
G

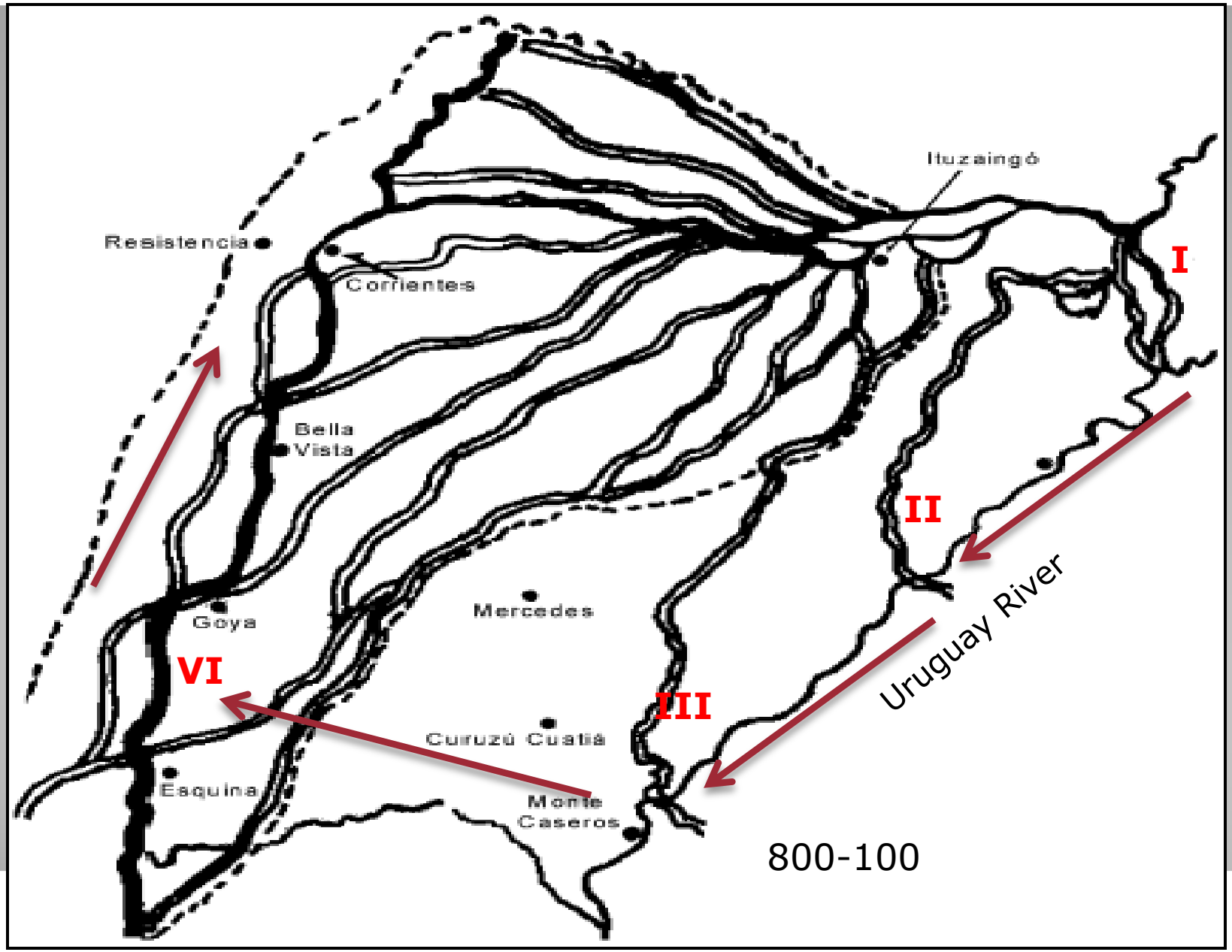


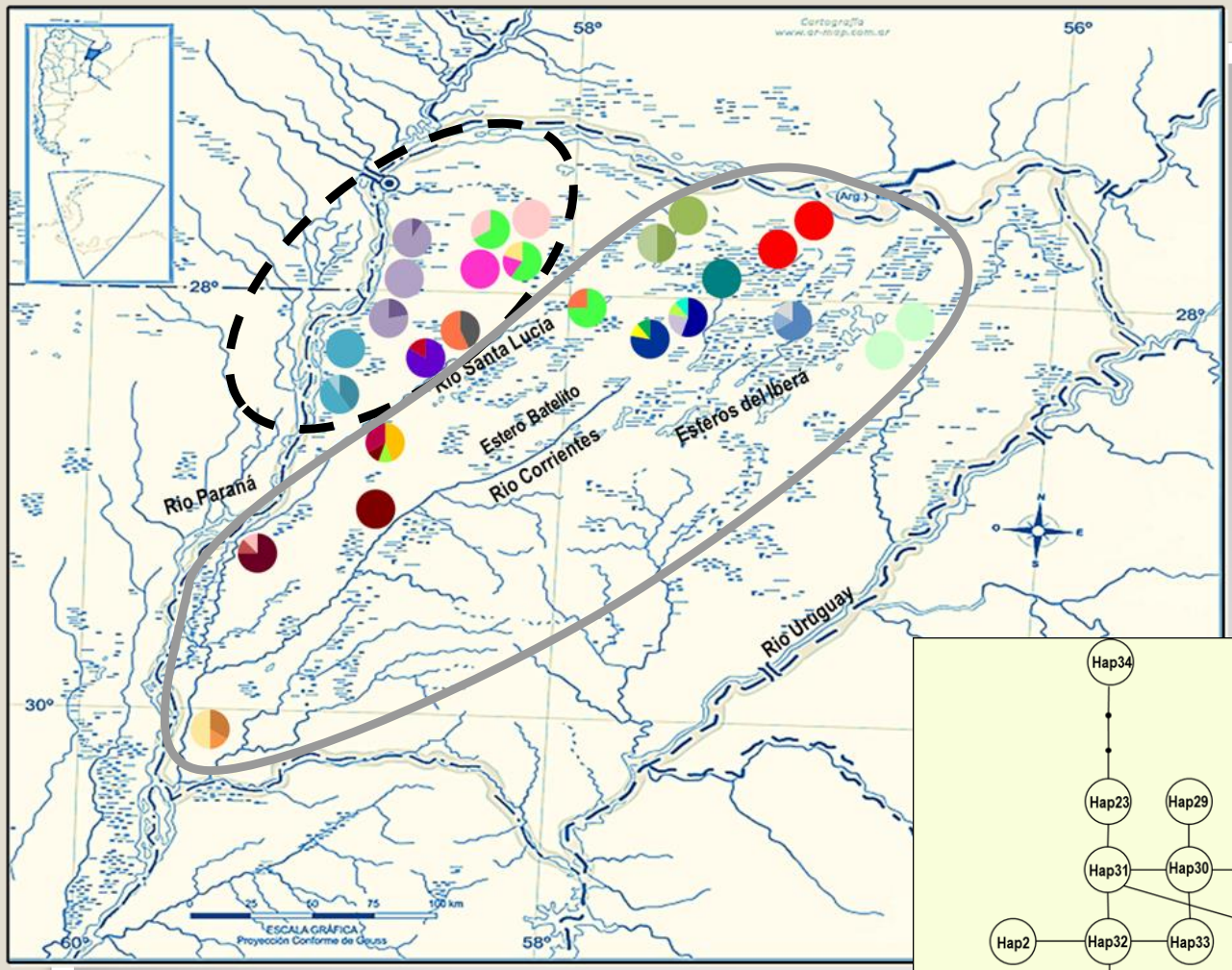
Geographical distribution of haplotypes



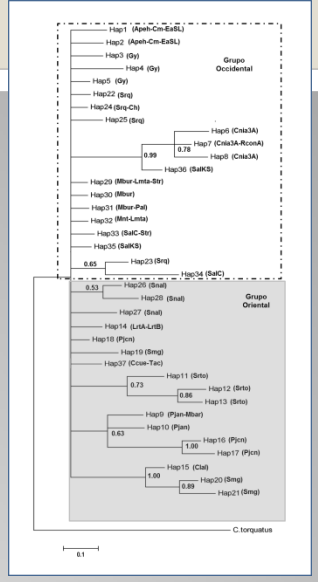
Haplotypes network



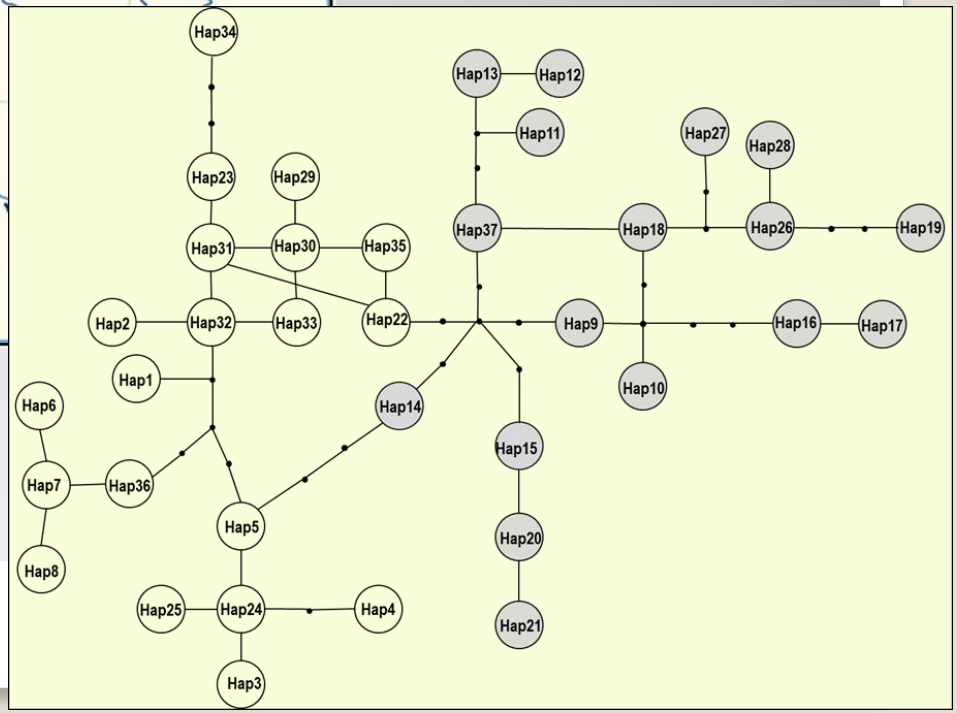

Ituzaingó
Resistencia
Corrientes
Bella Vista
Goya
Mercedes
Curuzú Cuatiá
Esquina
Monte Caseros
I
II
III
VI
Uruguay River
800-100

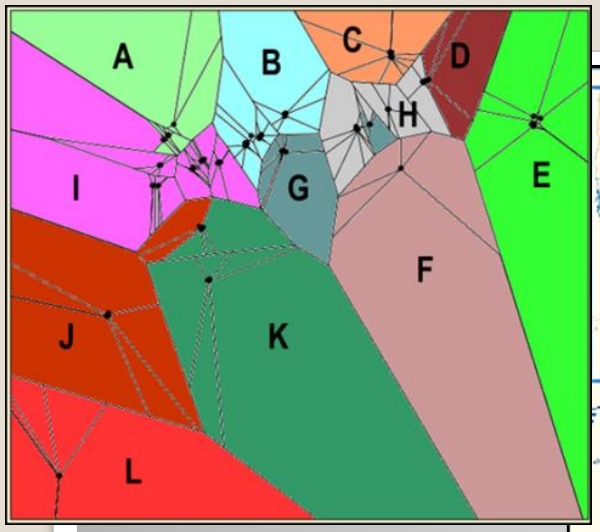


Geographical distribution of haplotypes



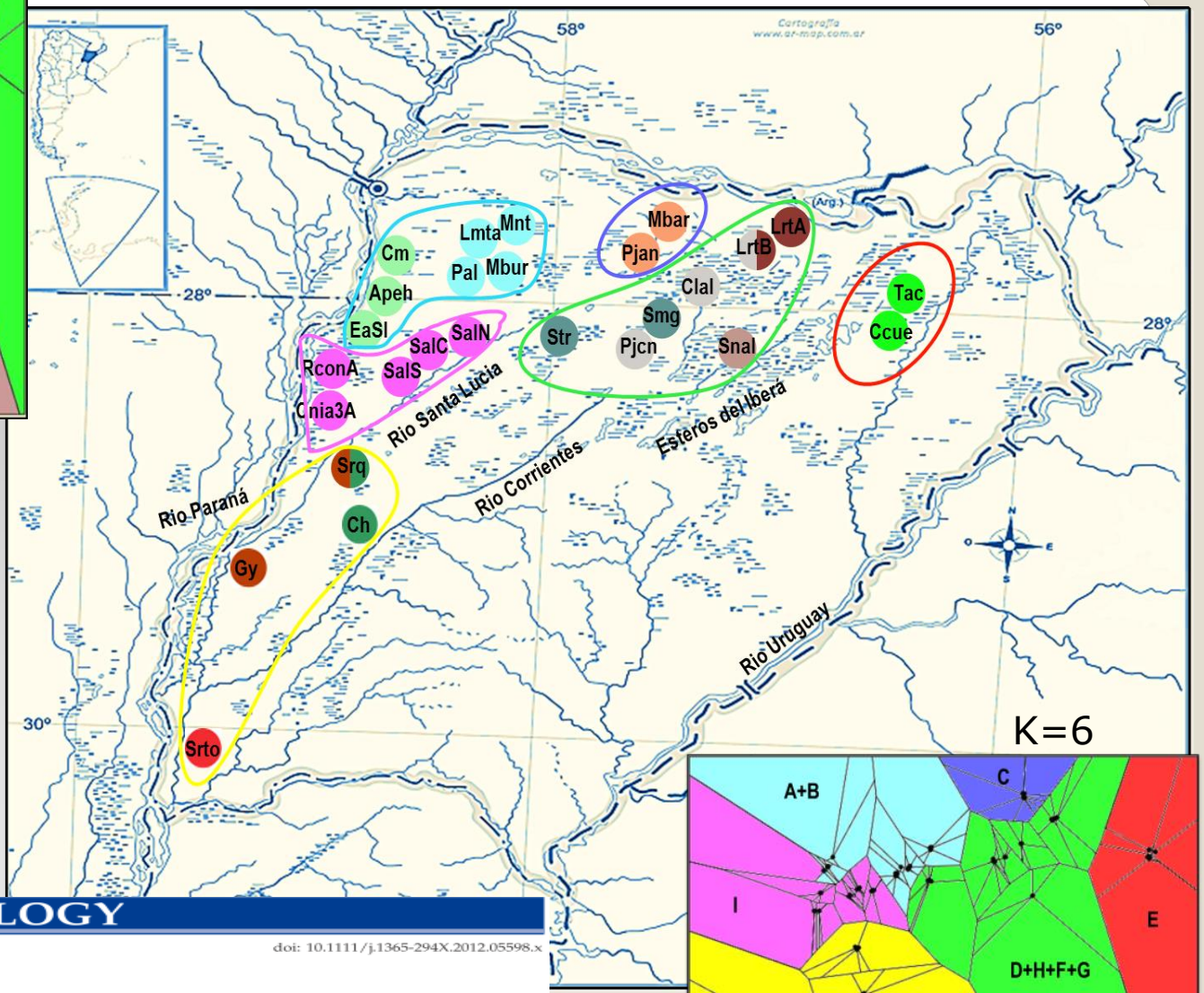
Haplotypes network





K=12

- 12 populations
- 6 linages.



K=6

MOLECULAR ECOLOGY
Molecular Ecology (2012)
doi: 10.1111/j.1365-294X.2012.05598.x

The evolution of a highly speciose group in a changing environment: are we witnessing speciation in the Iberá wetlands?

MARIA JIMENA GÓMEZ FERNÁNDEZ,*† OSCAR E. GAGGIOTTI‡ and PATRICIA MIROL*†

How well connected were/are the populations ?

Estimation contemporary and historical gene flow

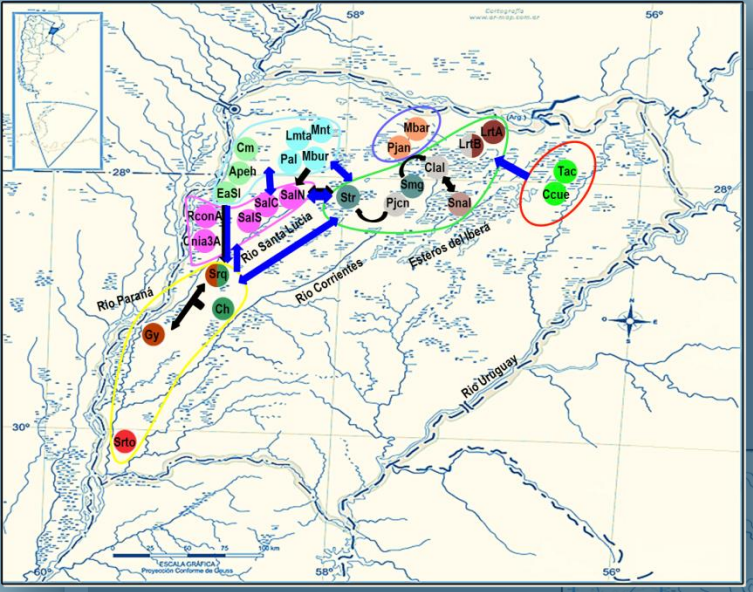
Two methods:

Coalescent approach (Lamarc, Kuhner 2006)

- Control Region fragment (mtDNA).
- Microsatellite loci (Nuclear genome)

Bayesian approach with MCMC sampling. (Bayesass, Wilson & Rannala 2003)

- Microsatellites loci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SalS
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Río Corrientes
Esteros del Iberá
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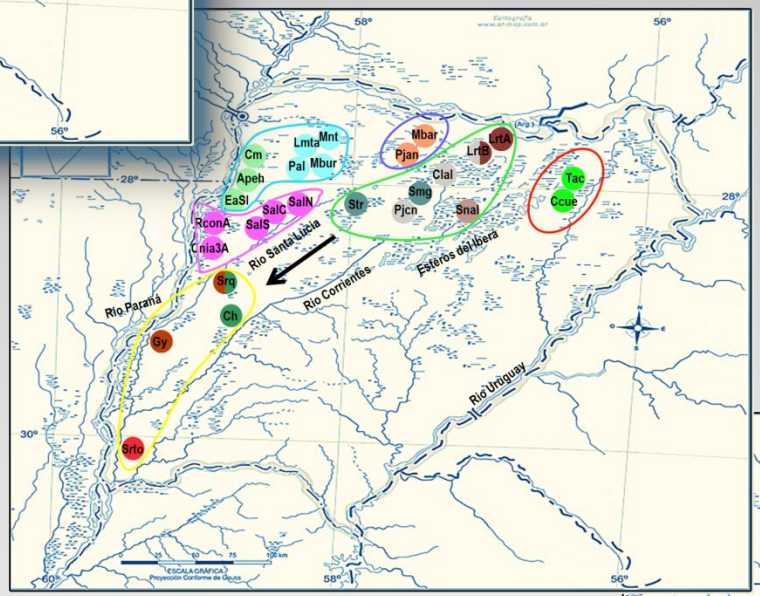
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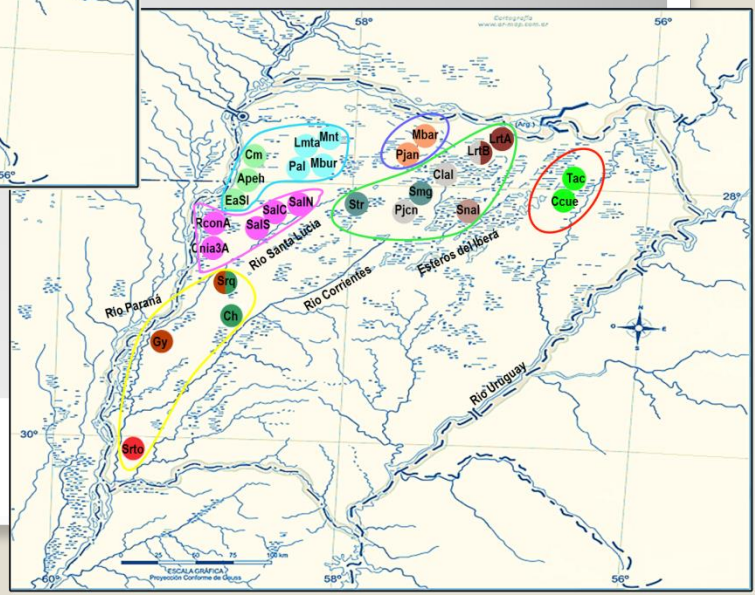
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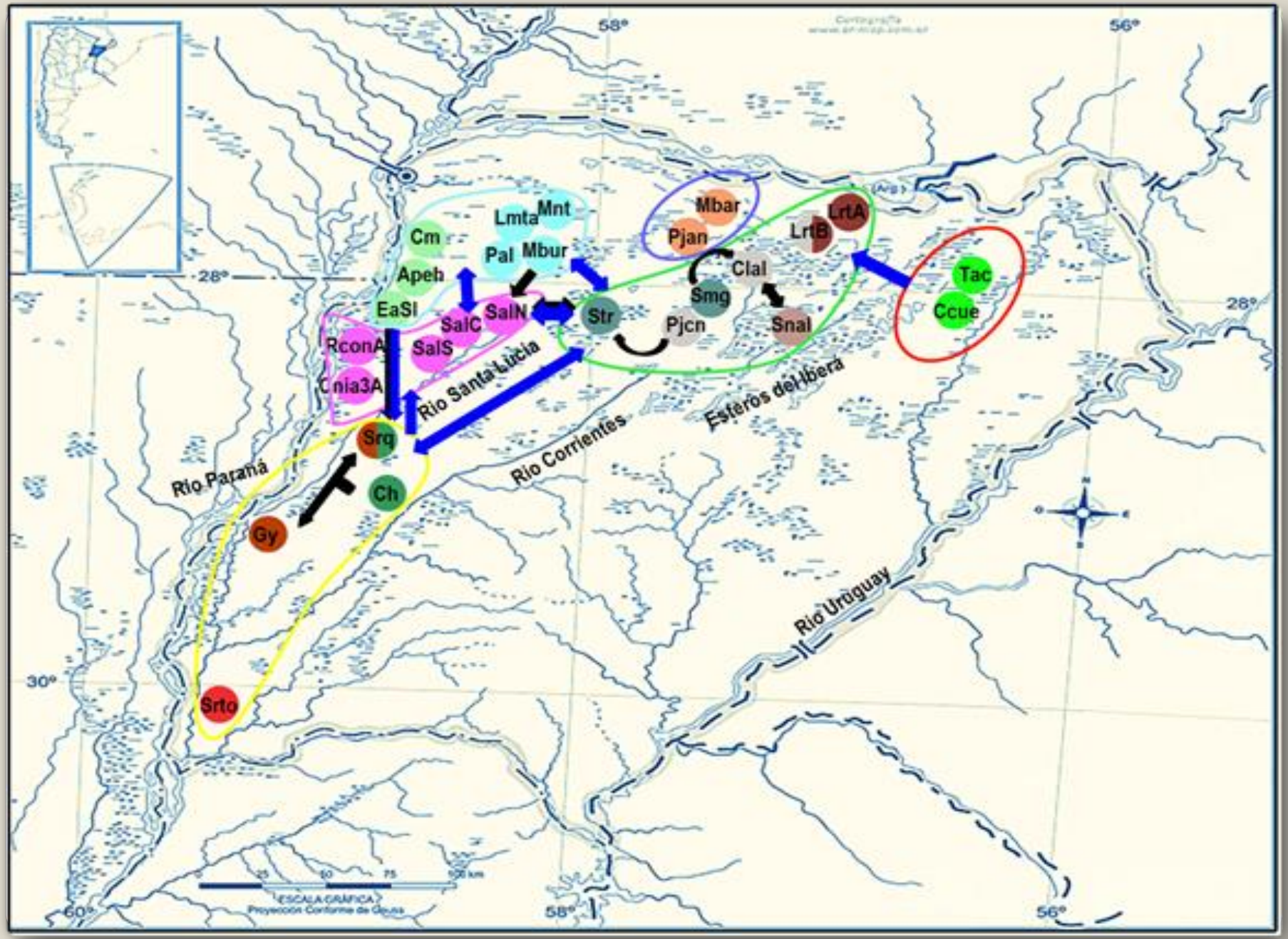
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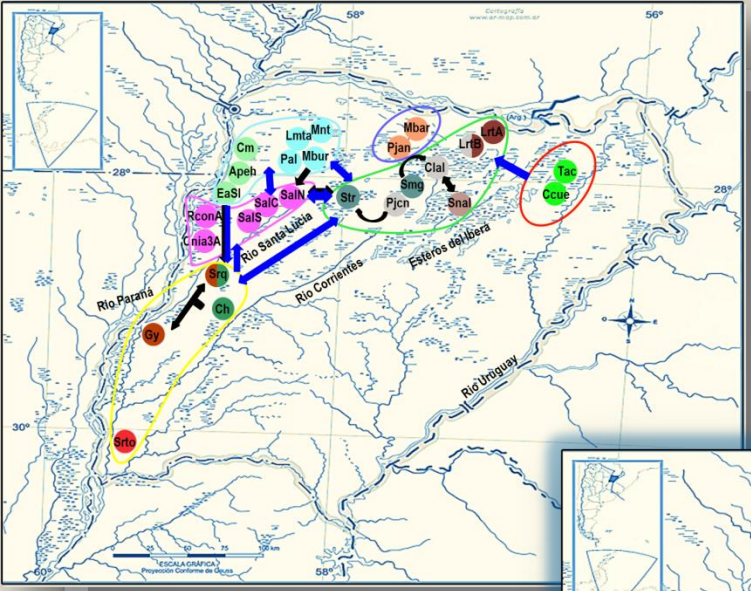
ESCALA GRÁFICA
Proyección Conforme de Gauss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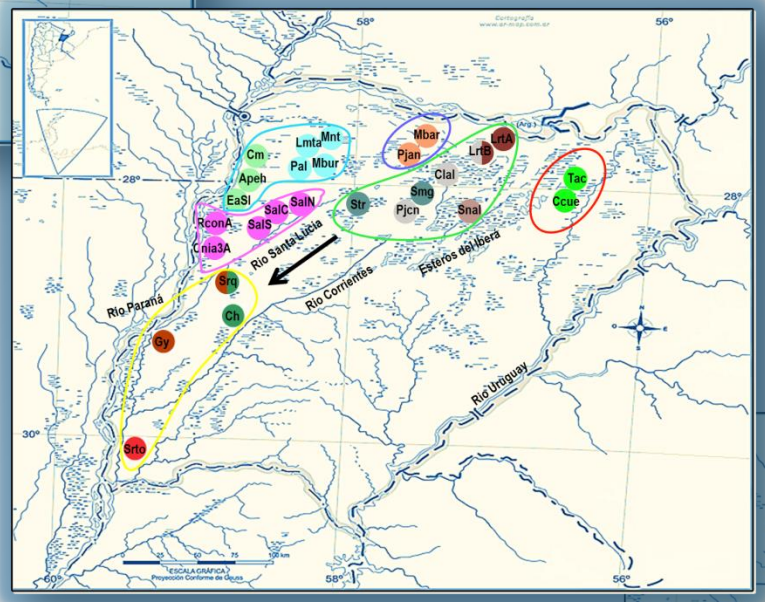
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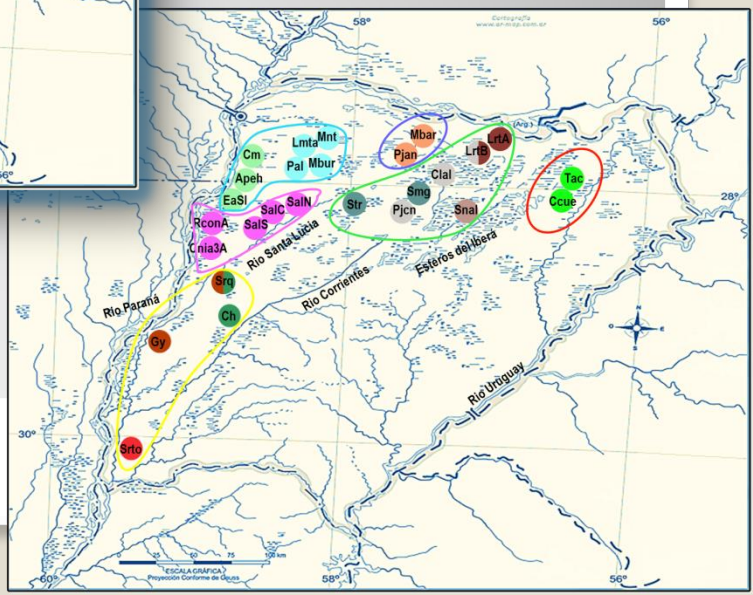
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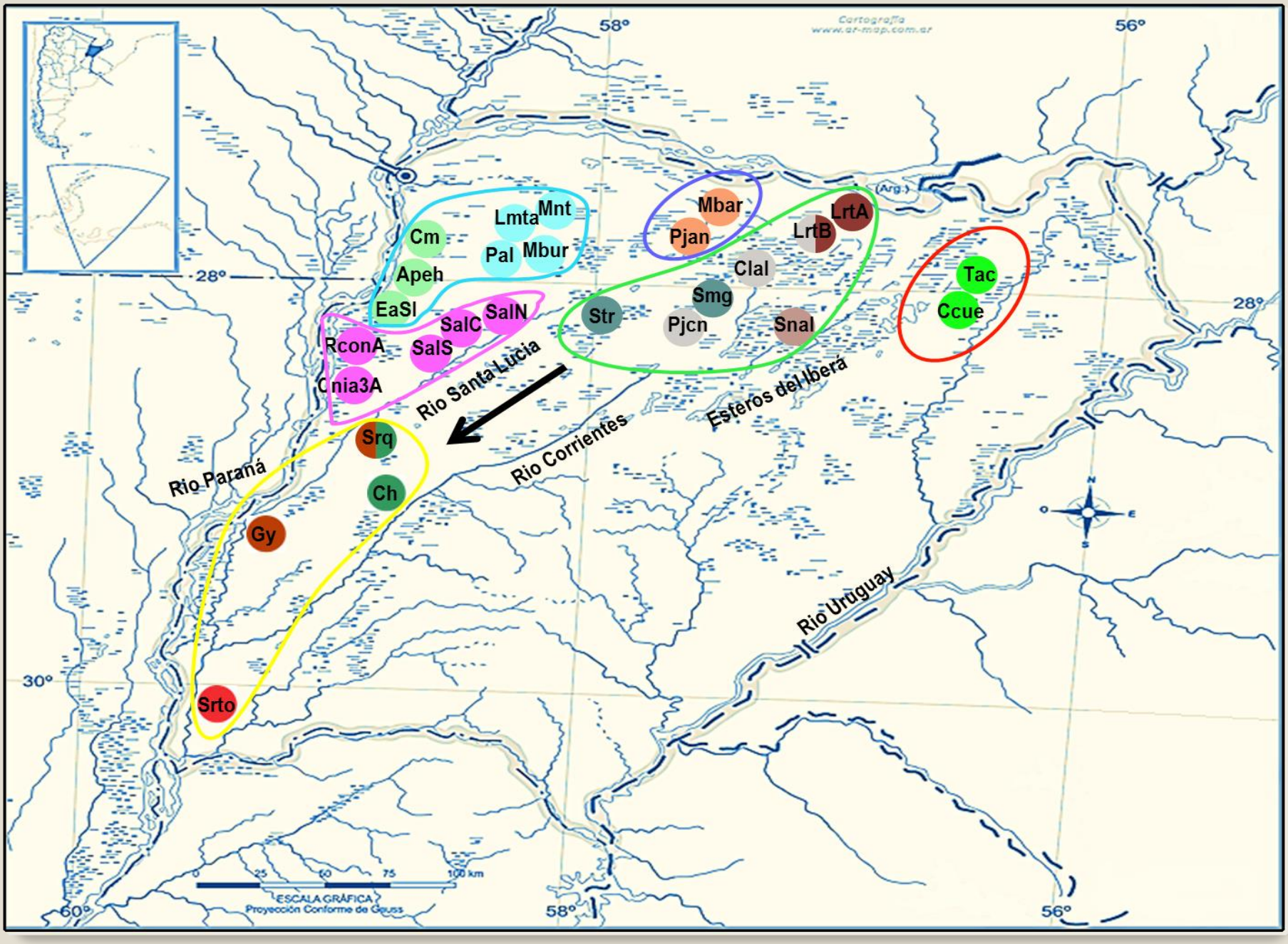
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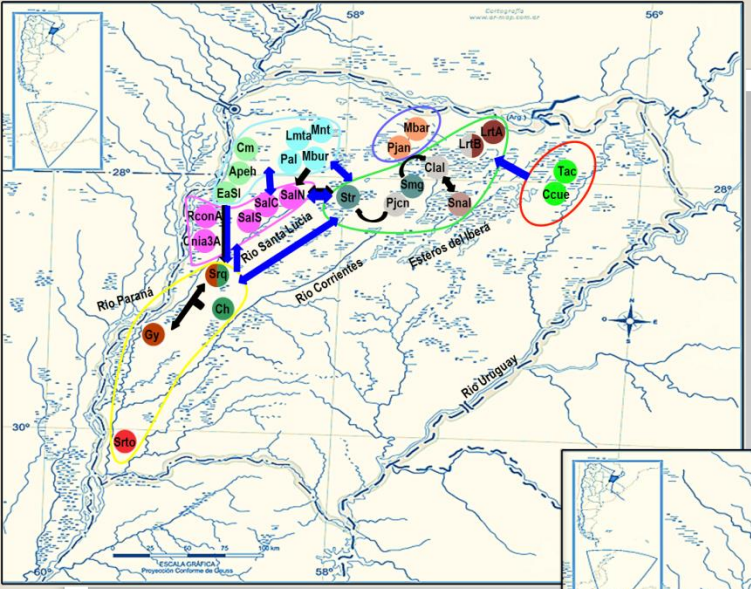
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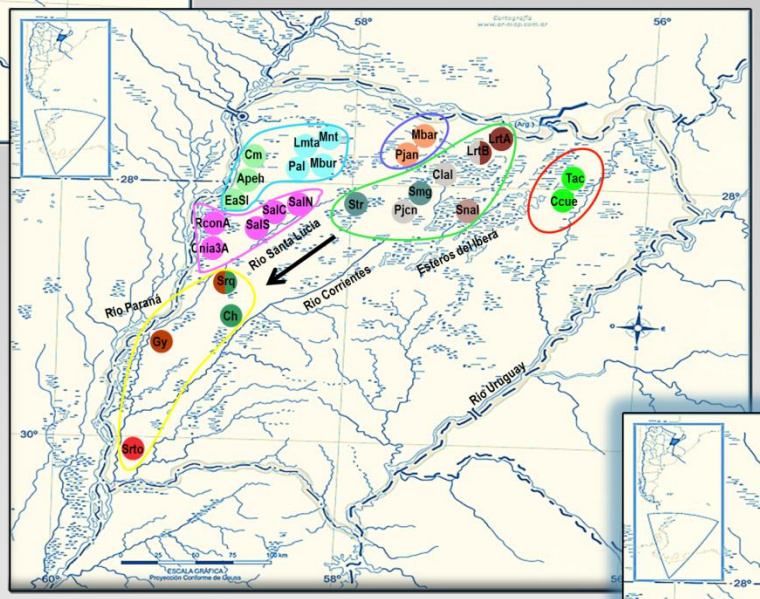
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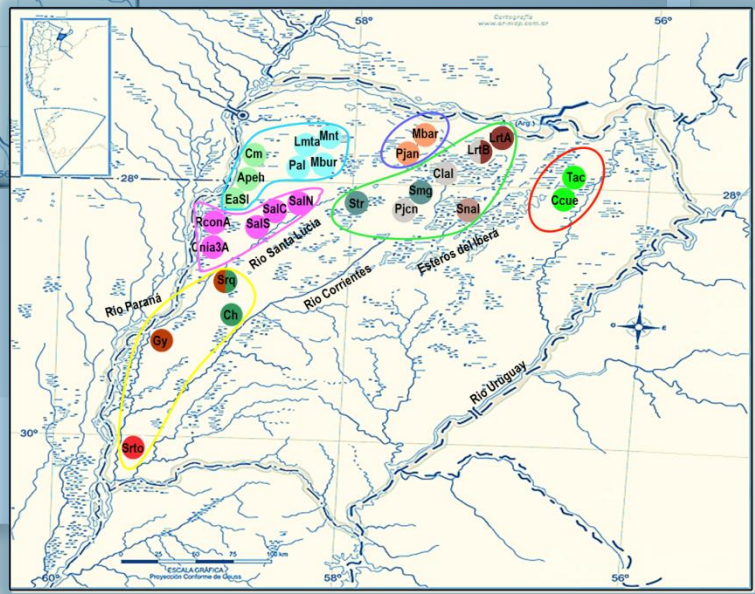
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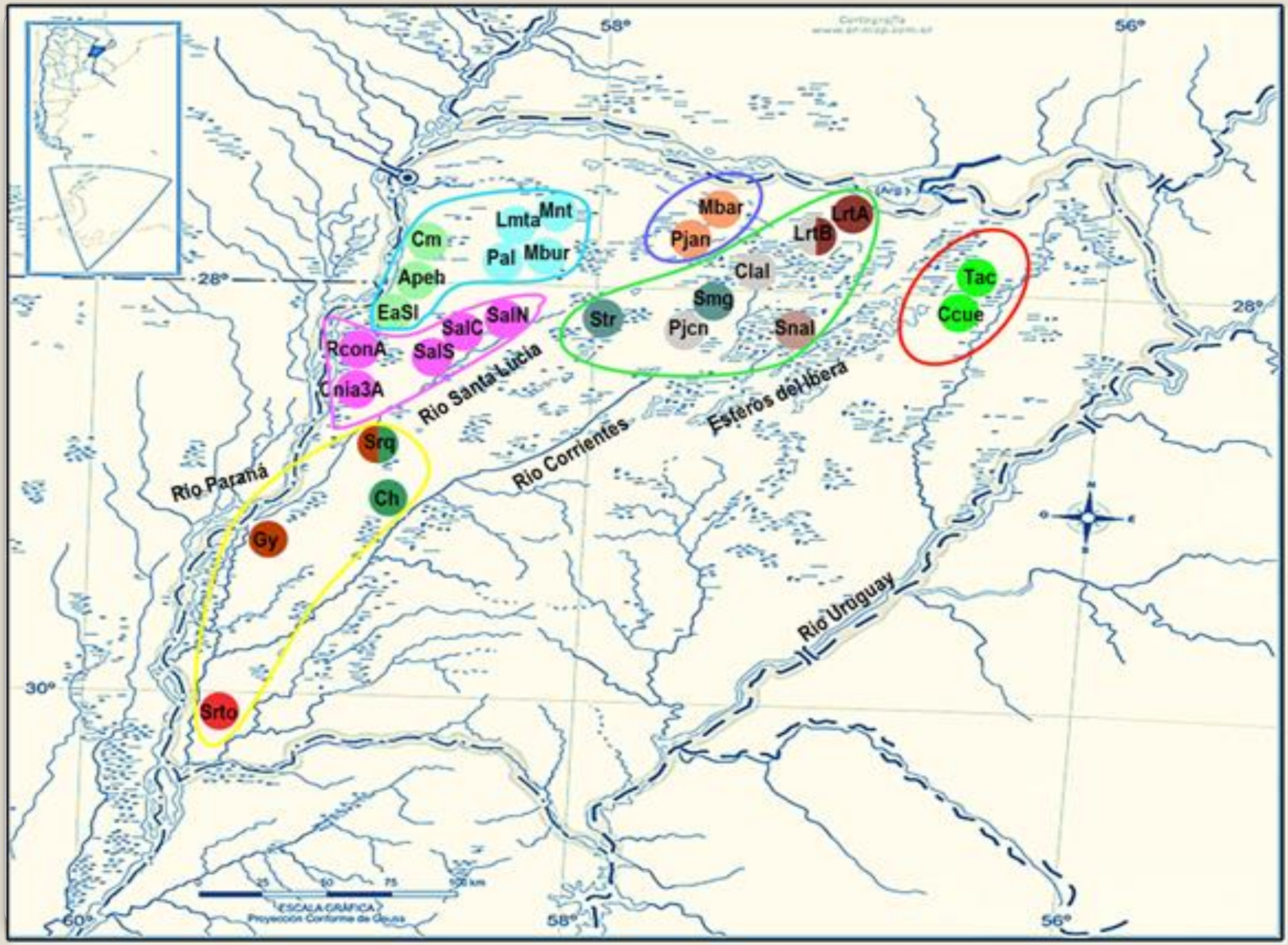
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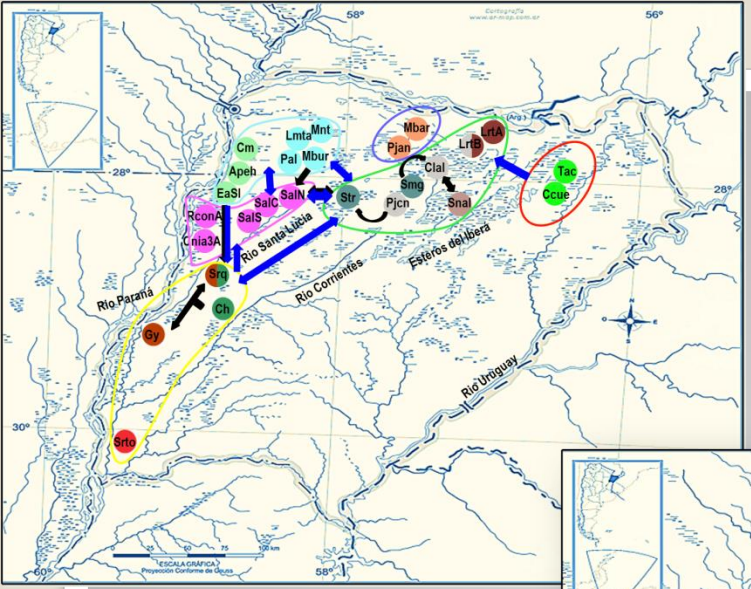
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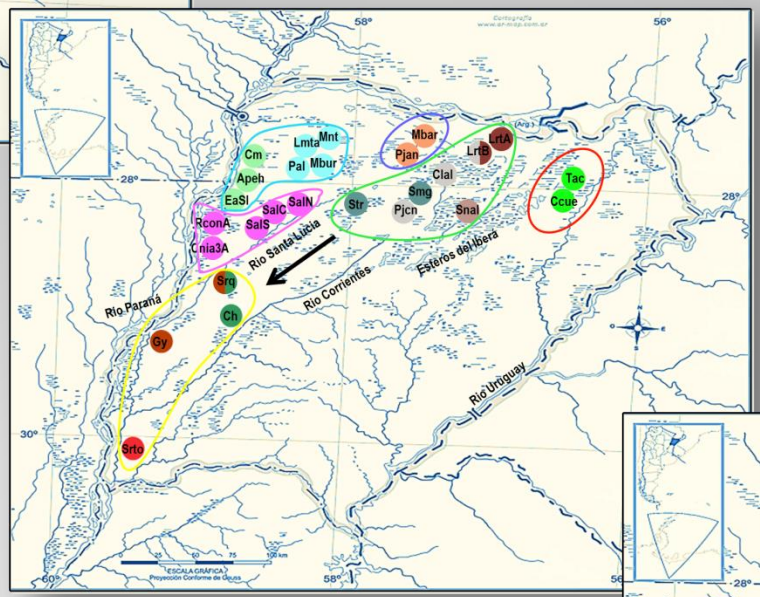
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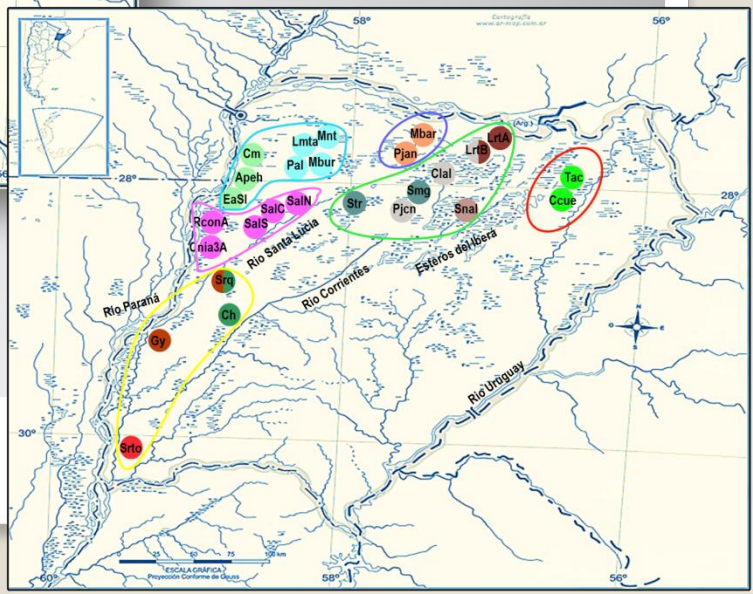
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30°
58°
56°
60°

Effect of different environmental factors on the genetic structure of populations

Initially 9 environmental factors.

Analysis of satellite imagery:

- **Habitat. (Ht)**.
- **Vegetation Index (VI)**
- **Elevation (E)**.

Several governmental institutions and projects:

- **Risk of flooding (Rfl)**.
- **Bulk density (BD).**
- **Annual average precipitation (Pp)**

Measure for distance:

- **longitude (Lon)**
- **latitude (Lat)**
- **Distance (D).**

Finally 6 Factors**: E, BD, VI, Ht, Pp and D**

Geste (Foll & Gaggiotti, 2006)

2^n models, being n the number of environmental factors.

$2^6=64$

Results

P(model=1)= 0.0519 (Constant)
P(model=2)= 0.0122 (Constant, G1)
P(model=3)= 0.00823 (Constant, G2)
P(model=4)= 0.00118 (Constant, G2, G1)
.
.
.
P(model=63)= 8.33e-05 (Constant, G6, G5, G4, G3, G2)
P(model=64)= 0.00 (Constant, G6, G5, G4, G3, G2, G1)

Step one. 6 Factors and 2 Clustering levels.(Localities, Populations)

Geste (Foll & Gaggiotti, 2006)

2^n models, being n the number of environmental factors.

2^6=64

Results

P(model=1)= 0.0519 (Constant)
P(model=2)= 0.0122 (Constant, G1)
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Geste (Foll & Gaggiotti, 2006)

2^n models, being n the number of environmental factors.

$2^6=64$

P(model=1)= 0.0519 (Constant)
P(model=2)= 0.0122 (Constant, G1)
P(model=3)= 0.00823 (Constant, G2)
P(model=4)= 0.00118 (Constant, G2, G1)
.
P(model=30)= 0.00 (Constant, G5, G4, G3, G1)
P(model=31)= 0.00 (Constant, G5, G4, G3, G2)
.
P(model=52)= 0.00128 (Constant, G6, G5, G2, G1)
.
P(model=63)= 8.33e-05 (Constant, G6, G5, G4, G3, G2)
P(model=64)= 0.00 (Constant, G6, G5, G4, G3, G2, G1)

Step one. 6 Factors and 2 Clustering levels. (Localities, Populations)

Sum of Posterior Probabilities

P(G1)= 0.716

P(G2)= 0.0933

P(G3)= 0.0849

P(G4)= 0.156

P(G5)= 0.0831

P(G6)= 0.879

Step two. 4 factors and two clustering levels.

Step one. 6 Factors and 2 Clustering levels.(Localities, Populations)

Sum of Posterior Probabilities

P(G1)= 0.716

P(G2)= 0.0933

P(G3)= 0.0849

P(G4)= 0.156

P(G5)= 0.0831

P(G6)= 0.879

P(model=1)= 0.0519 (Constant)
P(model=2)= 0.0122 (Constant, G1)
P(model=3)= 0.00823 (Constant, G2)
P(model=4)= 0.00118 (Constant, G2, G1)
.
.
.
P(model=63)= 8.33e-05 (Constant, G6, G5, G4, G3, G2)
P(model=64)= 0.00 (Constant, G6, G5, G4, G3, G2, G1)

Step two. 4 factors and two clustering levels.

Step one. 6 Factors and 2 Clustering levels. (Localities, Populations)

Sum of Posterior Probabilities

P(G1)= 0.716

P(G2)= 0.0933

P(G3)= 0.0849

P(G4)= 0.156

P(G5)= 0.0831

P(G6)= 0.879

Step two. 4 factors and two clustering levels.

Results.
Step one. 6 factors

Clustering level	Pb	Factors
Localities	**0.225**	**Distance+Elevation**
Populations	**0.155**	**Distance+Habitat+ Elevation**

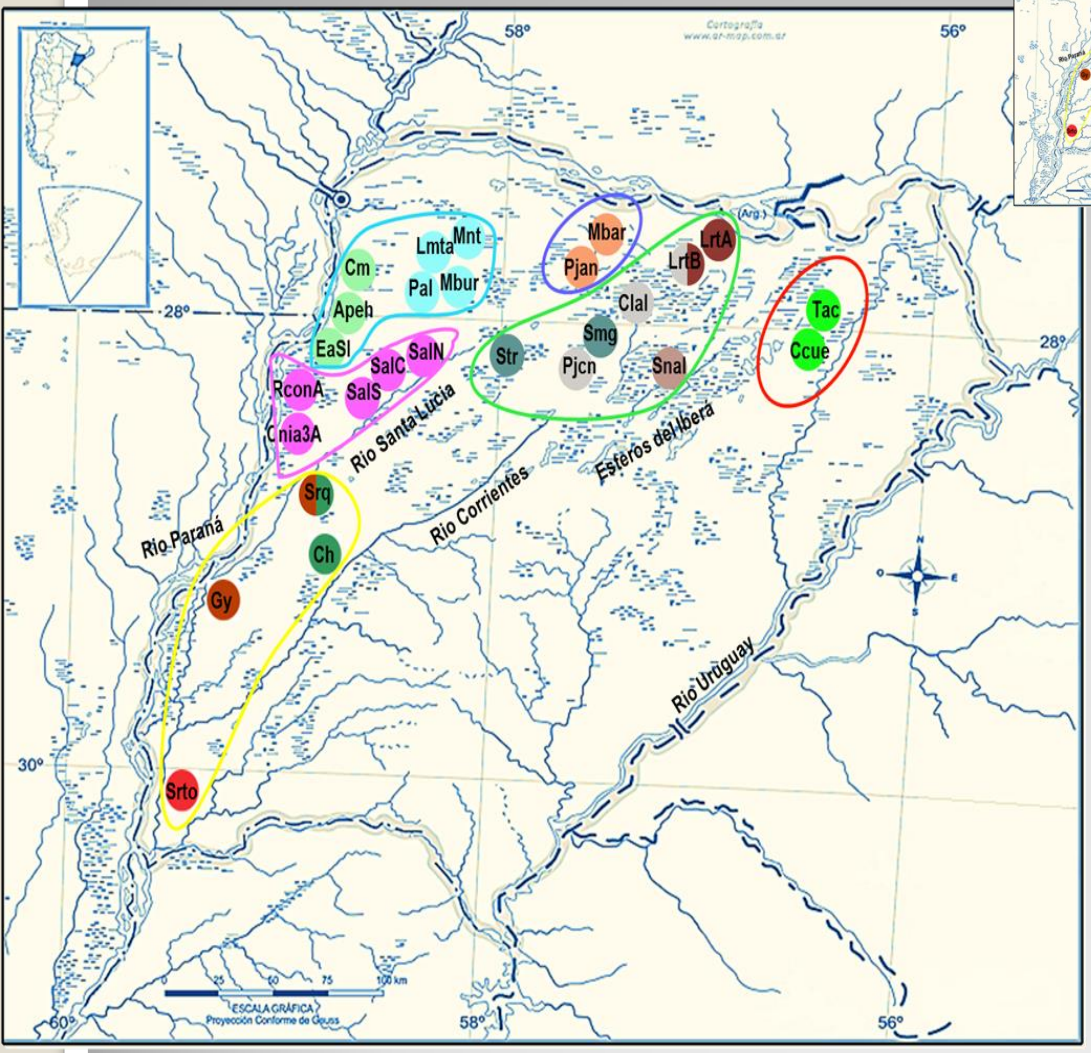
Factor	Sum of Posterior Probabilities	
	Clustering level	
	Localities	**Populations**
Elevation	**0.587**	**0.558**
Bulk Density	**0.254**	0.170
Vegetation Index	0.081	**0.241**
Habitat	**0.307**	**0.561**
Precipitation	0.078	0.195
Distance	**0.835**	**0.806**

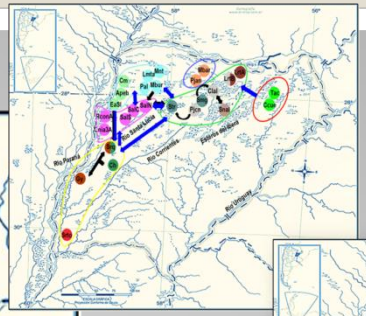
Step 2. 4 factors

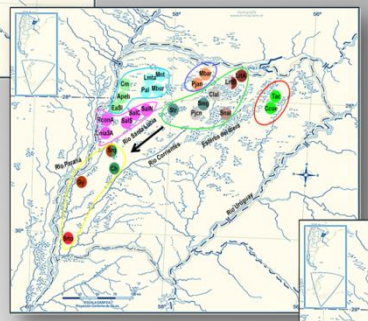
Custering level	Pb	Factors
Localities	**0.371**	**Distance+Elevation**
Populations	**0.172**	**Distance+Habitat+Elevation**

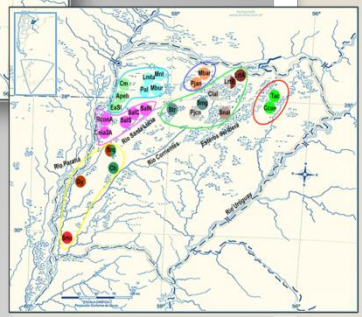
Clustering level	Factor	Regression coefficients	95% CI
Localities	C	-0.850	[-1.28; -0.433]
	Distance	**0.597**	**[0.184; 1.09]**
	Elevation	**0.457**	**[0.0437; 0.908]**
		0.969	[0.543; 1.99]
Popularions	C	-1.160	[-1.79;-0.515]
	Distance	**1.180**	**[0.450; 2.02]**
	Habitat	**0.737**	**[0.0669; 1.5]**
	Elevation	**0.642**	**[-0.0104; 1.41]**
		0.891	[0.340; 2.44]

Summary



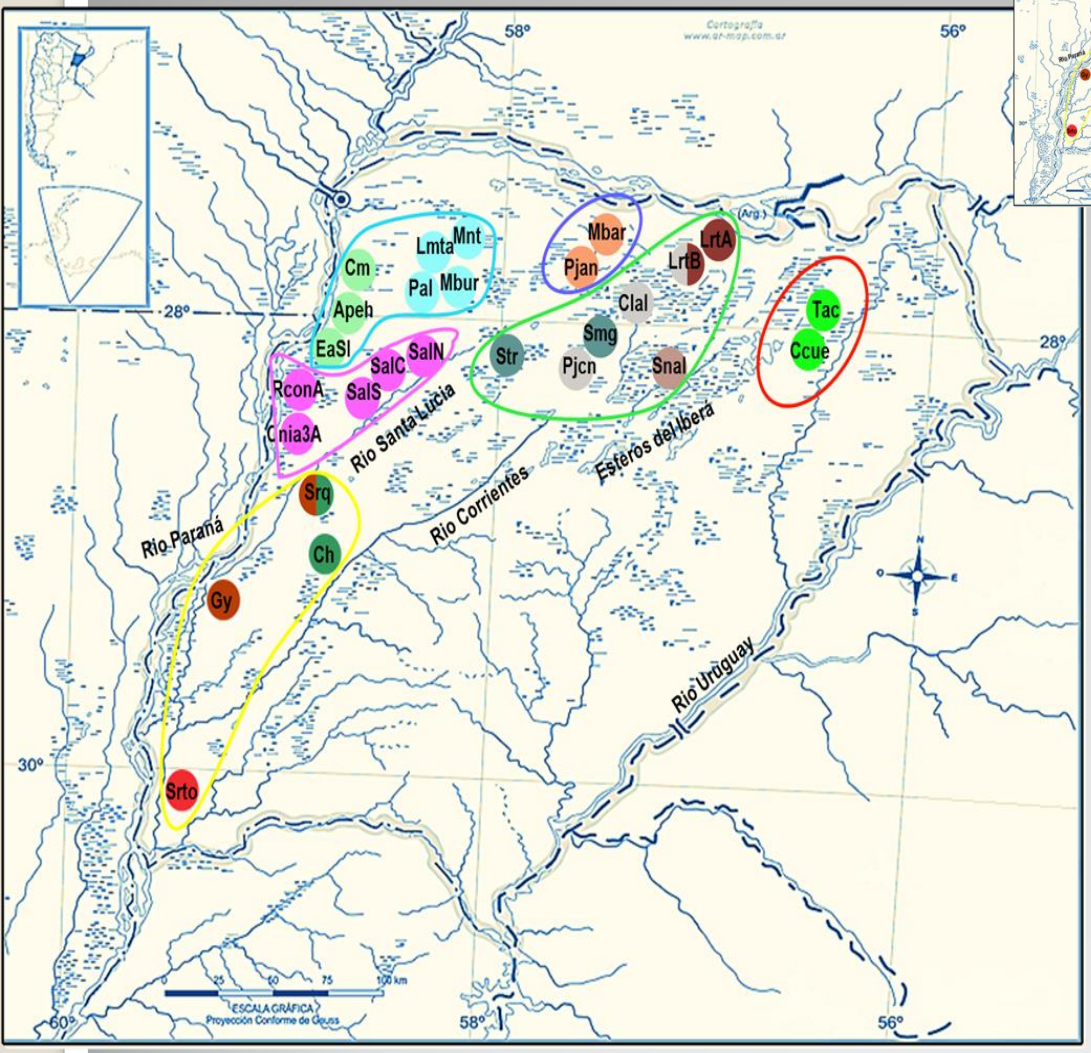


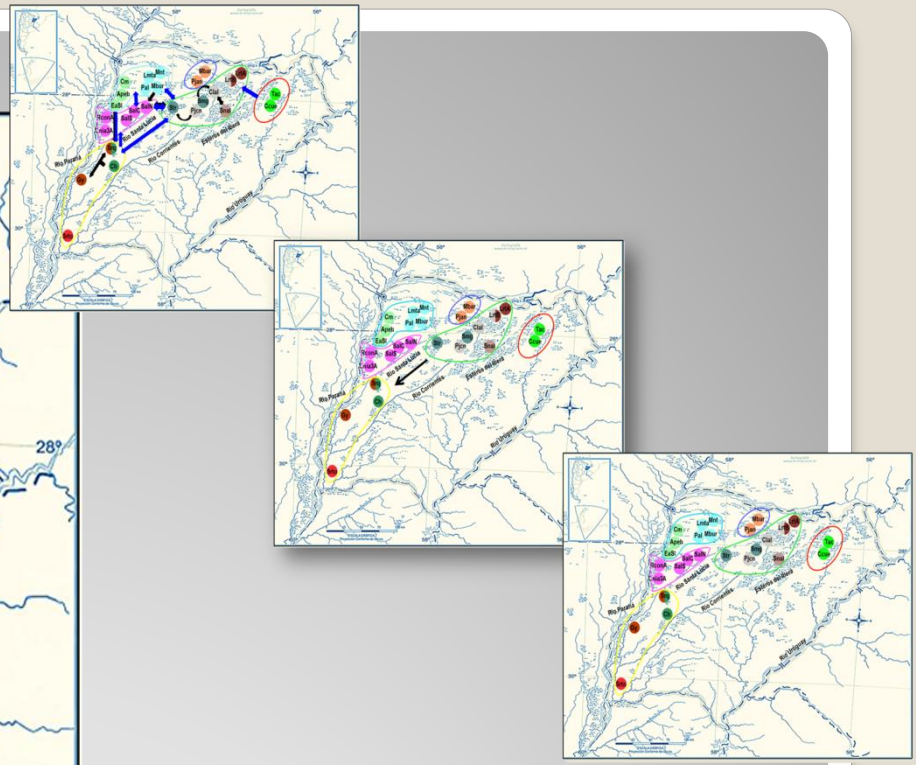




Connectivity

Summary





Connectivity

Thank you