

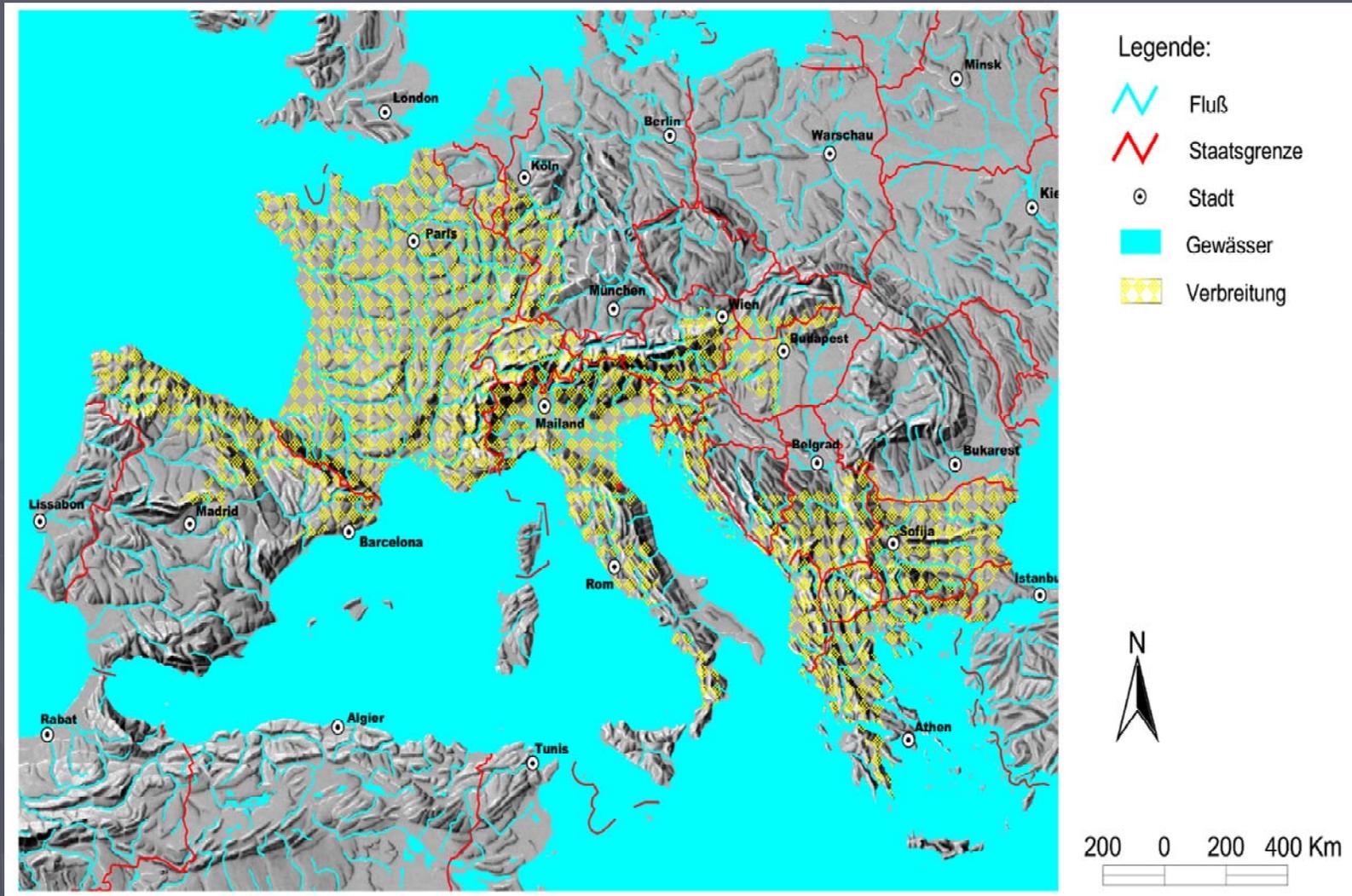
# Etudes sur la détermination des sous-espèces du lézard des murailles (*Podarcis muralis*, Laurenti 1768) vivant au Grand-Duché de Luxembourg



Franz Gassert

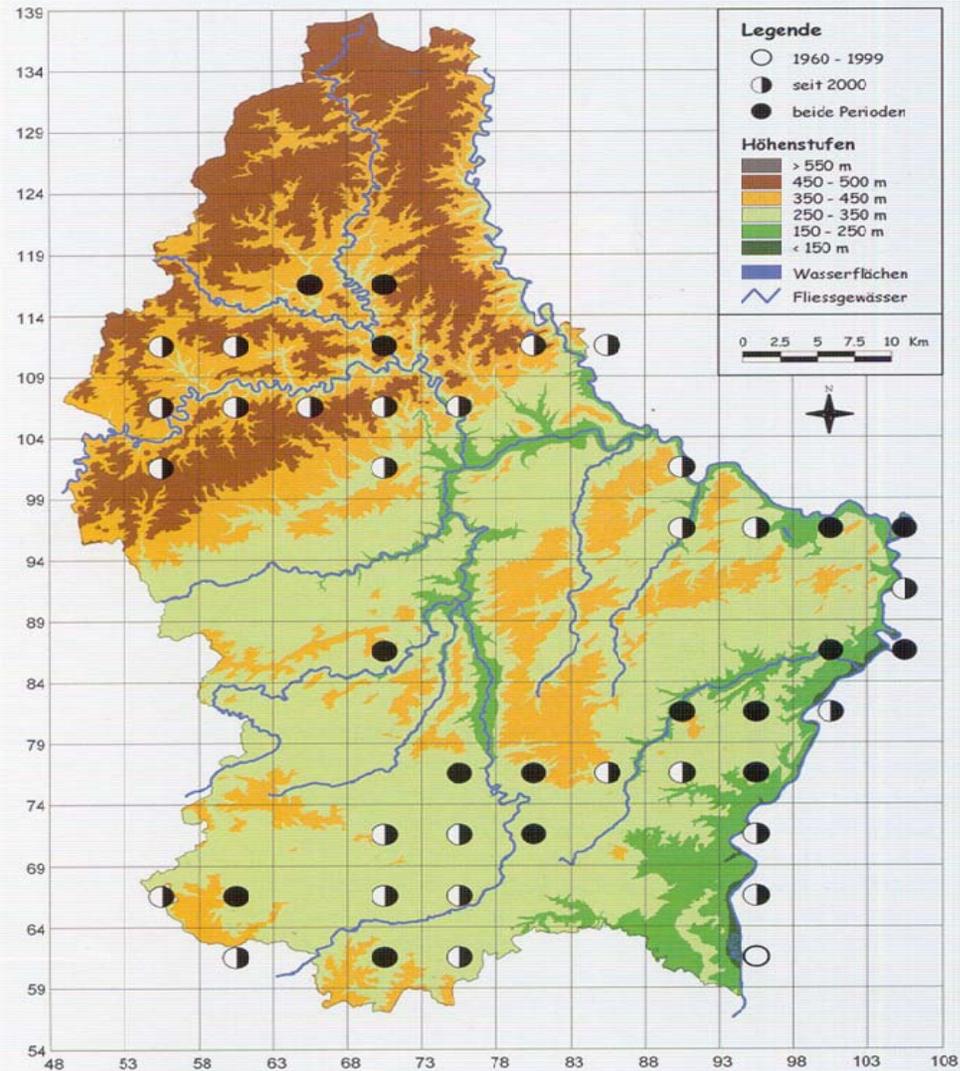


# Zone de distribution



# Distribution au Luxembourg

*Podarcis muralis* (Laurenti 1768)



Quellen:  
Ministère de l'Environnement (réseau hydrographique)  
Administration du Cadastre & Topographie (Limite d'Etat)

# Thèse 1

- ▶ Dans le nord de son aire de répartition, ils existent probablement deux différentes sous-espèces (BÖHME, 1986): *Podarcis muralis merremius* et *Podarcis muralis brogniardi*.
- ▶ Il y a deux voies d'immigration différentes.
  1. L'immigration à travers le Rhône et le Rhin (Moselle), *Podarcis muralis merremius*.
  2. L'immigration à travers la France du nord et la Meuse, *Podarcis muralis brogniardi*.
- ▶ Ils existent deux sous-espèces différents au Luxembourg.

## Thèse 2

- ▶ Selon SCHULTE et MAYER (2008) une seule sous-espèce existe au nord, *Podarcis muralis brogniardi*.

# Méthode

- ▶ Séquençage de l'ADN (mt. Cytochrome B).
- ▶ Photographie

# Sites d`échantillonnage en France



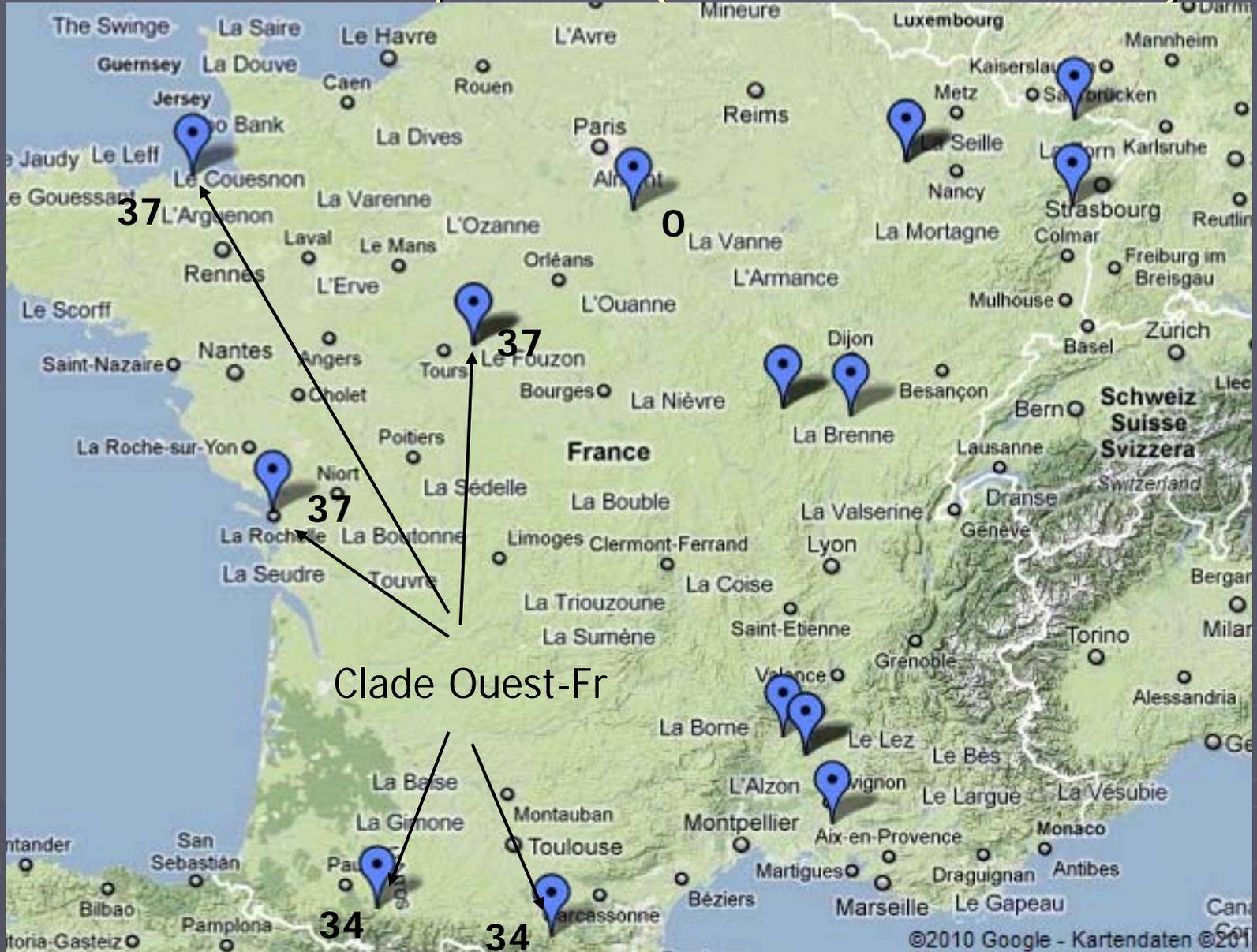
# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)

- ▶ Pyrénées (Montségur et Lourdes): 34
- ▶ La Rochelle et St. Malo (Atlantique): 37
- ▶ Loire (Amboise, Tours): 37
- ▶ **Fontainebleau: 0** (MEYER et. al. 2008)
- ▶ Provence: St. Rémy de Provence: 8
- ▶ Provence: Ardèche: 9
- ▶ Bourgogne: Autun: 2
- ▶ Bourgogne: Verdun sur le doubs: 10
- ▶ Alsace: Mont St. Odily: 1
- ▶ Lorraine: Bitche: 3
- ▶ Vallée de la Meuse (Euville): 2

# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)



# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)



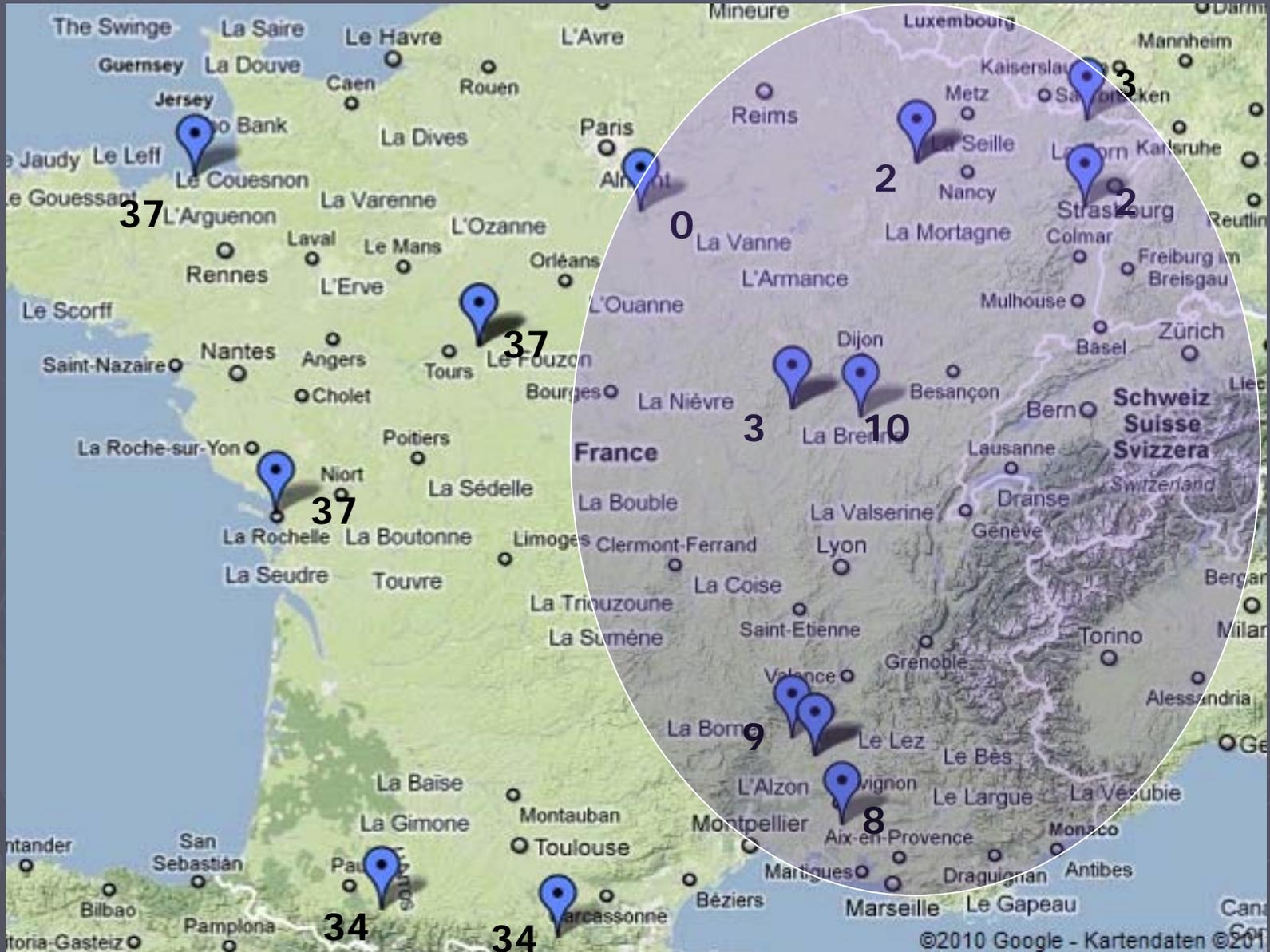
# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)



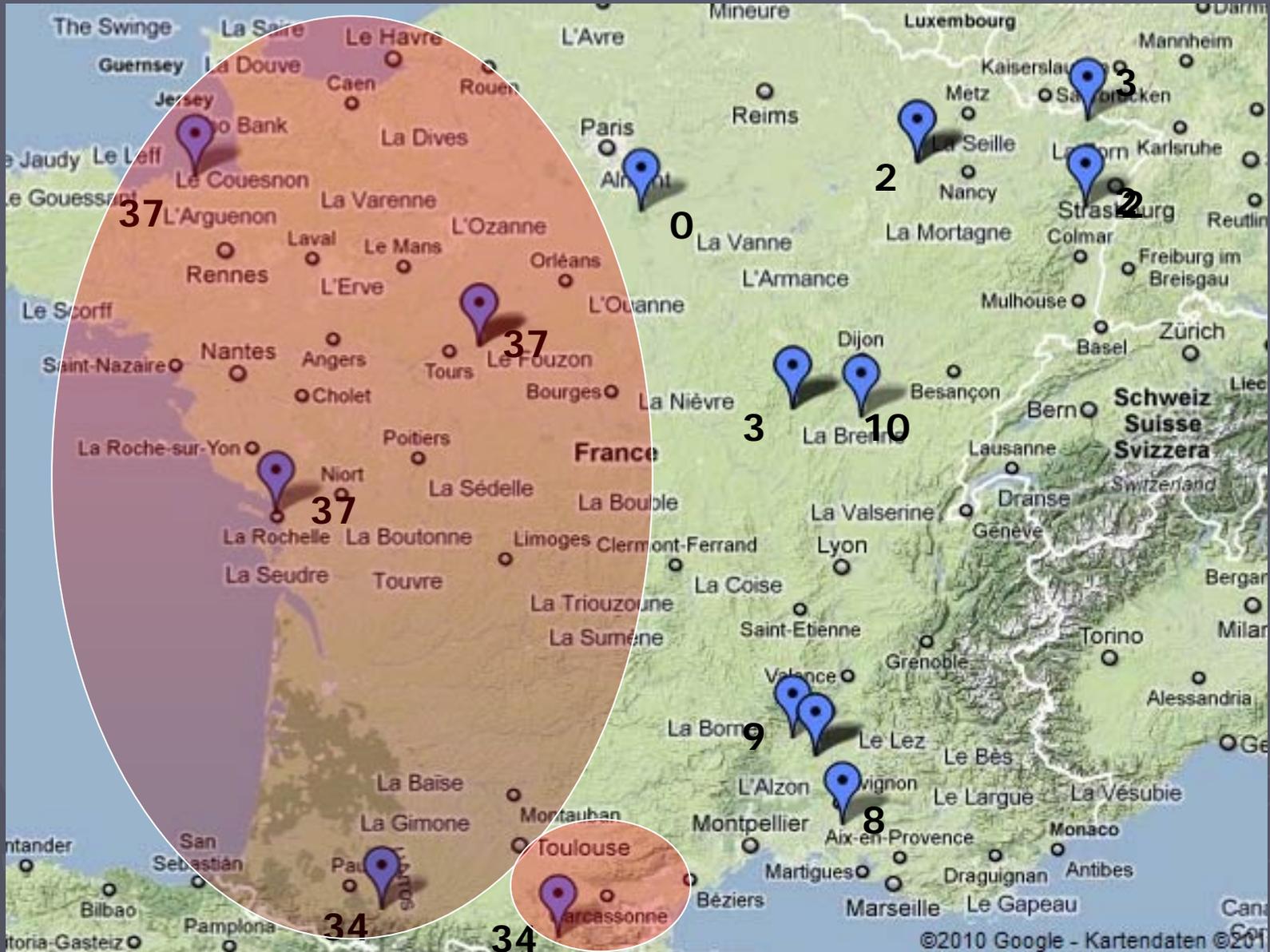
# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)



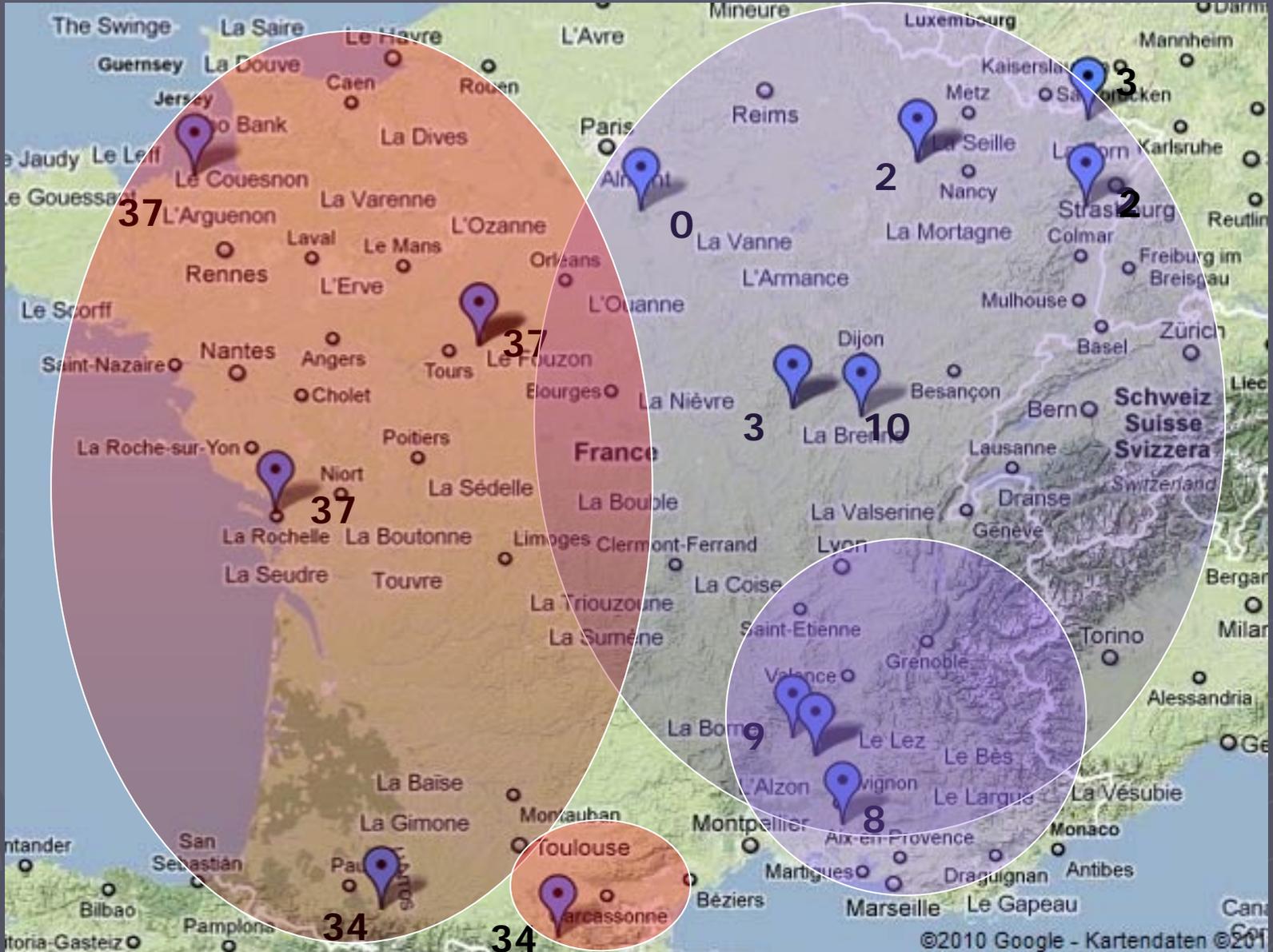
# Clade oriental français



# Clade occidental français



# Clades oriental français et occidental français



# Comparaison de deux séquences de Amboise (Loire) et Euville (Meuse)

Sequence Investigator - [Untitled]

File Edit View Window Help

A: C: G: T: N:

Consensus Attribute Search  
 Mismatch (!)  
 Ambiguity (?)  
 Disagreement (\*)  
 Insertion/Deletion (+/-)  
 Single Coverage (1)  
 Mutation Hotspot (M)  
 Low Quality (<)  
 Manual Edit

Consensus Text Search  
 Exact Match

Consensus: \_\_\_\_\_  
 Called Base: R  
 Quality Value: 0  
 Differences: ! ? \* <

Help

Codon Number	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174
Reference AA Translation	F	T	C	F	F	F	M	K	Q	D	Q	T	I	Q	Q	A	X	T	P	T
LL32Easternfrance.txt	TTC	ACC	TGC	TTT	TTC	TTC	ATG	AAA	CAG	GAT	CAA	ACA	ATC	CAA	CAG	GCT	TAA	ACT	CCA	ACA
Eu1-Sicnt.D02	TTC	ACC	TGC	TTT	TTC	TTC	ATG	AAA	CAG	GAT	CAA	ACA	ATC	CAA	CAG	GCT	TAA	ACT	CCA	ACA
Amb0-Sicnt.A02	TTC	ACC	TAC	TTT	TTC	TTC	ATG	AAA	CAG	GAT	CAA	ATA	ATC	CAA	CAG	GCT	TAA	ACT	CCA	ACA
Differences	<<<	<<<	< <	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	< <	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Consensus	TTC	ACC	TRC	TTT	TTC	TTC	ATG	AAA	CAG	GAT	CAA	AYA	ATC	CAA	CAG	GCT	TAA	ACT	CCA	ACA
Consensus AA Translation	F	T	CY	F	F	F	M	K	Q	D	Q	IT	I	Q	Q	A	X	T	P	T

Eu1-Sicnt.D02 (Forward)

Amb0-Sicnt.A02 (Forward)

Mismatch  
 Ambiguity  
 Disagreement  
 Insertion/Deletion  
 Mutation Hotspot  
 Low Quality  
 Manual Edit

LL32Easternfrance.txt  
 Eu1-Sicnt.D02  
 Amb0-Sicnt.A02

Ready

Start C:\Dokumente un... Main Menu - Versi... Sequence Analysis... Sequence Investig... Microsoft PowerPo... 470 NUM 16:22

# Comparaison de deux séquences de St. Martin d` Ardèche et Verdun sur le doubs (Bourgogne)

Sequence Investigator - [Untitled]

File Edit View Window Help

A: C: G: T: N:

**Consensus Attribute Search**

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

**Consensus Text Search**

Exact Match

<< >>

Consensus Called Base: Y

Quality Value: 0

Differences: ! ? \* <

Help

Codon Number	6	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Reference AA Translation	Q	I	S	P	P	H	F	H	L	S	L	T	F	T	E	T	S	S	T	
LL32Easternfrance.txt	CC	CAG	ATA	TCT	CCT	CCG	CAT	TTT	CAT	CTG	TCG	CTC	ACA	TTC	ACC	GAG	ACG	TCC	AGT	ACG
Bul-sicnt.H02	CC	CAG	ATA	TCT	CCT	CCG	CAT	TTT	CAT	CTG	TaG	CTC	ACA	TTC	ACC	GAG	ATG	TCC	AGT	ACG
SMA1-sicnt.D01	CC	CAG	ATA	TCT	CCT	CCG	CAT	TTT	CAT	CTG	TTG	CTC	ACA	TTC	ACC	GAG	ACG	TCC	AGT	ACG
Differences	<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Consensus	CC	CAG	ATA	TCT	CCT	CCG	CAT	TTT	CAT	CTG	TWG	CTC	ACA	TTC	ACC	GAG	AYG	TCC	AGT	ACG
Consensus AA Translation	Q	I	S	P	P	H	F	H	L	LX	L	T	F	T	E	MT	S	S	T	

**Bu1-sicnt.H02 (Forward)**

**SMA1-Sicnt.D01 (Forward)**

LL32Easternfrance.txt

Bul-sicnt.H02

SMA1-sicnt.D01

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

Start GMX - E-Mail, Free... Main Menu - Versio... Sequence Investig... Unterarten1.ppt Sequence Analysis 95 NUM 16:56

# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)



# Comparaison de deux sequences de Autun (Bourgogne) et Verdun sur le doubs (Bourgogne)

Sequence Investigator - [AT1-BU1.cgc]

File Edit View Window Help

A: C: G: T: N:

**Consensus Attribute Search**

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

**Consensus Text Search**

Exact Match

<< >>

Consensus Called Base: Y  
Quality Value: 0  
Differences: ! ? \* <

Help

Codon Number	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	7	
Reference AA Translation	L	D	E	A	Y	T	M	A	L	T	F	I	S	K	P	E	T	S	E	S	
Eastern-France-Clade-Fontainbl	A	TTG	GAC	GAG	GCC	TAT	ACT	ATG	GCT	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TCG	GAG	T
AT1-Sicnt.A01	A	TTG	GAC	GAG	GCC	TAT	ACT	ATG	GCT	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TCG	GAG	T
Bul-sicnt.H02	A	TTG	GAC	GAG	GCC	TAT	ACT	ATG	GCT	CTT	ACA	TTT	ACA	TCG	AAA	CCT	GAA	ACA	TCG	GAG	T
Differences	<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<I	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<
Consensus	A	TTG	GAC	GAG	GCC	TAT	ACT	ATG	GCT	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TCG	GAG	T
Consensus AA Translation	L	D	E	A	Y	T	M	A	L	T	F	I	S	K	P	E	T	S	E	S	

**AT1-Sicnt.A01 (Forward)**

**Bu1-sicnt.H02 (Forward)**

Eastern-France-Clade-Fontainbl-korrekt1.txt

AT1-Sicnt.A01

Bu1-sicnt.H02

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

Mittwoch, 24. Februar 2010

Start GMX - E-Mail, FreeMai... Main Menu - Version 9.0 Sequence Investigat... Sequence Analysis 17:33

# Sites d'échantillonnage en Luxembourg



# Nombre de paires de bases différentes (900 bp) Fontainebleau, LL32: (MEYER et. al. 2008)

## ► Luxembourg Nord:

1. Esch-sur-Sûre: 2
2. Michelau, Wilerwiltz, Kautenbach: 2
3. Bourscheid: 3, C: unique
4. Vianden: 2
5. Vallée de la Wark: 2
6. Beaufort: 2

## ► Luxembourg Mid:

1. Ansembourg: 2
2. La Rochette: 2
3. Luxembourg cité: 2

## ► Luxembourg Sud:

1. Wasserbillig: 2
2. Remich: 2

## ► Luxembourg Sud-Ouest

1. Dudelange: 3, C unique

# Clade oriental français au Luxembourg



# Comparaison de deux séquences de Dudelange et Esch-sur-Sûre

Sequence Investigator - [Du1-EsS1.cqz]

File Edit View Window Help

A: C: G: T: N:

**Consensus Attribute Search**

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

**Consensus Text Search**

Exact Match

Consensus

Called Base: G

Quality Value: 0

Differences: \* <

Help

Codon Number	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	5	
Reference AA Translation	S	S	T	D	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	
LL32Easternfrance.txt	G	TCC	AGT	ACG	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACA	GTG	CTT	CCA	TAT	TTT	TTA	T
Du1-Sicnt.G03	G	TCC	AGT	ACG	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	T
EsS1-Sicnt.H02	G	TCC	AGT	ACG	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	T
Differences	<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Consensus	G	TCC	AGT	ACG	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	T
Consensus AA Translation	S	S	T	D	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	

2545,89; 1,24 Du1-Sicnt.G03 (Forward)

2656,19; 3,48 EsS1-Sicnt.H02 (Forward)

LL32Easternfrance.txt

Du1-Sicnt.G03

EsS1-Sicnt.H02

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

Start

C:\Dokumente und Ei... Main Menu - Version 9,0 Sequence Analysis - [...] Sequence Investigat...

135 NUM

16:12

# Comparaison de deux sequences d`Autun (Bourgogne) et de Beaufort (Luxembourg)

Sequence Investigator - [AT1-Bea1.cqg]

File Edit View Window Help

A: C: G: T: N:

Consensus Attribute Search

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

Consensus Text Search

Exact Match

Consensus

Called Base: G

Quality Value: 0

Differences: \* <

Help

Codon Number	3	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Reference AA Translation	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	Y	T	
Eastern-France-Clade-Fontainbl	TA	TCC	GCA	ATC	TTC	ATG	CCA	ACA	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC	ACA
AT1-Sicnt.A01	TA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC	ACA
Bea1-Sicnt.D02	TA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC	ACA
Differences	<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Consensus	TA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC	ACA
Consensus AA Translation	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	Y	T	

AT1-Sicnt.A01 (Forward)

2450.00; 0.75

Bea1-Sicnt.D02 (Forward)

2578.00; 0.72

Eastern-France-Clade-Fontainbl-korrekt1.txt

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

Freitag, 26. Februar 2010

Start LEO Ergebnis... C:\Dokument... Microsoft Pow... Text zur Präs... Main Menu - V... Sequence Inv... 14:14

# Résultats de séquençage

- ▶ Toutes les populations en Luxembourg correspondent au clade oriental français.
- ▶ Deux populations ont leur propre base d'échanges (Bourscheid au nord et Dudelange au sud-ouest).
- ▶ Toutes populations sont autochtone.
- ▶ Aucune population est introduit de loin, pas même les populations les plus isolées (Chateau d'Ansembourg, Chateau de Beaufort, Vallée de la Wark).

# Podarcis muralis de la vallée de la moselle



# Podaris muralis de Luxembourg du Nord



# Podarcis muralis de la vallée de la Wark



# Podarcis muralis du Ansembourg



# Petit présent pour la 25<sup>ème</sup> anniversaire du groupe Raïne

- ▶ Séquençage d` un lézard des murailles de l` Anhée, échantillonné a` l`année 2003

# Résultat de séquençage: Anhée, Belgique

Sequence Investigator - [Be21-k2.cgc]

File Edit View Window Help

A: C: G: T: N:

**Consensus Attribute Search**

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

**Consensus Text Search**

Exact Match

Consensus Called Base: T  
Quality Value: 16  
Differences: \* 1 <

Help

Codon Number	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	8	
Reference AA Translation	L	T	F	I	S	K	P	E	T	S	E	S	S	F	Y	F	X	L	X	P	
LL32Easternfrance.txt	T	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TCG	GAG	TCC	TCC	TTC	TAC	TTC	TAG	TTA	TAG	C
Be21-k2-Sicnt.G01_10021109TS(3)	T	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TTG	GAG	TCC	TCC	TTC	TAC	TTC	TAG	TTA	TAG	C
Be21-k2-L15335.G02_10021111V1(1)	T	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TTG	GAG	TCC	TCC	TTC	TAC	TTC	TAG	TTA	TAG	C
Differences											1*1										
Consensus	T	CTT	ACA	TTT	ATA	TCG	AAA	CCT	GAA	ACA	TTG	GAG	TCC	TCC	TTC	TAC	TTC	TAG	TTA	TAG	C
Consensus AA Translation	L	T	F	I	S	K	P	E	T	L	E	S	S	F	Y	F	X	L	X	P	

Be21-k2-Sicnt.G01\_10021109TS(3)\_10021115BI (Forward)

Be21-k2-L15335.G02\_10021111V1(1)\_10021115DN (Forward)

LL32Easternfrance.txt

Be21-k2-Sicnt.G01\_10021109TS(3)\_10021115BI

Be21-k2-L15335.G02\_10021111V1(1)\_10021115DN

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

224 NUM

Start Microsoft PowerPoint ... GMX - E-Mail, FreeMai... Main Menu - Version 9.0 Sequence Investigat... 11:30

Je vous remercie pour votre attention



Franz Gassert





# Comparaison de deux séquences de Beaufort et de la vallée de la Wark

Sequence Investigator - [Bea1-W3-Sicnt.cgc]

File Edit View Window Help

A: C: G: T: N:

Consensus Attribute Search

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

Consensus Text Search

Exact Match

Consensus

Called Base: G

Quality Value: 0

Differences: \* <

Help

Codon Number	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	5	
Reference AA Translation	D	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	
Eastern-France-Clade-Fontainbl	G	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACA	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	A
Bea1-Sicnt.D02	G	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	A
W3-Sicnt.B02	G	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	A
Differences	<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<	<<<
Consensus	G	GAT	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	A
Consensus AA Translation	D	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	

Bea1-Sicnt.D02 (Forward)

W3-Sicnt.B02 (Forward)

Eastern-France-Clade-Fontainbl-korrekt1.txt

Bea1-Sicnt.D02

W3-Sicnt.B02

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

135 NUM

Start

LEO Ergebnis... C:\Dokument... Microsoft Pow... Text zur Prés... Main Menu - V... Sequence Inv...

14:11



# Clade E-France et ?



# Urft, Allemagne

Sequence Investigator - [U7.cpq]

File Edit View Window Help

A: ■ C: ■ G: ■ T: ■ N: ■

Consensus Attribute Search

- Mismatch (!)
- Ambiguity (?)
- Disagreement (\*)
- Insertion/Deletion (+/-)
- Single Coverage (1)
- Mutation Hotspot (M)
- Low Quality (<)
- Manual Edit

Consensus Text Search

Exact Match

Consensus

Called Base: G

Quality Value: 35

Differences: \*1

Help

Codon Number	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Reference AA Translation	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	Y
LL32Easternfrance.txt	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACA	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC
U7-k-Sicnt.E01_10021011RF	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	ttA	TCT	GCA	TTT	ATC	TAC
U7-k-L15335.E02_10021011JY																				
Differences	111	111	111	111	111	111	111	111	11*	111	111	111	111	111	111	111	111	111	111	111
Consensus	GAC	TTA	TCC	GCA	ATC	TTC	ATG	CCA	ACG	GTG	CTT	CCA	TAT	TTT	TTA	TCT	GCA	TTT	ATC	TAC
Consensus AA Translation	D	L	S	A	I	F	M	P	T	V	L	P	Y	F	L	S	A	F	I	Y

2995,00; 0,03 U7-k-Sicnt.E01\_10021011RF (Forward)

4586,38; 2,95 U7-k-L15335.E02\_10021011JY (Forward)

LL32Easternfrance.txt

U7-k-Sicnt.E01\_10021011RF

U7-k-L15335.E02\_1002

- Mismatch
- Ambiguity
- Disagreement
- Insertion/Deletion
- Mutation Hotspot
- Low Quality
- Manual Edit

Ready

135 NUM

Start Microsoft PowerPoint ... GMX - E-Mail, FreeMai... Main Menu - Version 9.0 Sequence Investigat... 11:05