

Risk mapping and surveillance

Methods and their applications

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RVFV : Challenge, Prevention and Control
November 13-15, 2012



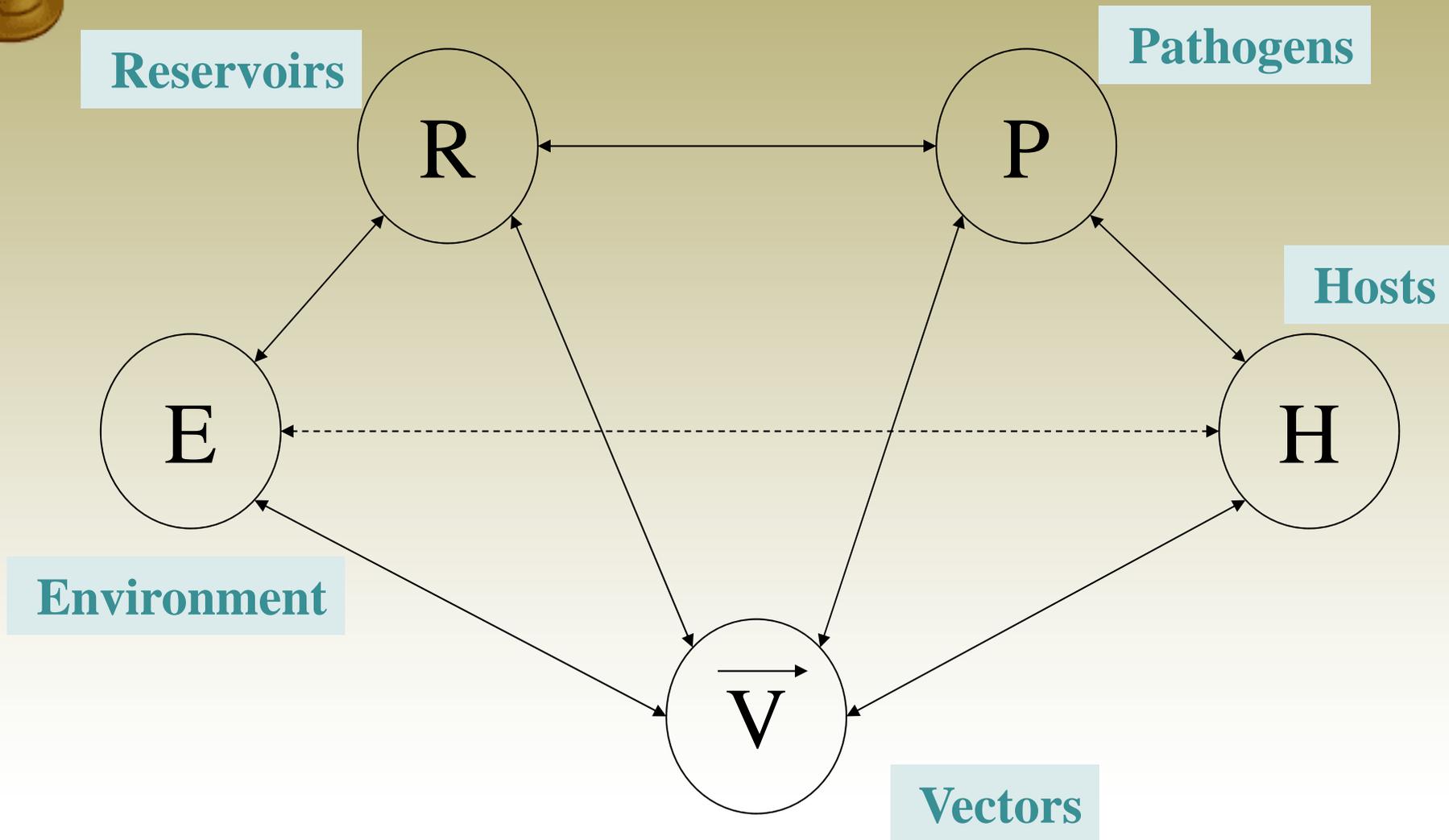


Risk mapping and surveillance : Methods and their applications

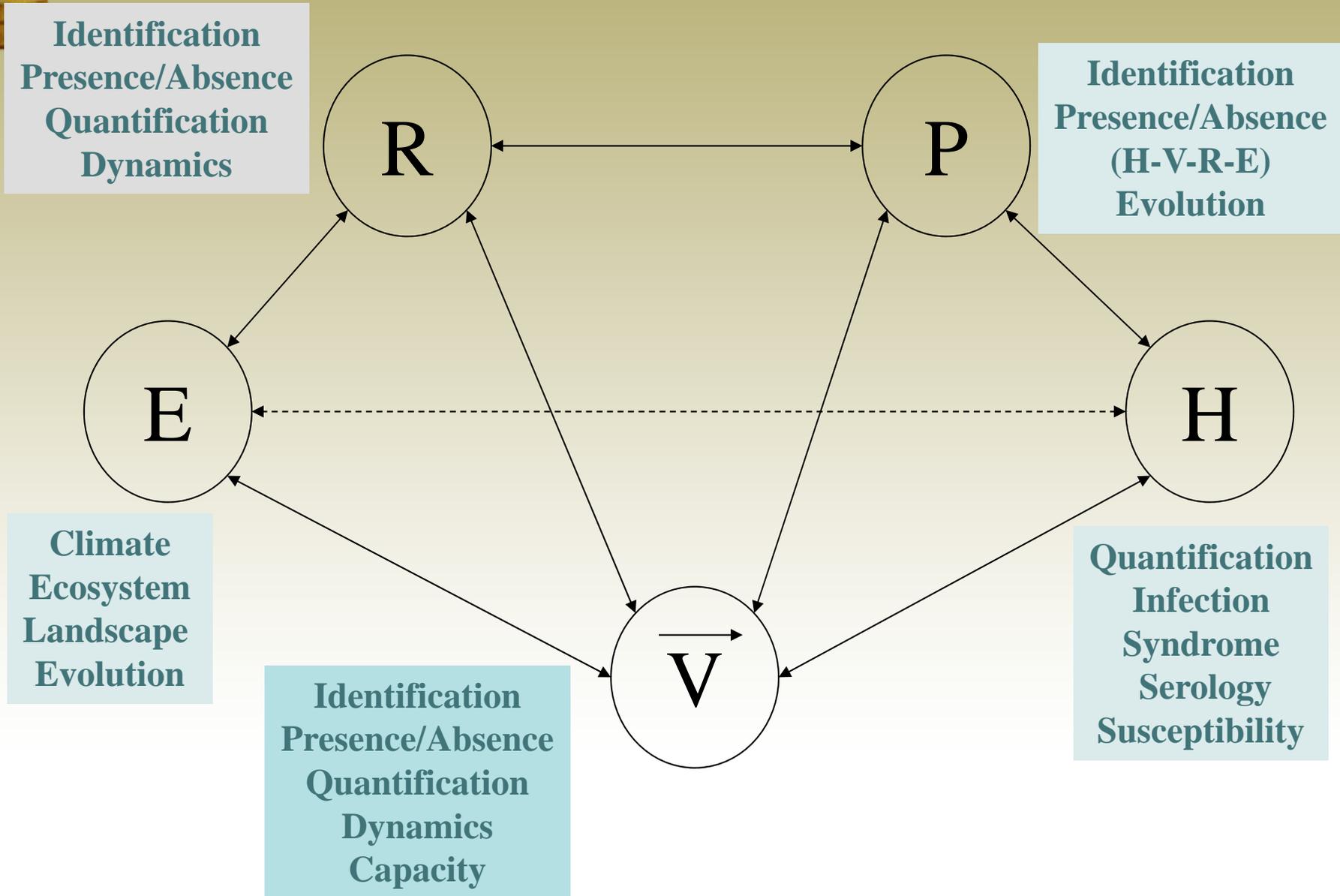
PLAN

- **Vector-based approach**
- **Surveillance Objectives**
- **Keys in a vector-based surveillance system**

A vector-based approach



A vector-based approach





Surveillance Objectives

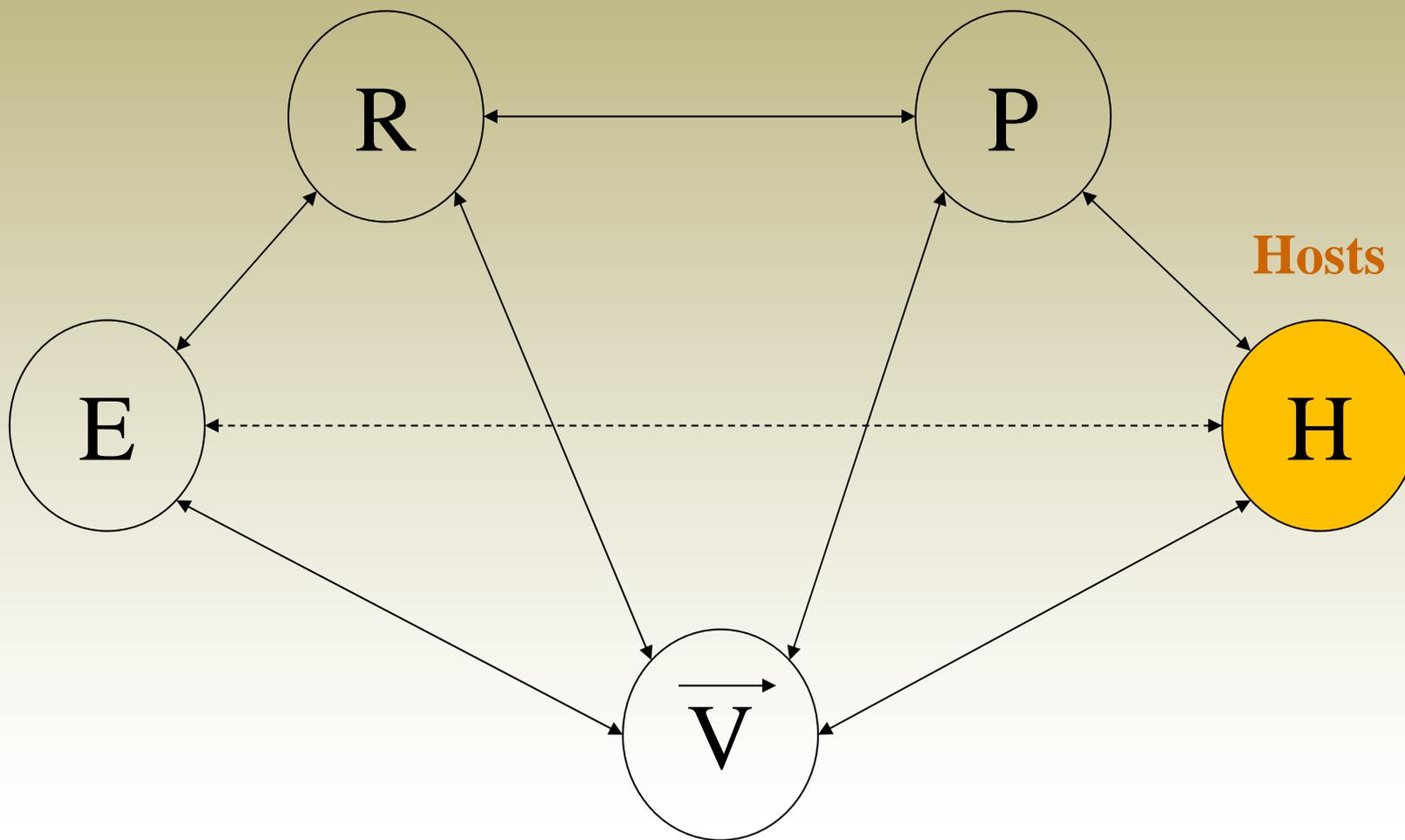
- **Vigilance**

- Detection of an outbreak caused by a new vector borne disease in a country
 - RVF in southern France
- Detection of a novel serotype of a known disease
 - The case of BTV-8 in northern Europe (Netherlands)
- Risk prediction of a new outbreak of a known or unknown disease

- **Surveillance**

- Efficiency of implemented control methods
 - BTV8 and BTV1 in France
- Epidemiological changes
 - West Nile in the Camargue zone
 - RVF in East Africa

A vector-based surveillance system





Hosts

- Quantification
- Detection of the aetiologic agent
 - Clinical/syndromic surveillance
 - Sero- Surveillance (longitudinal, case-study surveys)
 - Virus Surveillance
- Resistance/ Susceptibility

① RVF in Comoros, Mayotte, 2009

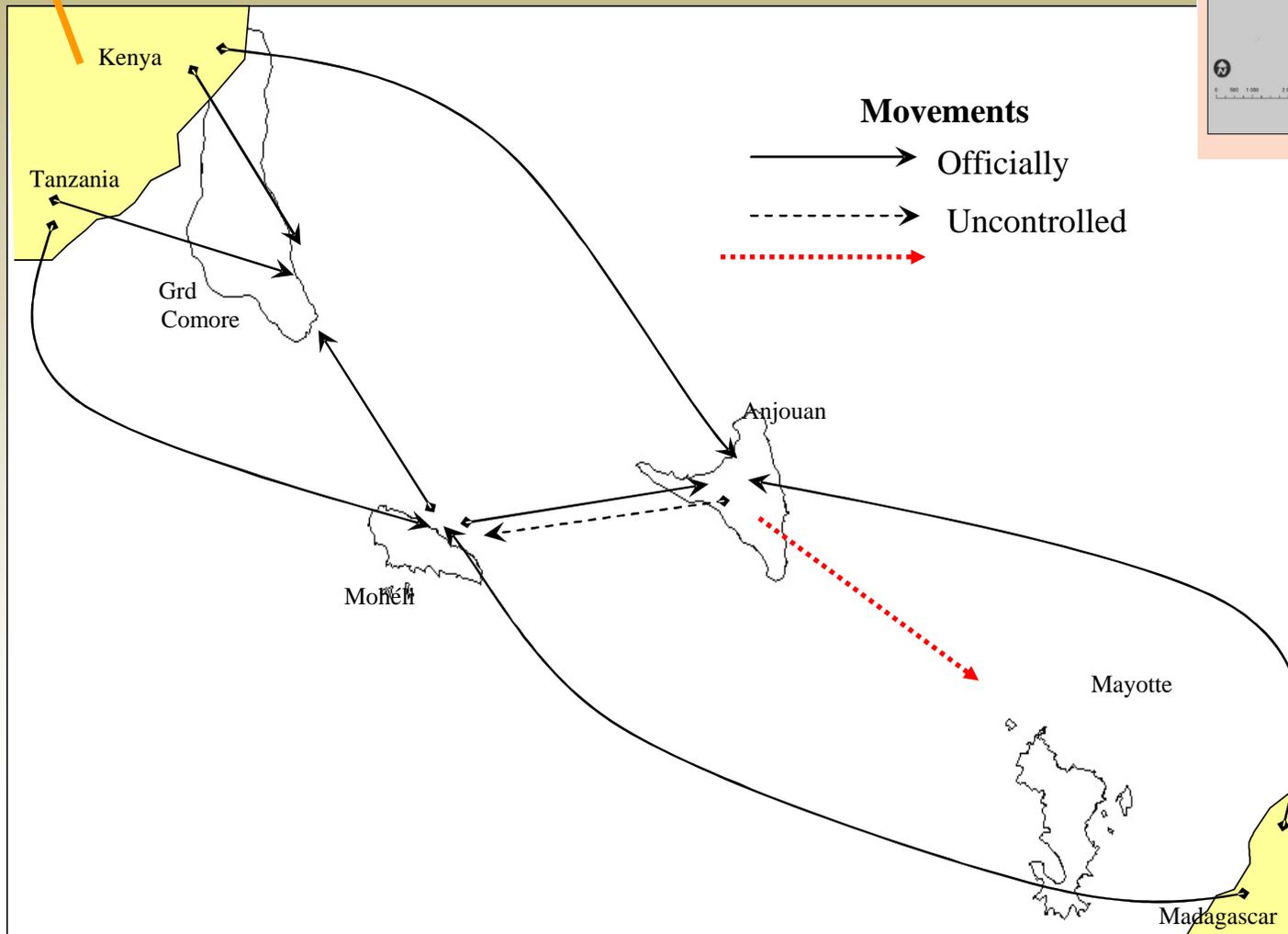
② RVF in Senegal, 1998

③ WN in southern France, 2000



① RVF in Comoros, Mayotte

Outbreaks in 2006-2007





What happened in Mayotte (1/4)



First reported case: Child, 12 years old, September 2007, Comoros
Retrospective survey on 250 dengue-like syndromes in humans has confirmed the existence of 10 RVF cases (Sissoko et al., 2009)

3 different studies following the human case (Comoros)

1. **Studies focused in M'Tsangamougi area –March 2008 and animals from illegal movements**
2. **Retrospective study on bovine sera from 2007 and 2008**
3. **Development of a serosurveillance network based on sentinel herds (goats) to follow up the virus circulation**



What happened in Mayotte (2/4)

1. Studies focused in M'Tsangamougi area –March 2008 and illegally imported goats (2/2)- April 2008

- 13 animals IgG+ and 3 IgM+ among 79 zebus tested
- Follow-up of bovines found seronegative in March 2008



One seroconversion has been observed among the 18 seronegative bovines

- Follow-up of one caprine farm (9 seropositives among 12 tested goats) and 4 other bovine farms (16 found + among 53 bovines)
- Among 29 illegally imported animals, 4 were IgG+ and 2 IgM +

In conclusion,



- among the 79 tested zebus, 13 were seropositive in April 2008
- among the 29 illegally imported goats, 4 positive IgG and 2 with IgM (14%)



Recent circulation of the virus



What happened in Mayotte (3/4)

2. Retrospective study on bovine sera from 2007 and 2008

Material

- Sera from zebu stored in the veterinary laboratory from 2007-2008
- Random sampling
- Sampling performed between June 2007 and May 2008

Results

- 304 animals were tested in 104 different farms
- **Distribution in 14 villages**
 - ⇒ **Virus Circulation all over the island**
 - ⇒ **Importation from neighbouring and suspected islands**



Distribution, by village of the IgG seropositive farms

(nombre d'animaux positifs/ total)

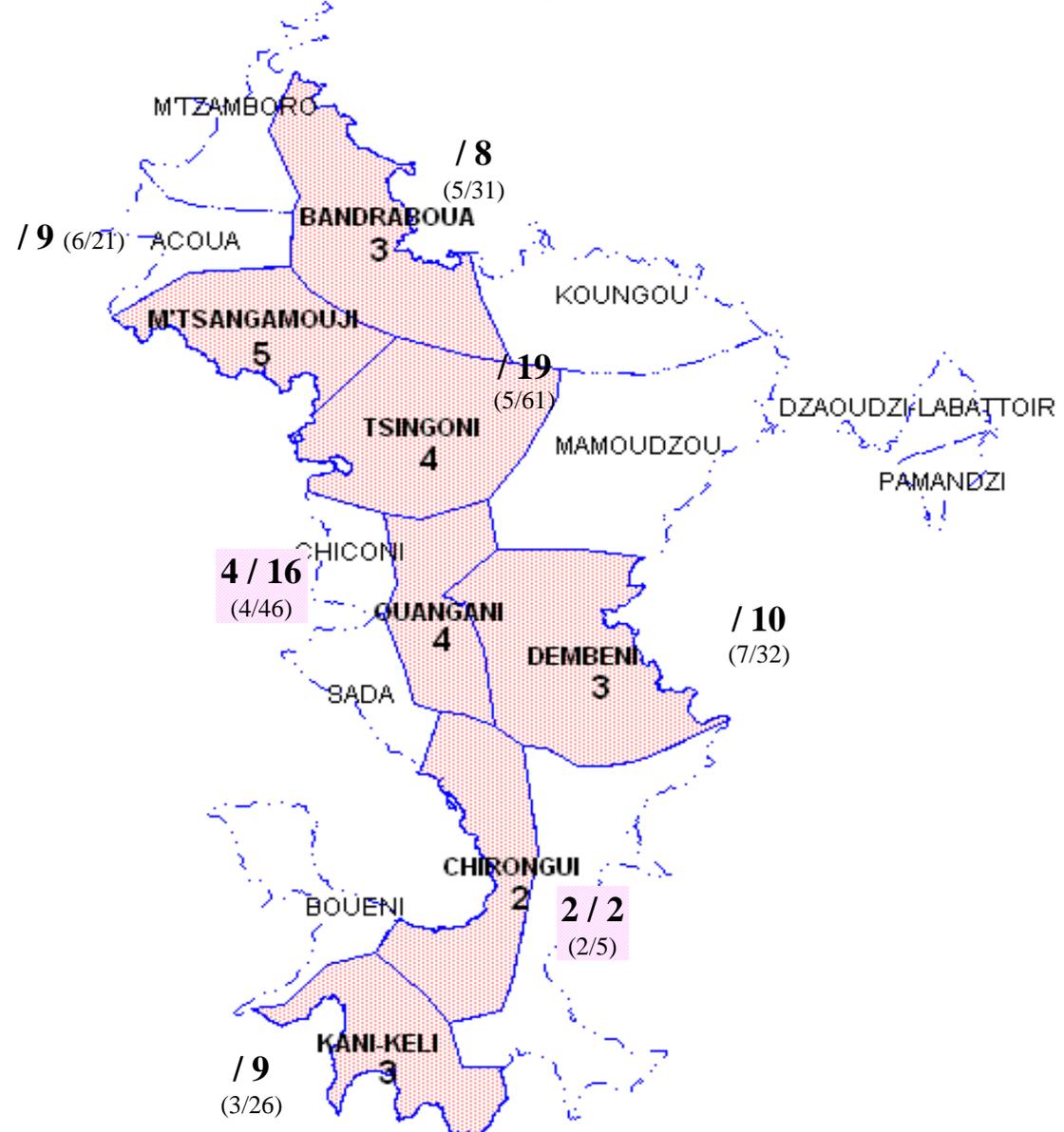
Results

- 32 positives meaning 11 % of SP (IC : 7-14)

- Distribution:
 - ✓ In 7 of the 14 tested villages
 - ✓ In 24 farms

⇒ Circulation of the virus in the whole island

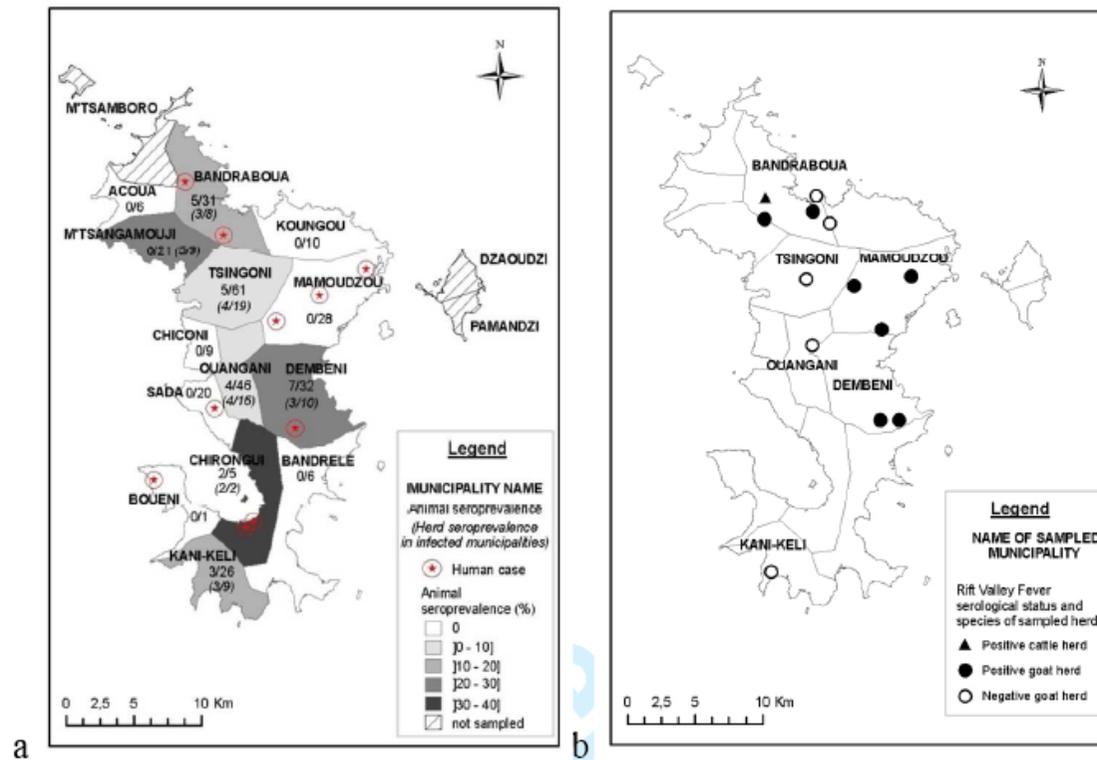
Nombre de cheptels porteurs d'Ig Totaux FVR par commune





DISTRIBUTION of the FVR SEROPOSITIVE RUMINANTS FARMS in MAYOTTE (Follow up of the 104 bovines sampled in May 2008 with 13 cheptels ovines/caprines)

Figure 2: Rift Valley fever in Mayotte. a. human cases and animal and herd seroprevalences, b. status of herds sampled for the longitudinal serological study





What happened in Mayotte (4/4)

3. Definition of sentinel herds (goats) to follow up the virus circulation

- 13 caprine farms under investigation
 - Between 4 and 35 animals (mean : 21)
- 272 samples have been analysed

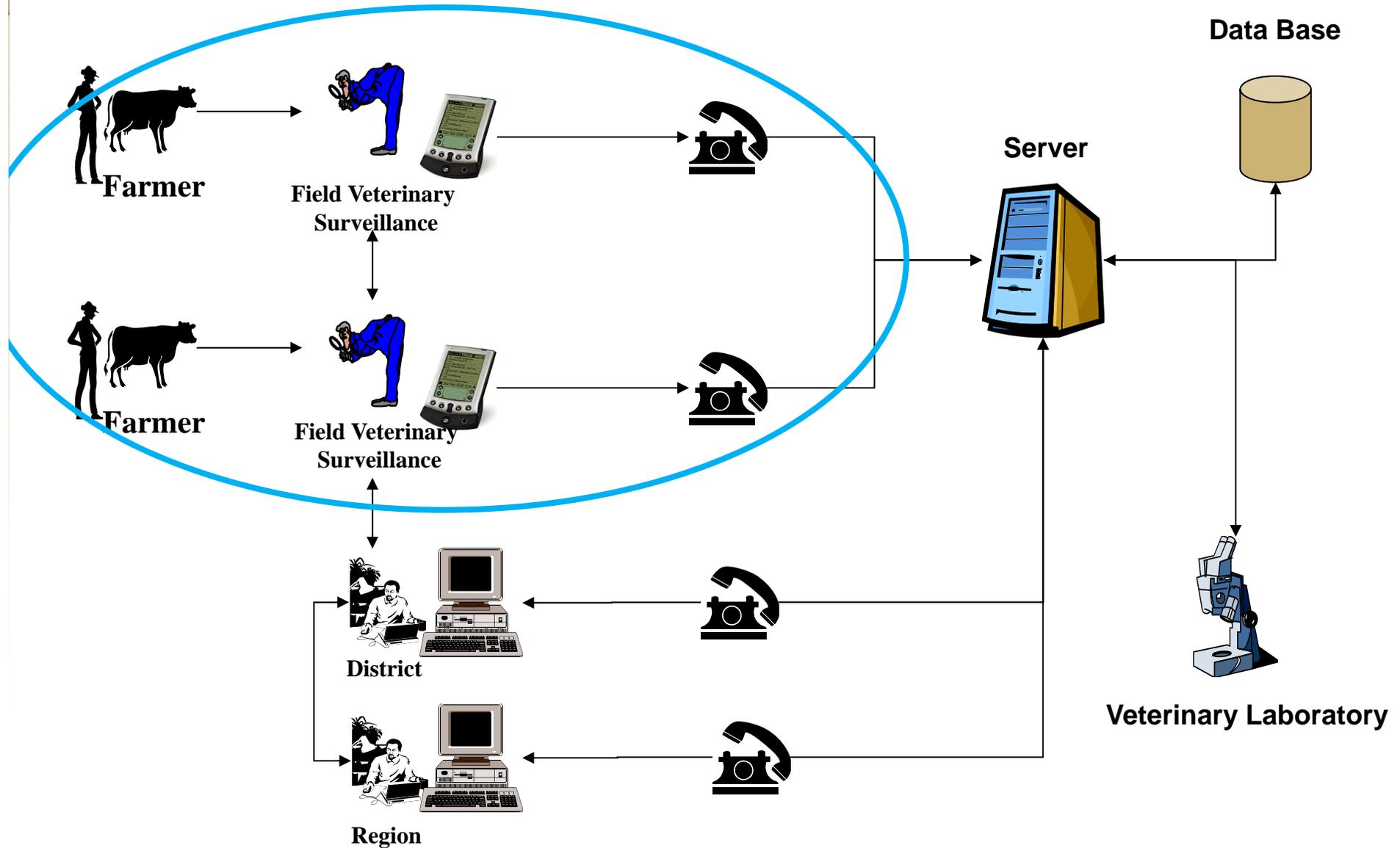
Only, 5 farms were found seronegative and therefore followed up as sentinel herds

- Herds Seroprevalence: 62 % (IC : 35% - 88 %)
- Intra-herd Seroprevalence between 6 and 42 %

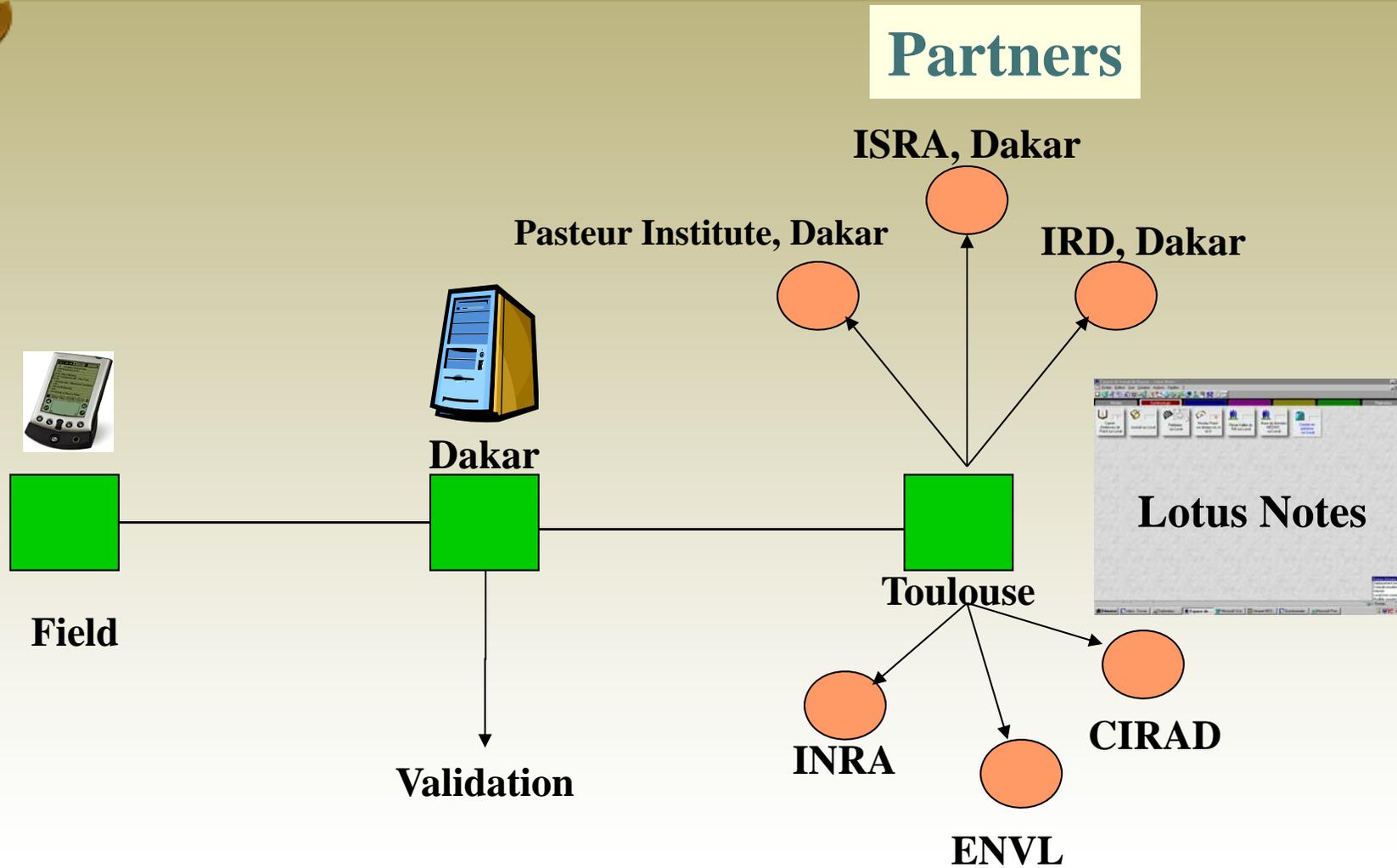
⇒ **5 goats herds (between 4 and 35 goats) kept as sentinels**

⇒ **Sampled every 6 to 8 weeks**

② RVF Information in Senegal

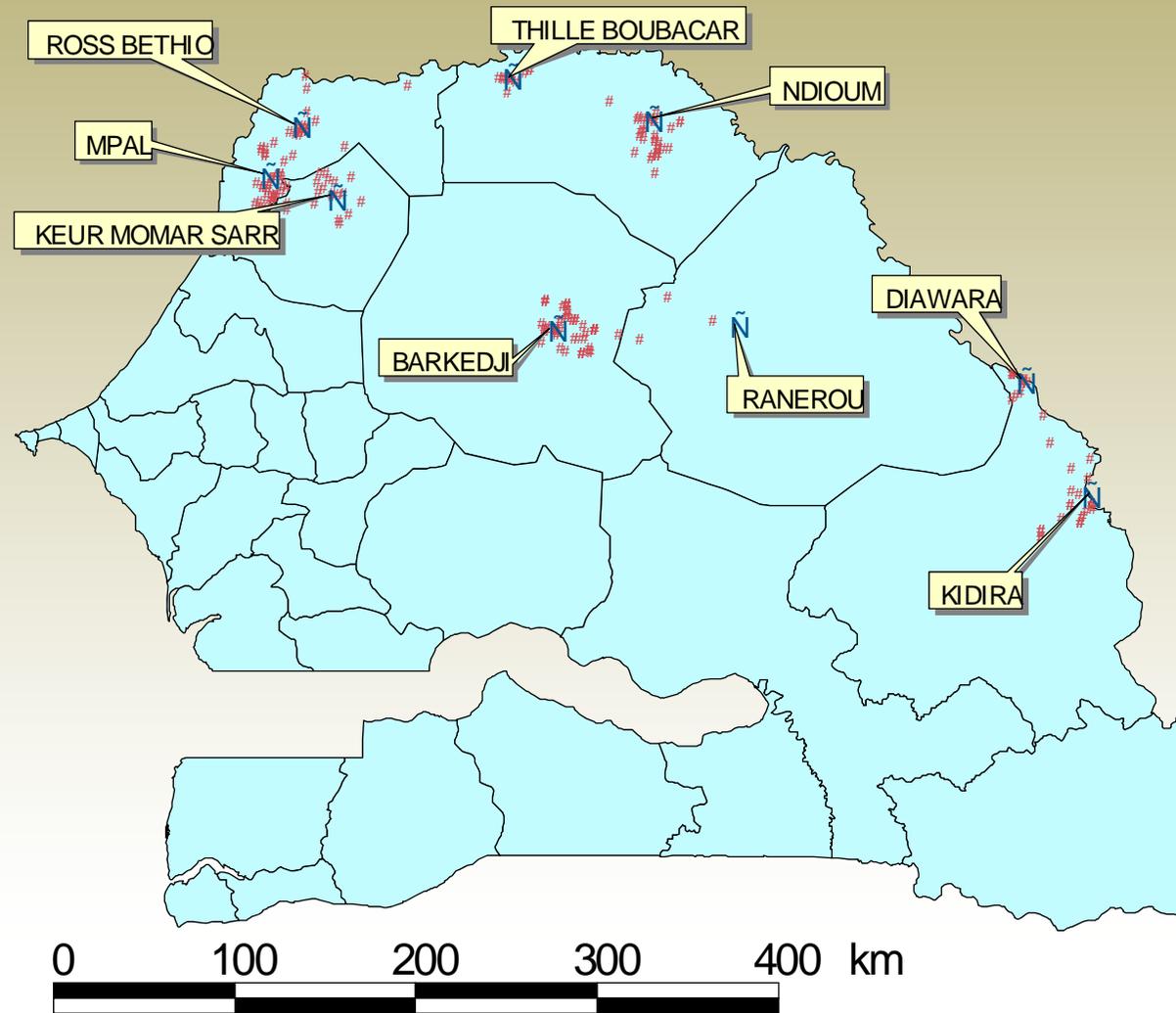


Real-time Access to the data

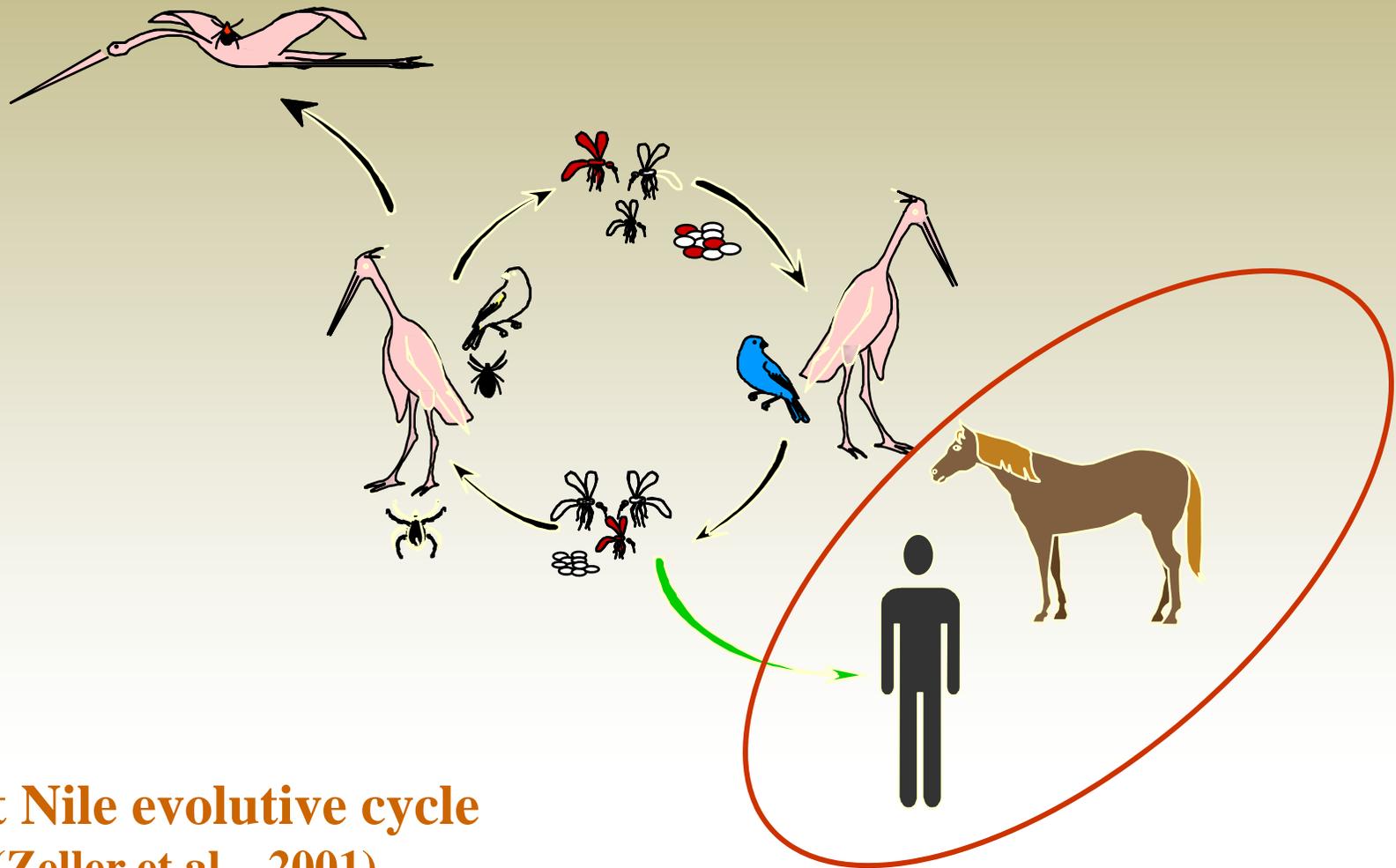




Outbreaks Maps



③ The case of West Nile : Detection of the pathogen

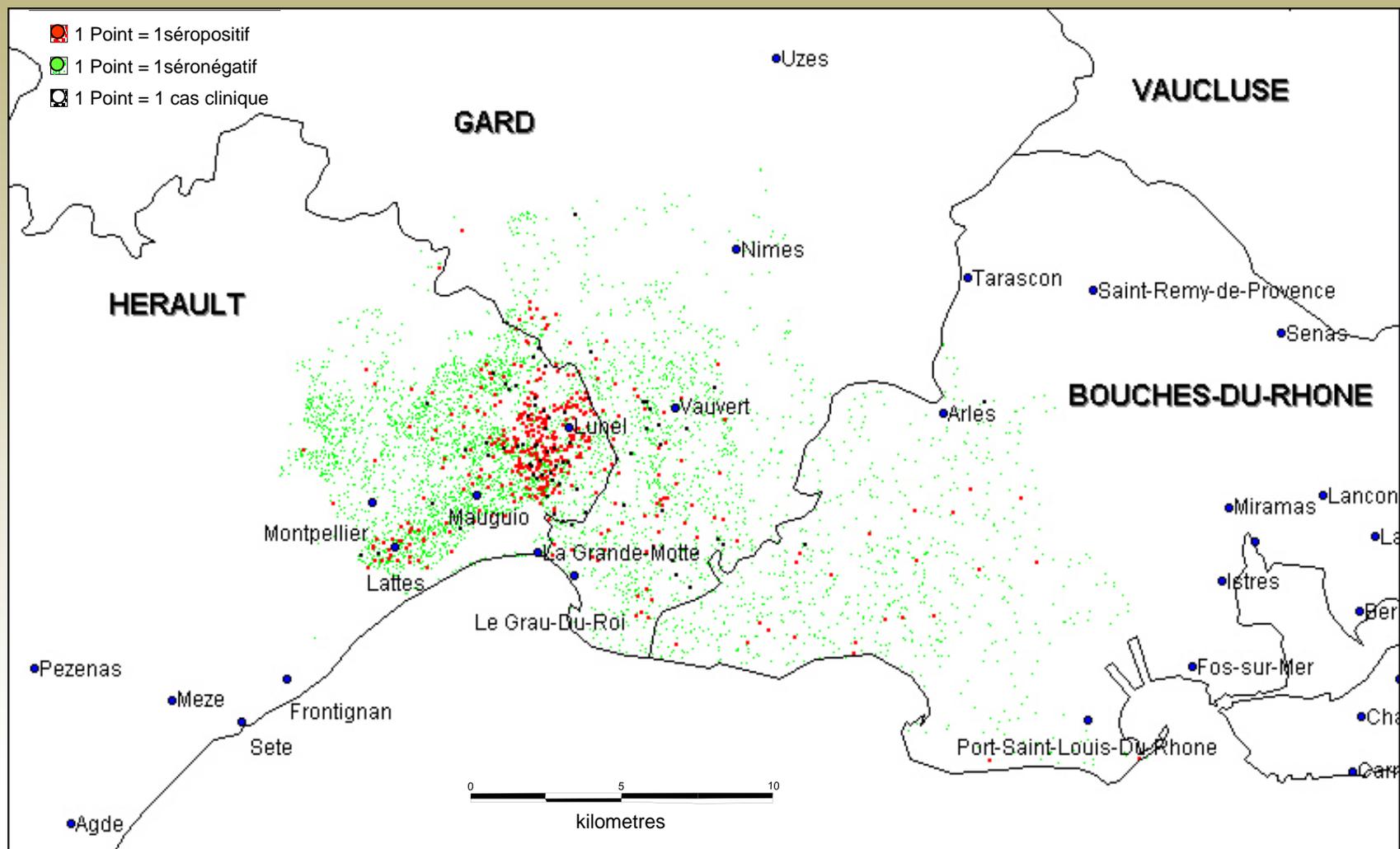


West Nile evolutive cycle
(Zeller et al., 2001)

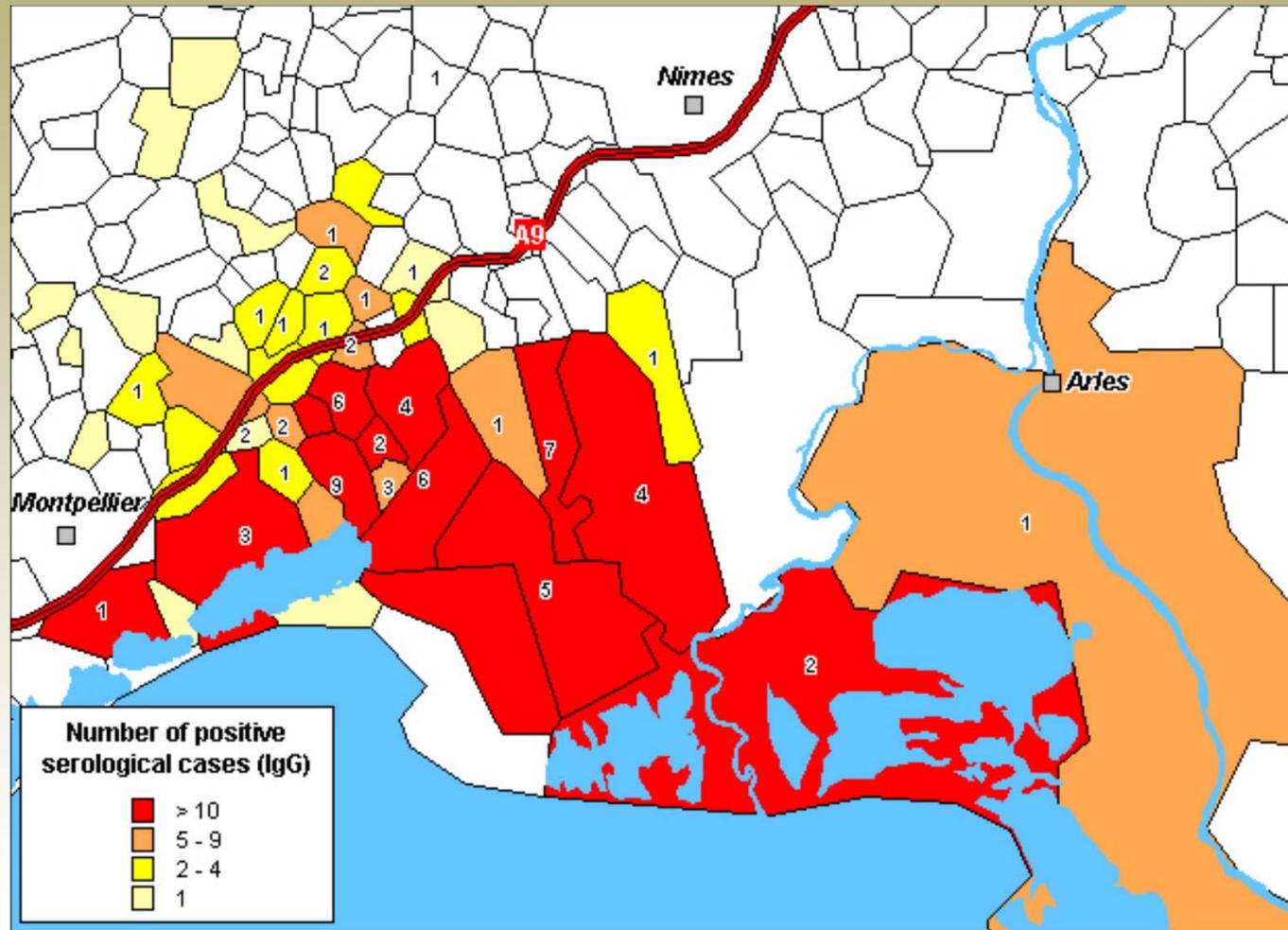


2000

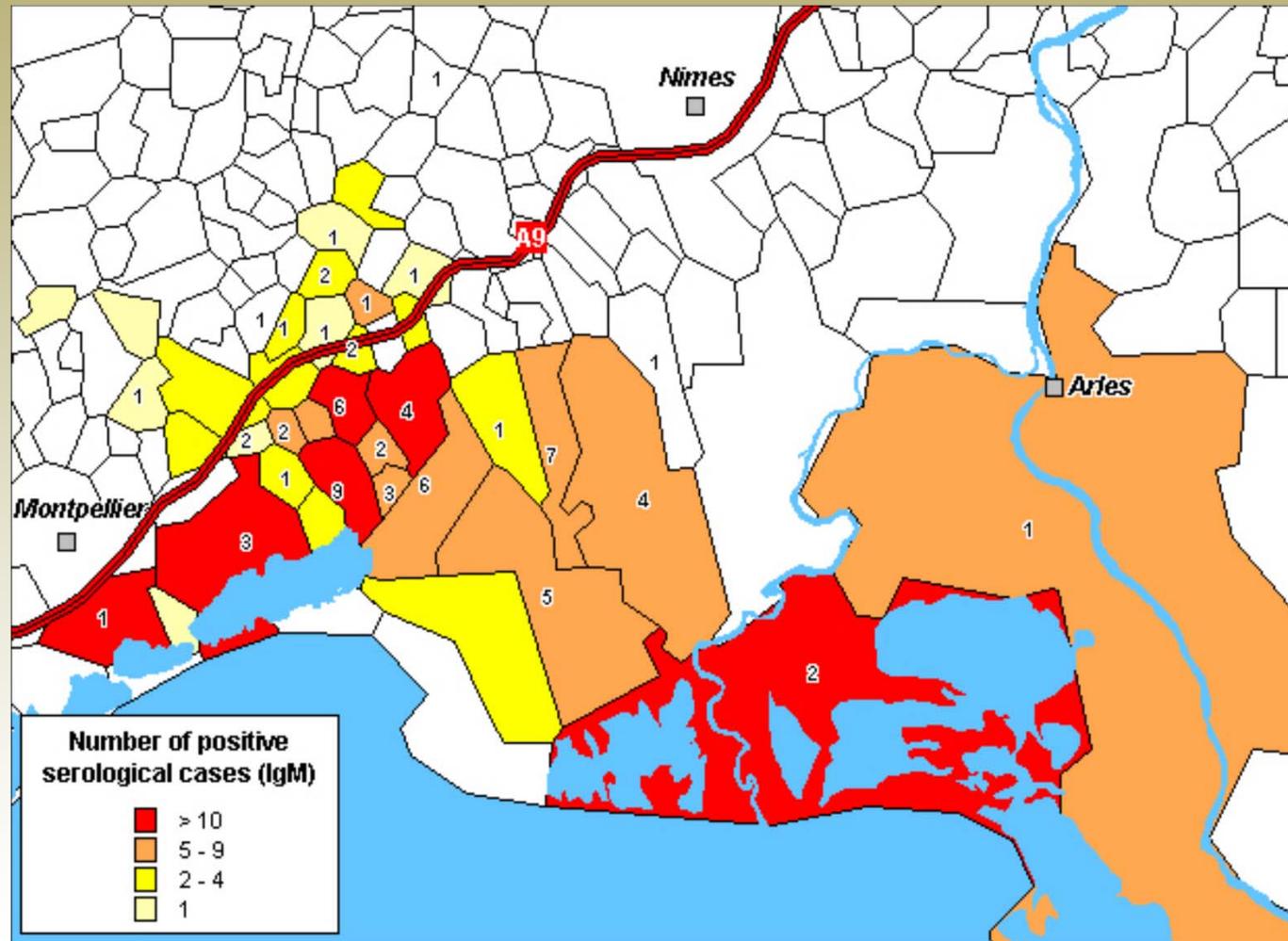
West-Nile serologic surveillance, 2000



Distribution of the 428 IgG positive equines



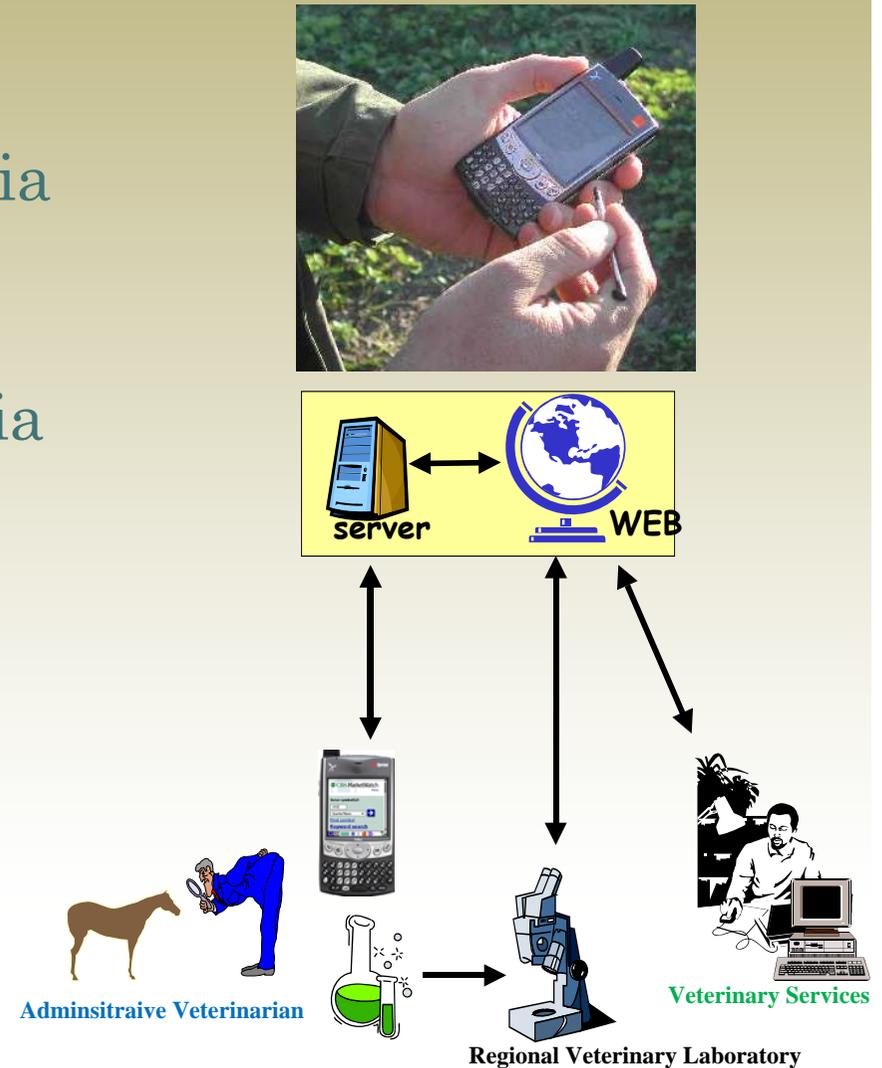
Distribution of the 177 IgM positive equines

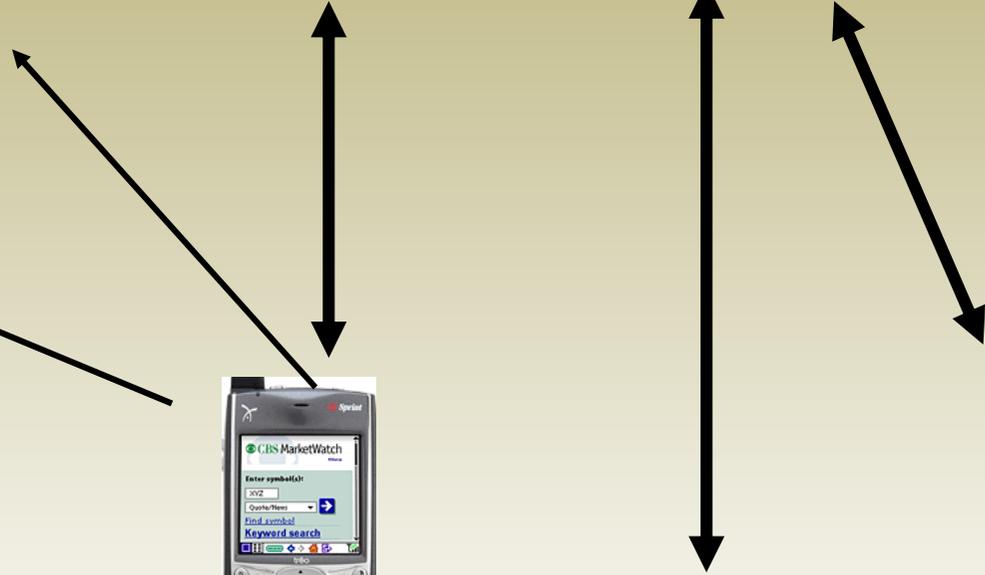
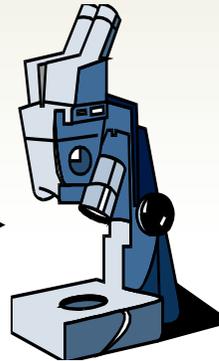
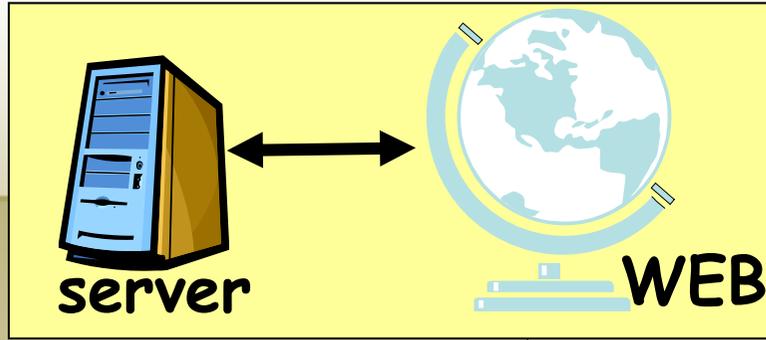


IgM levels: Crucial in terms of early detection

Early detection

- The information regarding the suspected case is sent via a GSM- Real-time process
- Access to the information via a Website and Emails
- One third of the suspected case were detected through this network







S.I.M.E.

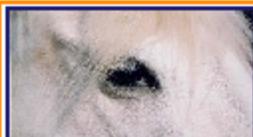
Système d'Information Maladies des Equidés

page de connexion

Utilisateur :

Mot de passe :

valider



Système d'Information Maladies des Equidés

page d'accueil

S.I.M.E.

ACCUEIL

FICHES

HISTORIQUE

TEST

NOUVELLE FICHE

DECONNECTER

Ce site permet de consulter les fiches de recueil clinique ayant été envoyées au serveur par un dispositif portable. Son contenu est accessible à travers le menu ci-dessus, dont voici les items :

Accueil : affiche cette page d'accueil.

Fiches : affiche la liste de fiches de recueil clinique.

Historique : affiche des statistiques concernant la réception des fiches de recueil clinique sur le serveur.

Test : affiche la liste de fiches de recueil clinique de test.

Nouvelle fiche : permet la saisie et l'enregistrement d'une nouvelle fiche de recueil clinique.

Déconnecter : ferme la session utilisateur et réaffiche la page de login (il est important de cliquer sur ce lien avant de quitter le site pour que d'éventuelles mises à jour soient sauvegardées).



Système d'Information Maladies des Equidés

fiches

S.I.M.E.

ACCUEIL

FICHES

HISTORIQUE

TEST

NOUVELLE FICHE

DECONNECTER

	code vété	date ▲	propriétaire	équidé	localisation	résultat	mort
🔍	APO	01/11/2004	Richard	Vagabond	Les smm		
🔍	APO	01/11/2004	Alarcon	Cesar	13200 arles		
🔍	APO	24/10/2004	Gudin	Lou du vidourle	13590 meyreuil		
🔍	APO	16/10/2004	Roulph	Merueys	30670 aigues-vives		
🔍	MCR	14/10/2004	BONILLO	BARON	30220 AIGUES-MORTES		17/10/2004
🔍	MCR	12/10/2004	PLION	OBER	30220 AIGUES-MORTES		
🔍	APO	12/10/2004	Arnaud	bibi	Smm 13460		
🔍	FGE	11/10/2004	Raquin	Poma	Rapehes les arles		
🔍	MCR	11/10/2004	ROCHE	NASSAU	30600 VAUVERT		
🔍	APO	05/10/2004	David	Courlis de brune	Smm 13460		
🔍	JCL	05/10/2004	AUBANEL	PARTISAN	30800 SAINT GILLES		
🔍	MCR	04/10/2004	LAPENDRIE	PENNY	30 600 VAUVERT		
🔍	EMA	04/10/2004	DUBOSCQ	ANAI			
🔍	MCR	02/10/2004	MAUSE	LISTELLE	30 600 VAUVERT		
🔍	MCR	02/10/2004	BRUN	AOUSTIN	30 600 VAUVERT		
🔍	MCR	02/10/2004	MOUTIER	BANDIT	30 600 VAUVERT		
🔍	MCR	30/09/2004	BARTHELEMY	FARO	30800 SAINT GILLES		30/09/2004
🔍	JCL	29/09/2004	SCHROEBELER	VIANA	Arles 13200		
🔍	MCR	29/09/2004	BONNET	ISO	30800 SAINT GILLES		
🔍					13460 LES SAINTES MARIES DE		



Système d'Information Maladies des Equidés

historique des fiches reçues

S.I.M.E.

ACCUEIL

FICHES

HISTORIQUE

TEST

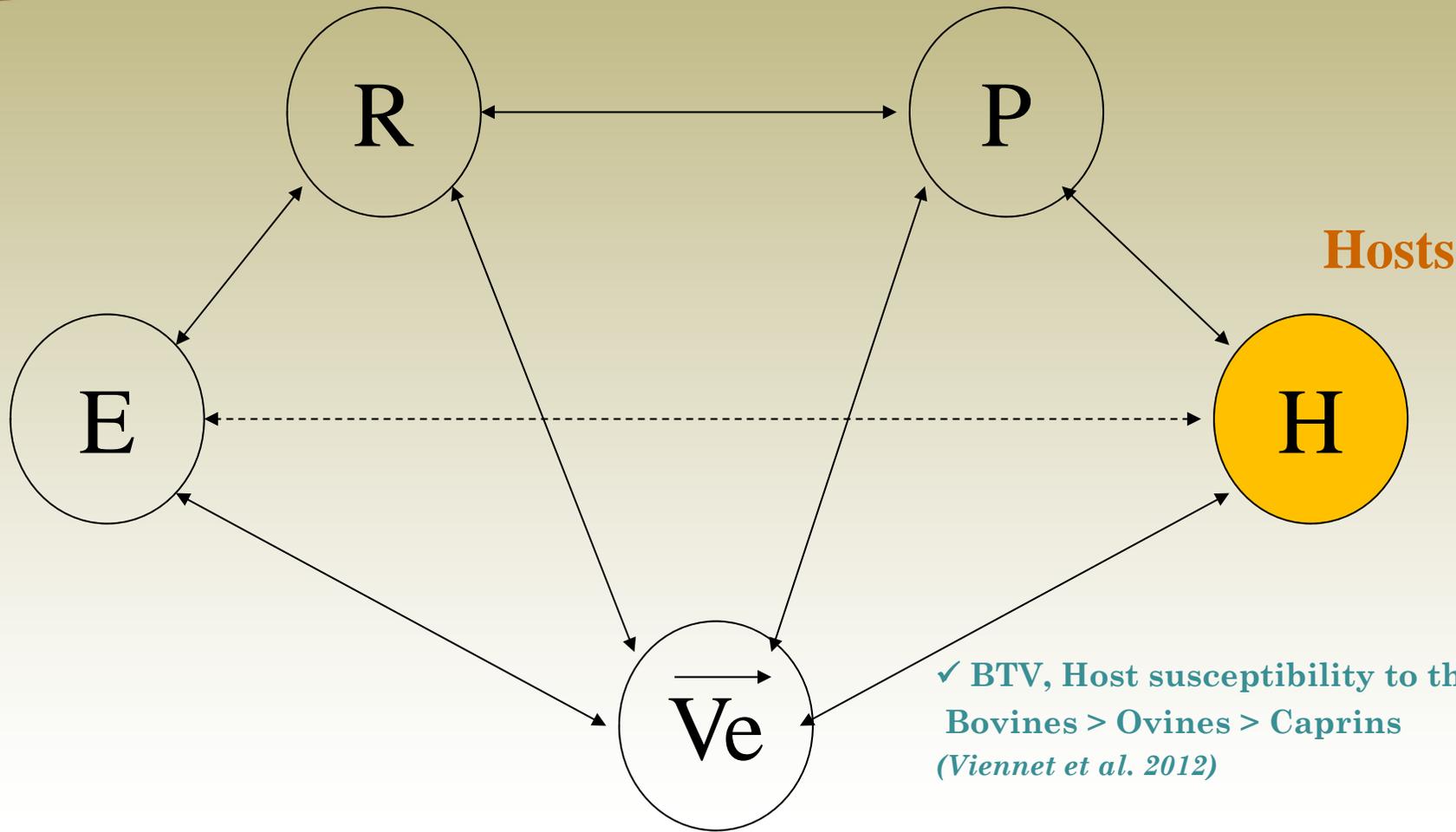
NOUVELLE FICHE

DECONNECTER

date de réception	nombre de fiches
03/11/2004	2
28/10/2004	1
22/10/2004	1
18/10/2004	2
15/10/2004	1
13/10/2004	1
11/10/2004	1
06/10/2004	1
05/10/2004	6
04/10/2004	1
30/09/2004	5
29/09/2004	10
28/09/2004	1
27/09/2004	5
26/09/2004	1
25/09/2004	2
21/09/2004	5
20/09/2004	1
17/09/2004	2
15/09/2004	3



Host susceptibility **H**



✓ BTV, Host susceptibility to the vector
Bovines > Ovines > Caprins
(Viennet et al. 2012)

✓ West-Nile, Host susceptibility To the
disease : Old persons and children >
others

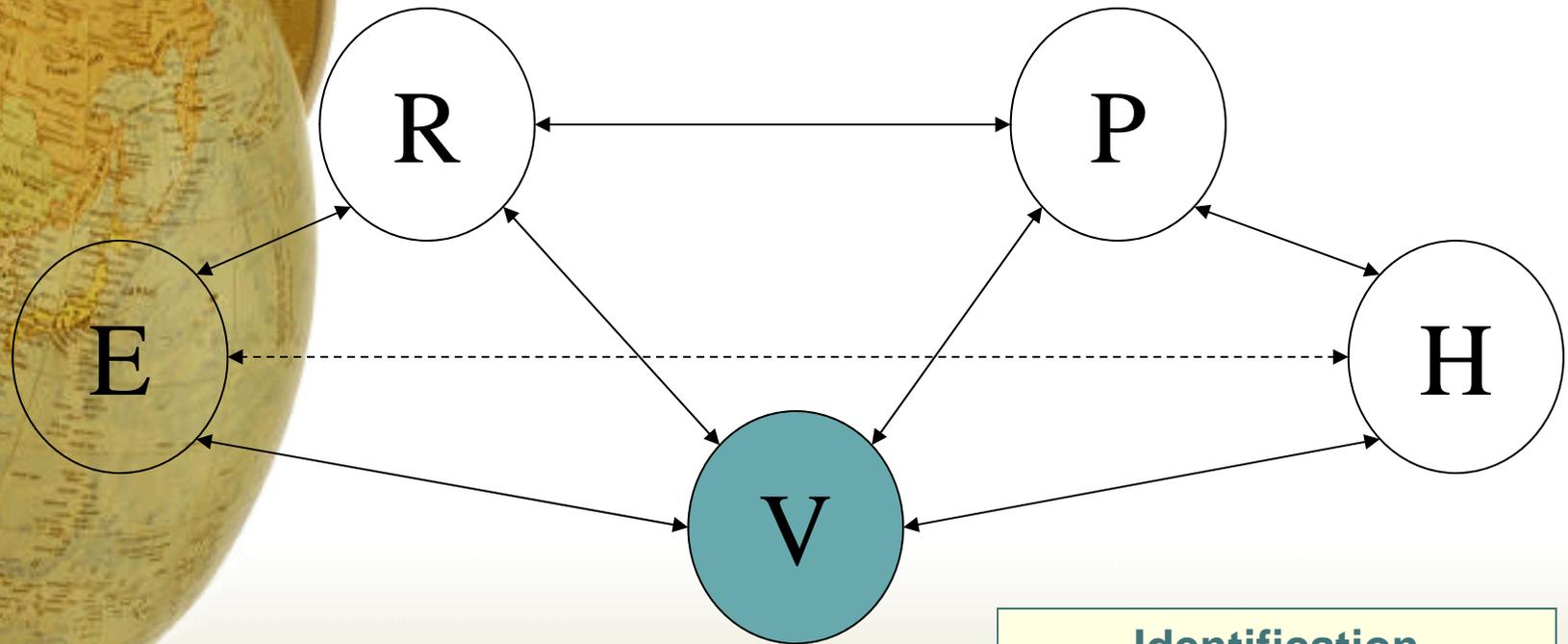


Conclusions – Hosts-



- **A oriented surveillance, when the hosts are easy to identify**
- **Early warning system even if it is late compared to the vector part**

A vector-based approach



Vectors

Identification
Presence/Absence
Quantification
Dynamics
Capacity/ Competence

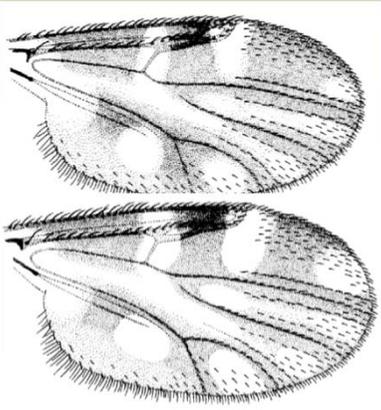
① The case of
Culicoides into
mainland France



Identification of the vectors involved in BTV transmission

Ceratopogonidae, haematophagous
More than 1253 species
About 40 involved in Orbivirus transmission

C. obsoletus



C. scoticus

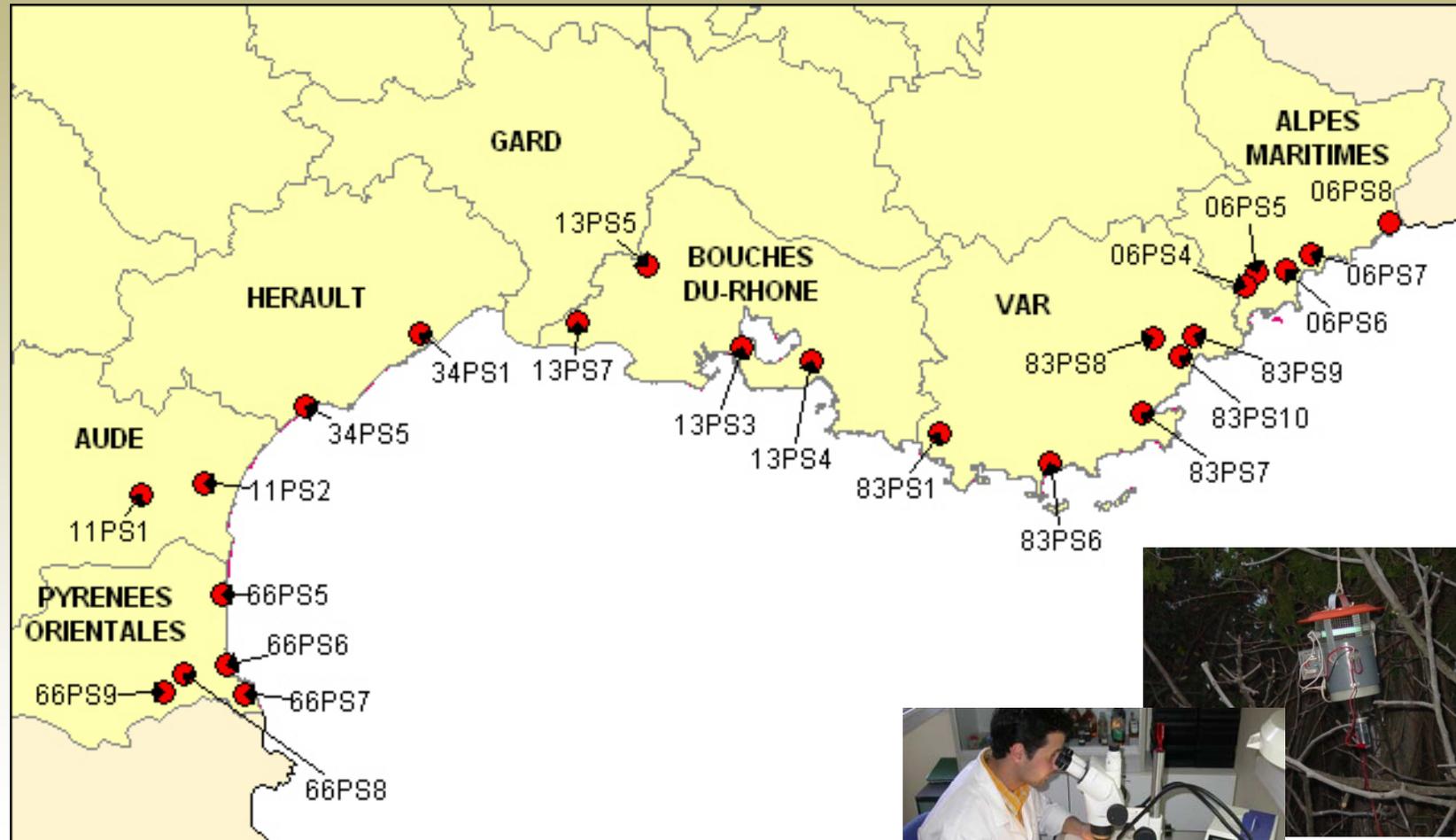
imicola Complex
Obsoletus Group
Pulicaris Group

Morphological identification
Type of traps

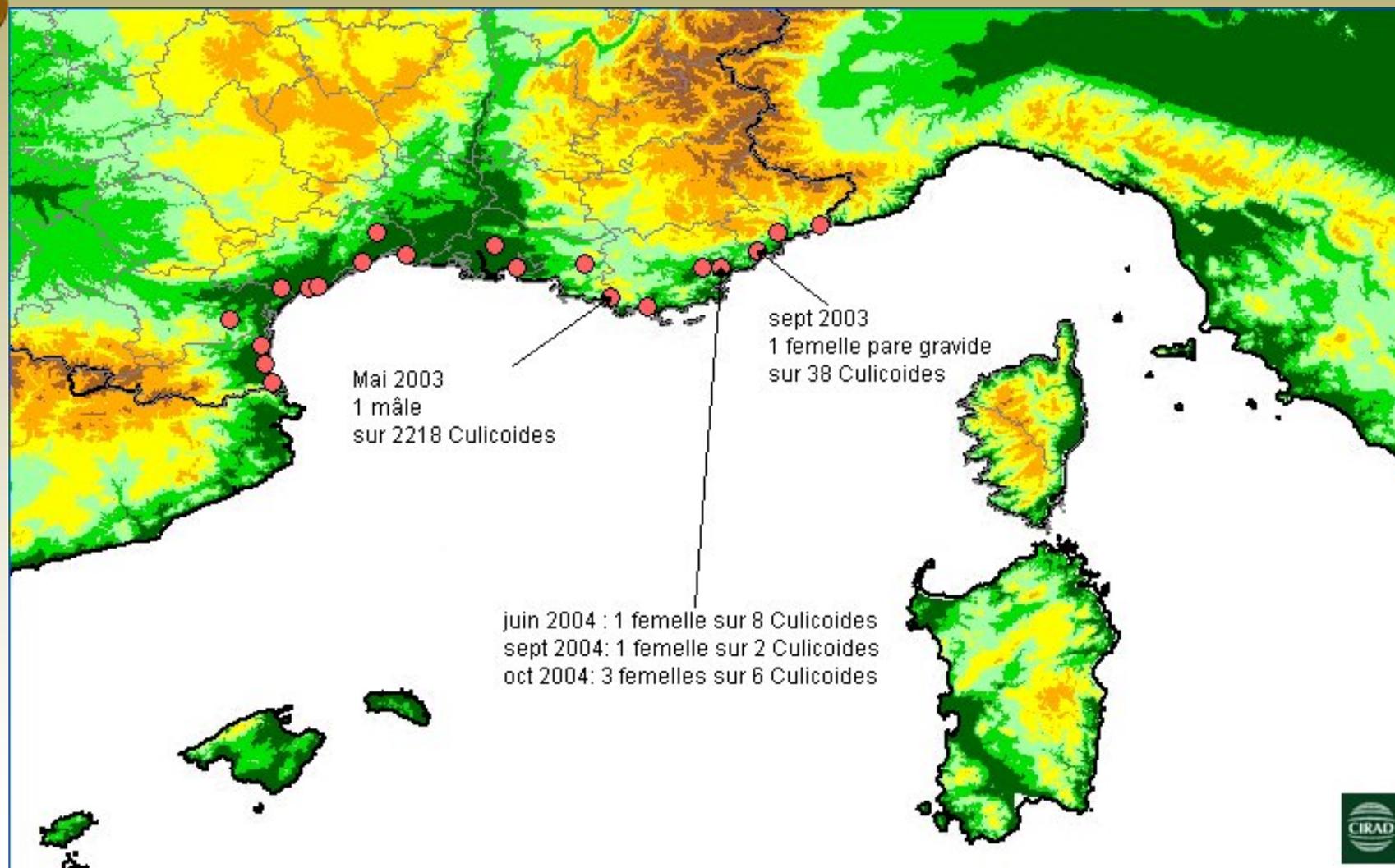




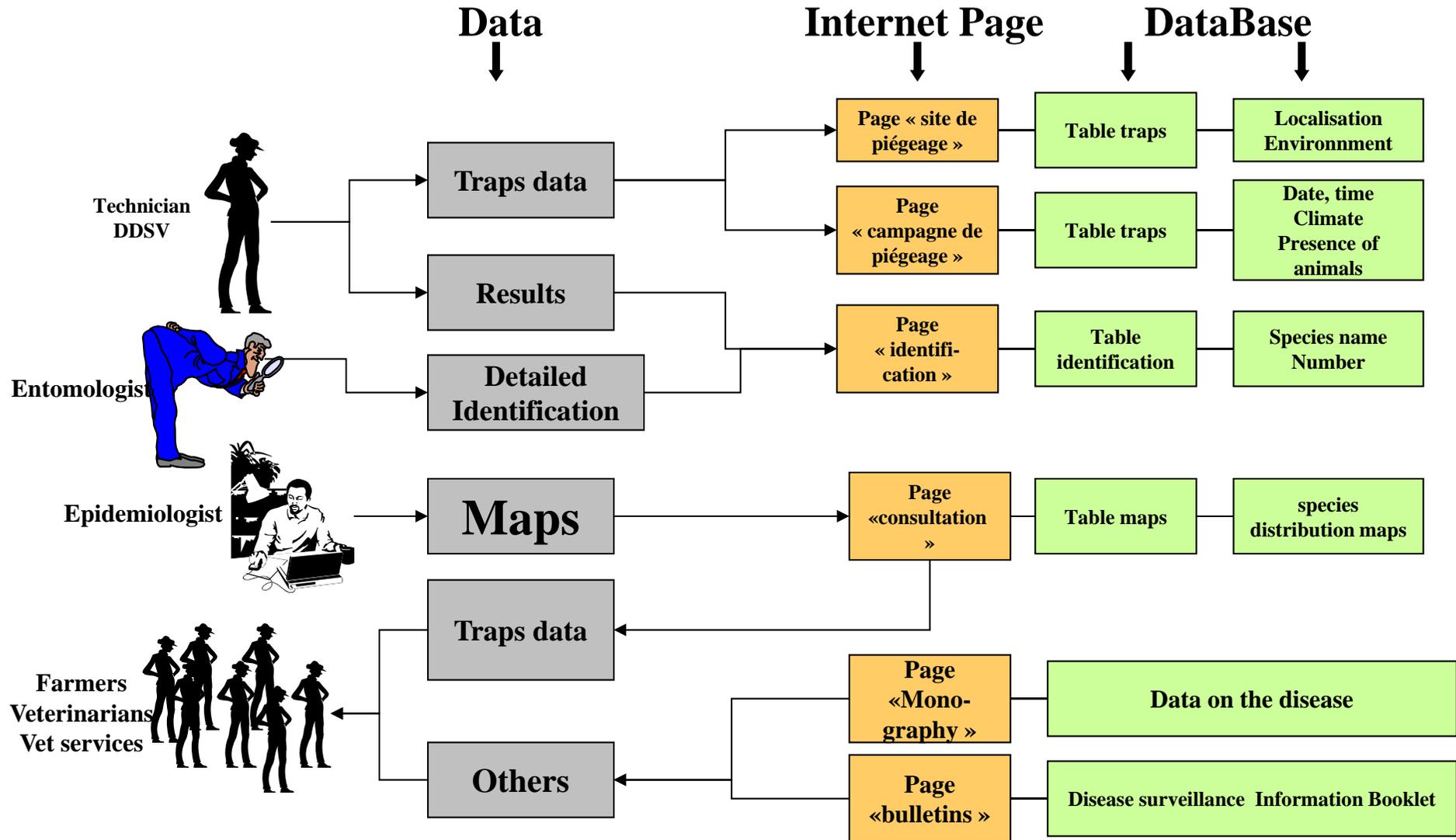
Entomological surveillance, Culicoides, France, 2002-2006



2003-2004: Settlement of *C. imicola* in southern France



BTV DATA BASE for BTV surveillance





SURVEILLANCE

Fièvre catarrhale du mouton



Surveillance de la Bluetongue en France

Internet Explorer recommandé

- Accueil
- **Bulletins**
- DESCRIPTIF DE LA MALADIE
 - Monographie
 - Vademecum
- Partenaires
- Liens
- Résultats entomosurveillance
- ACCÈS RÉSERVÉ

Connexion

Base de données



SURVEILLANCE

Fièvre catarrhale du mouton



MINISTÈRE
DE L'AGRICULTURE
DE L'ALIMENTATION
DE LA PÊCHE
ET DES AFFAIRES RURALES

Les bulletins

Régulièrement des bulletins pour faire le point sur la maladie et sa progression sont édités.

Afin de les consulter, cliquez sur le mensuel qui vous intéresse dans le tableau ci - dessous.

Année 2001

[Juin](#)
[Juillet](#)
[Août](#)
[Septembre](#)
[Octobre](#)
[Novembre](#)

Année 2002

[Juin](#)
[Juillet](#)
[Août](#)

Année 2003

[Juin](#)

Année 2004

[Août 2003 - Juillet 2004](#)



Déterminations :

Campagne :

2BPL6-4

Date de la détermination :

Identification of single species per campaign

Espèce :

achrayi

Ajouter cette espèce dans la détermination

Estimation :

Type de détermination :

Estimatif

Récapitulatif pour une campagne :

Sélectionnez une campagne existante dans la liste :

2BPL6-4

Rechercher

Campagne : 2BPL4-2

Data about species for the whole campaign

Estimation

Détermination définitive

Espèce	Valeur	Espèce	Nombre
Culicoides sp.	8	newsteadii	7
		univittatus	1



SURVEILLANCE

Fièvre catarrhale du mouton



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- Connexion
- Base de données

Consultation

Campagnes

Identifiant Campagne	Date de début
()	



Afin d'obtenir la liste des campagnes effectuées pour un site, cliquez sur la commune de votre choix.

La liste des campagnes apparaît alors dans le tableau ci-contre.

Afin de connaître le détail des espèces trouvées pour une campagne, cliquez sur son identifiant dans le tableau.

Les résultats s'affichent dans une nouvelle fenetre.



Surveillance de la Bluetongue en France

Internet Explorer recommandé

- Accueil
- Bulletins
- DESCRIPTIF DE LA MALADIE

Monographie

Vademecum

- Partenaires
- Liens

■ Résultats entomosurveillance

- ACCÈS RÉSERVÉ

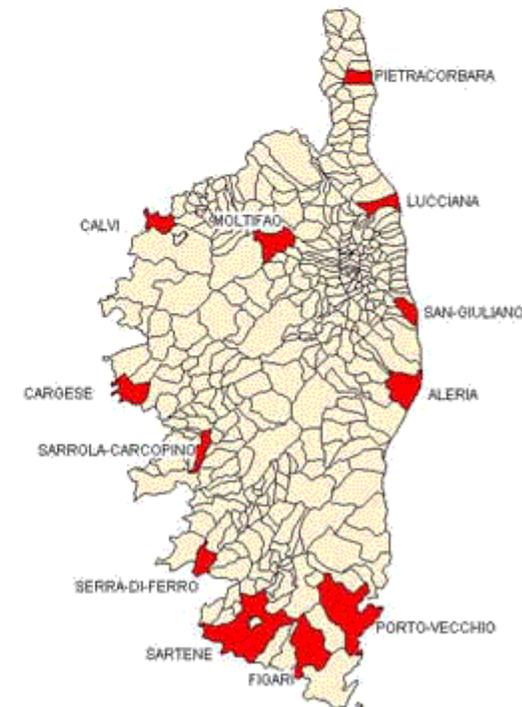
Connexion

Base de données

Consultation

Campagnes (GRAU DU ROI)

Identifiant Campagne	Date de début
30PS1-1	2002-05-15
30PS1-2	2002-06-17
30PS1-3	2002-07-18
30PS1-4	2002-08-28
30PS1-5	2002-10-03
30PS1-6	2002-10-29
30PS1-7	2002-11-20
30PS1-8	2003-05-27
30PS1-9	2003-07-22
30PS1-10	2003-07-31
30PS1-11	2003-08-22
30PS1-12	2003-10-07
30PS1-13	2003-11-26
30PS1-14	2004-01-28
30PS1-15	2004-02-12
30PS1-16	2004-03-10
30PS1-17	2004-04-19
30PS1-18	2004-05-17
30PS1-19	2004-06-16
30PS1-20	2004-07-28
30PS1-21	2004-08-30
30PS1-22	2004-09-21



Afin d'obtenir la liste des campagnes effectuées pour un site, cliquez sur la commune de votre choix.

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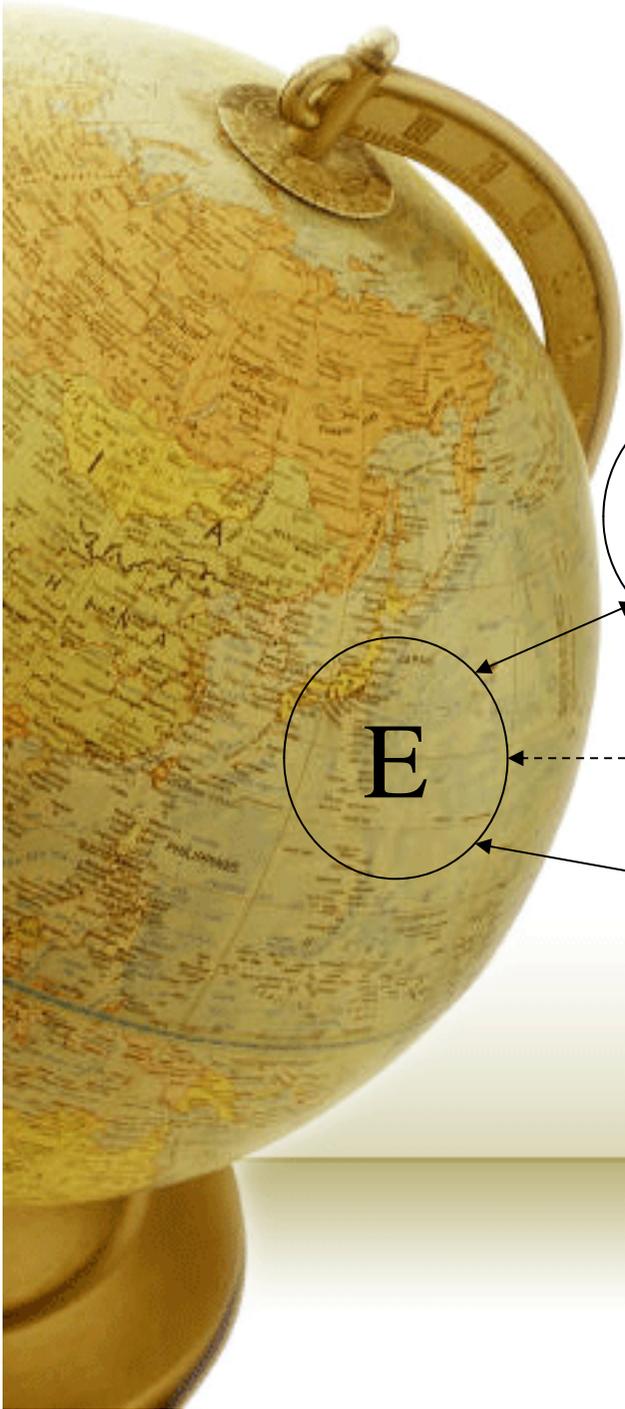
Les résultats s'affichent dans une nouvelle fenetre.

Date de début : 04-04-01		Date de fin : 2004-04-02	
Commune :	PORTO VECCHIO	Piège 2APL6	
Code :	CONFIDENTIEL	Latitude : CONFIDENTIEL	Altitude
		Longitude : CONFIDENTIEL	
		Elevage : Ovins	
Environnement du site :	Prairie bordée d'une rivière. Piège placé contre la bergerie		
Heure début de piégeage :	19:00:00	Température 18.0000	Météo Temps calme et dégagé
Heure de fin de piégeage :	08:45:00	Température 16.0000	Météo Temps calme et dégagé
Présence d'animaux :	oui	Observations complémentaires :	

Espèce	Détermination estimée	Nombre
Ceratopogonidae sp		7
Culicoides sp.		281
Obsoletus gr.		113

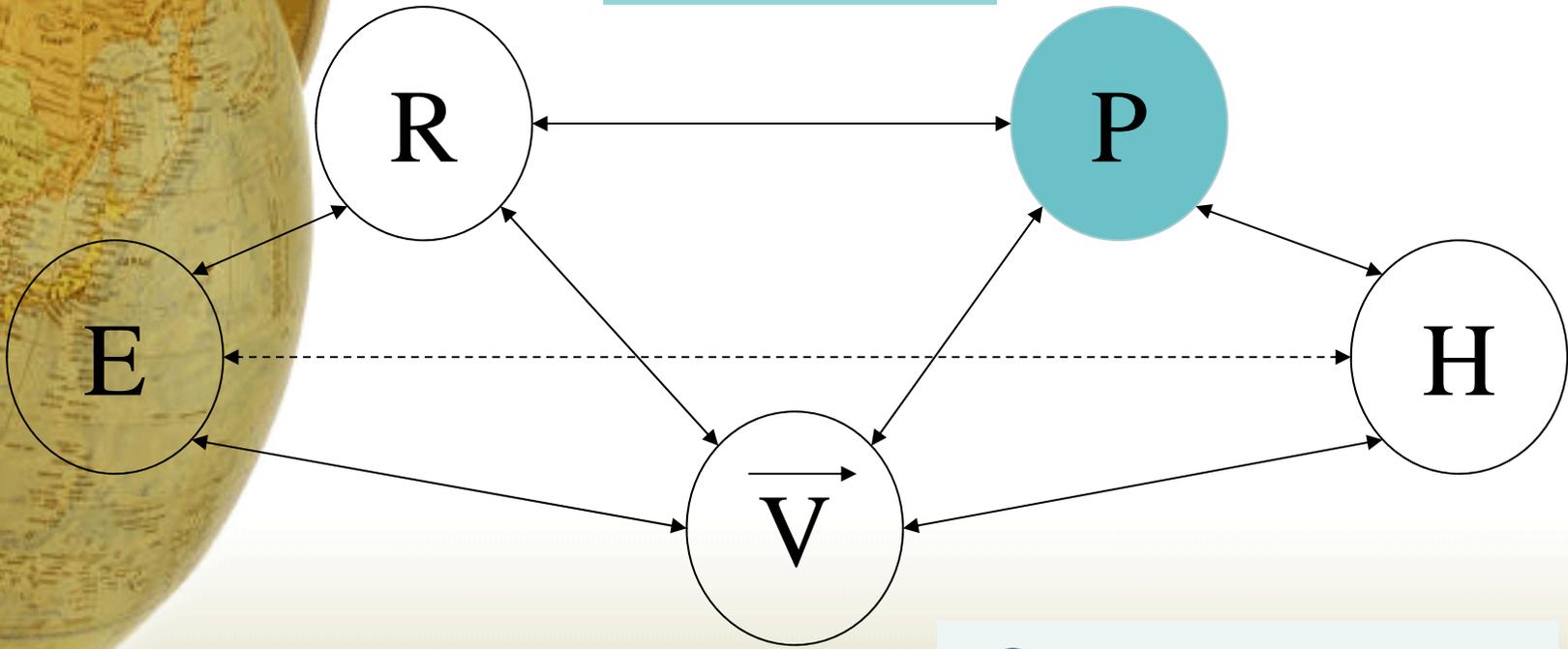
Espèce	Détermination définitive	Nombre
Ceratopogonidae sp		7
imicola		2
lupicaris		6
newsteadi		127
obsoletus		40
pulicaris		24
santonicus		1
scoticus		73
univittatus		7

Vector competence
Finances (Surveillance, Research)



Identification
Presence/Absence
Evolution

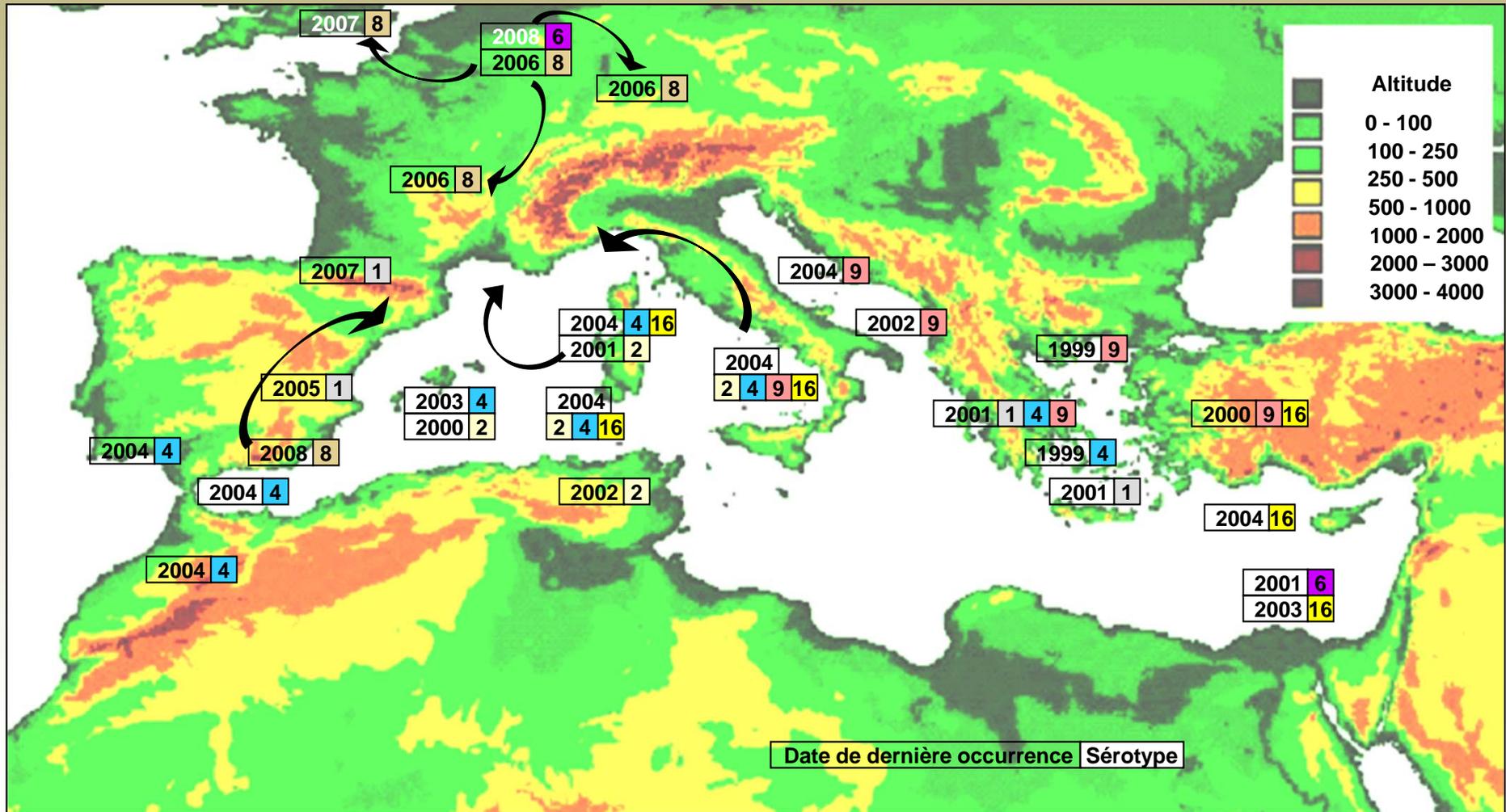
Pathogens



- ① BTV in Europe
- ② RVF in Mayotte



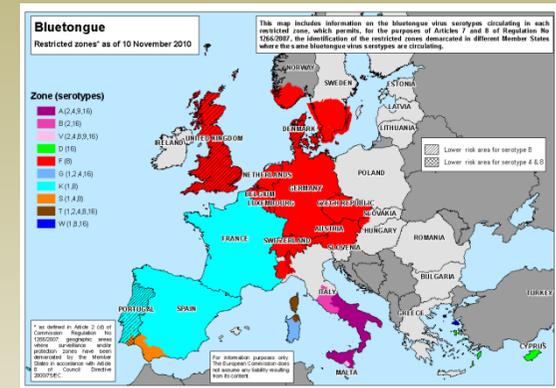
① BTV in Europe : more than 26 serotypes





Identification of new pathogens transmitted by *Culicoides*

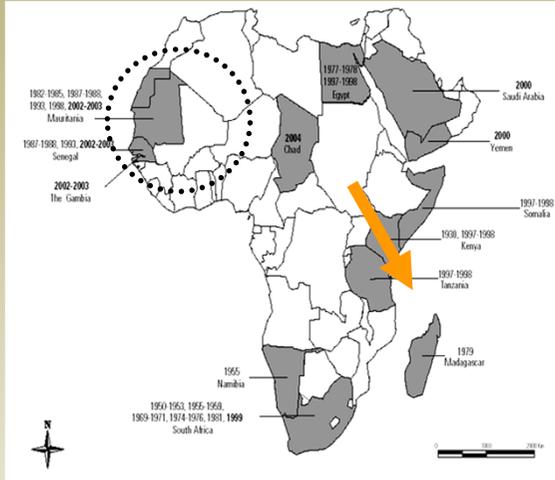
- New BTV serotype = new disease ?
- Target animals: ovines, but BTV8 in bovines
- BTV6 in Netherlands announced october 24, 2008
 - 3 days later: vaccine serotype
- TOV in Switzerland
 - Toggenburg orbivirus announced Promed November 2 2008
 - No clinics
- Schmallenberg virus in Germany with congenital malformation, December 2011





② RVF in Mayotte

Phylogenetic relationships to help in the identification of the introduction process of the disease



Chevalier et al., 2004

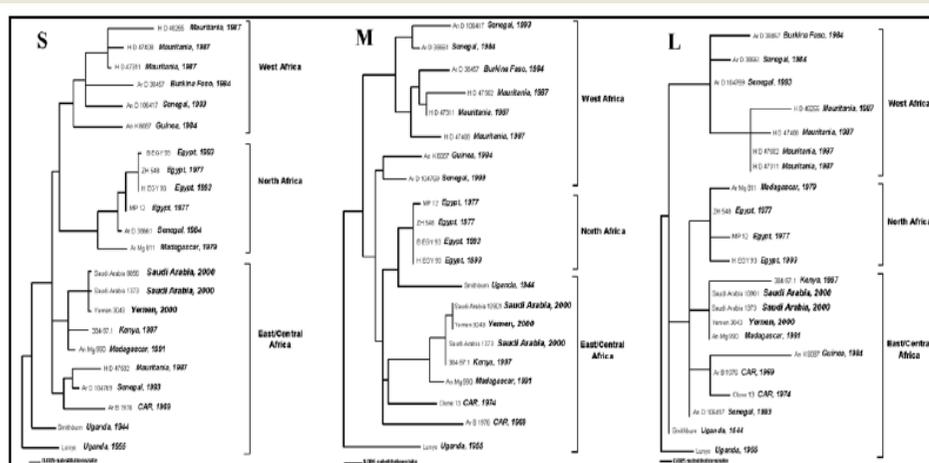
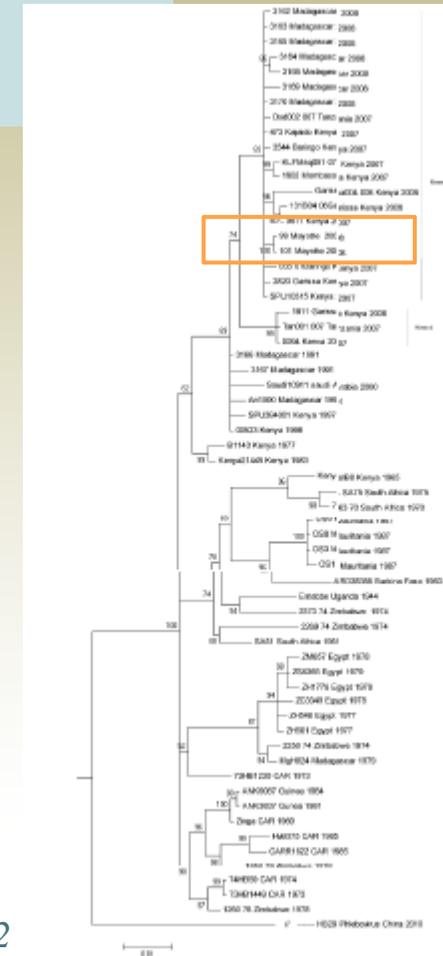


Figure. Phylogenetic relationship of the S, M, and L RNA segments of Rift Valley fever viruses. Maximum likelihood analysis of the nucleotide (nt) sequence differences among a 661-nt region of S RNA segment (Panel A), a 708-nt region of the M RNA segment (Panel B), and a 176-nt region of the L RNA segment (Panel C) of RVF viruses was performed by using PAUP4.0b10 (Sinauer Associates Inc., Sunderland, MA).



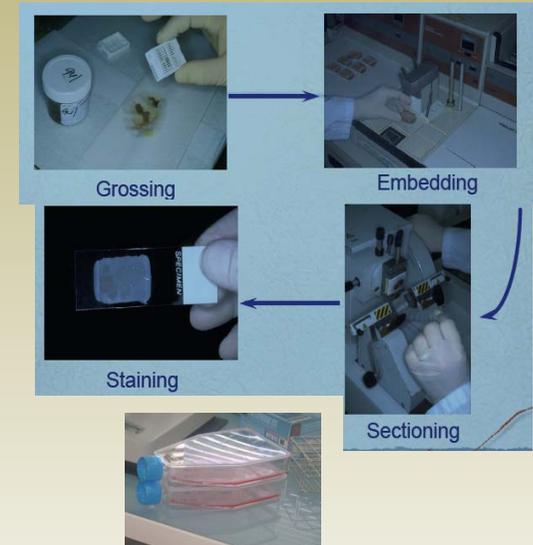
Schoemaker et al., 2002



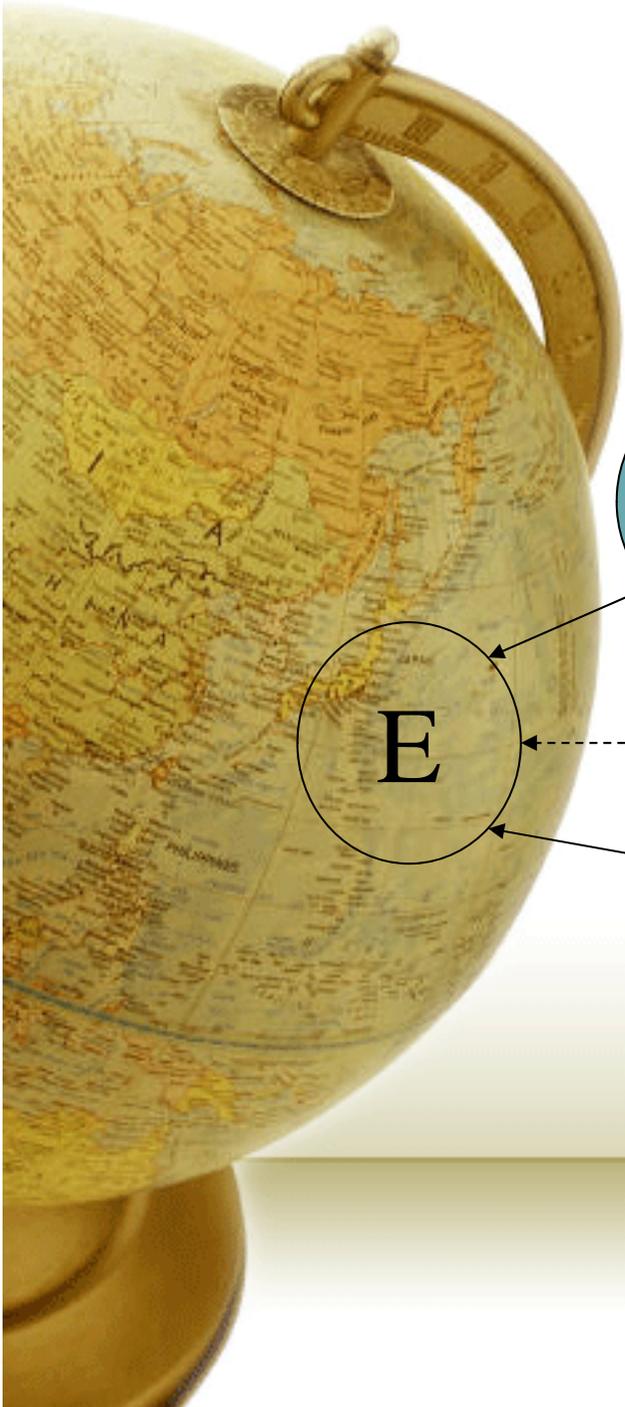
Where to look for the pathogen ?

Importance for updated diagnostic tools

- In the Hosts
 - The most common and easiest
- In the Vectors
 - Hard
 - Frustrating , low significance
- Reservoir
 - Important to better understand the disease epidemiology

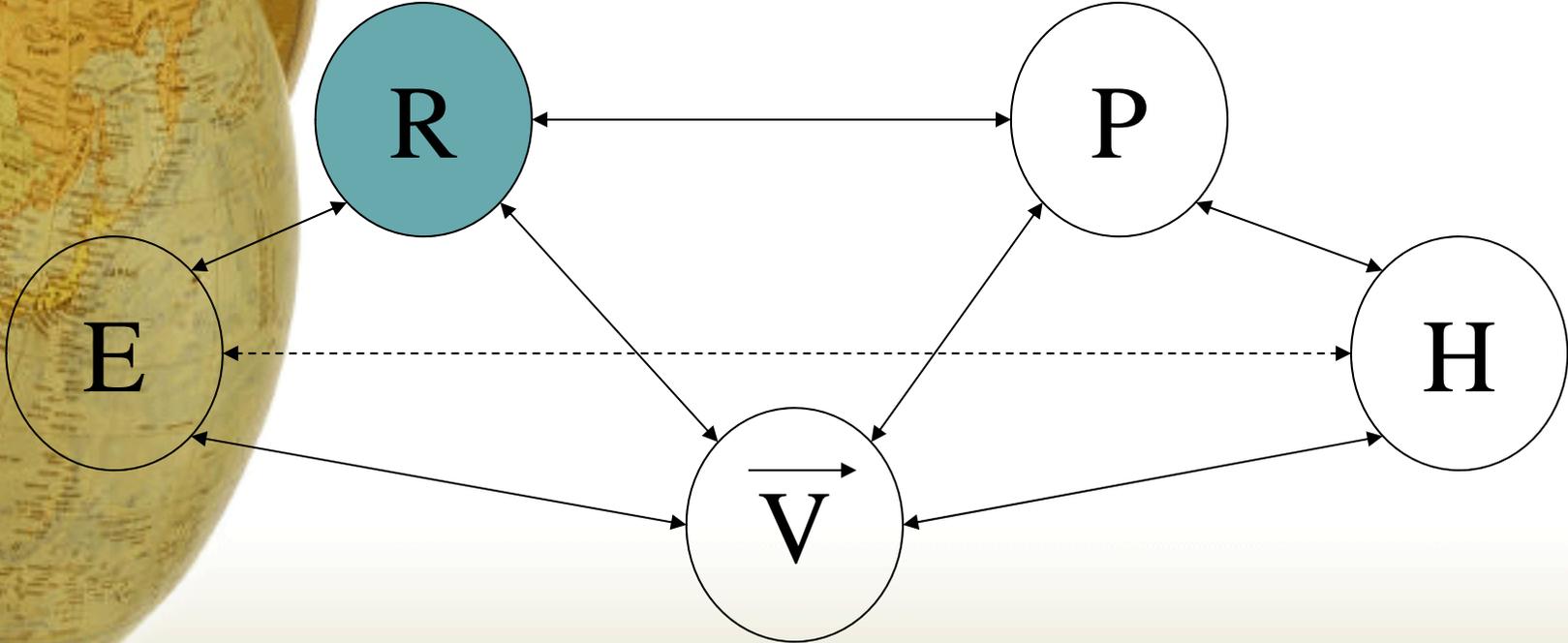


Important to work in close collaboration with the National and International Reference Laboratories with updated diagnostic techniques with a short delay in terms of response



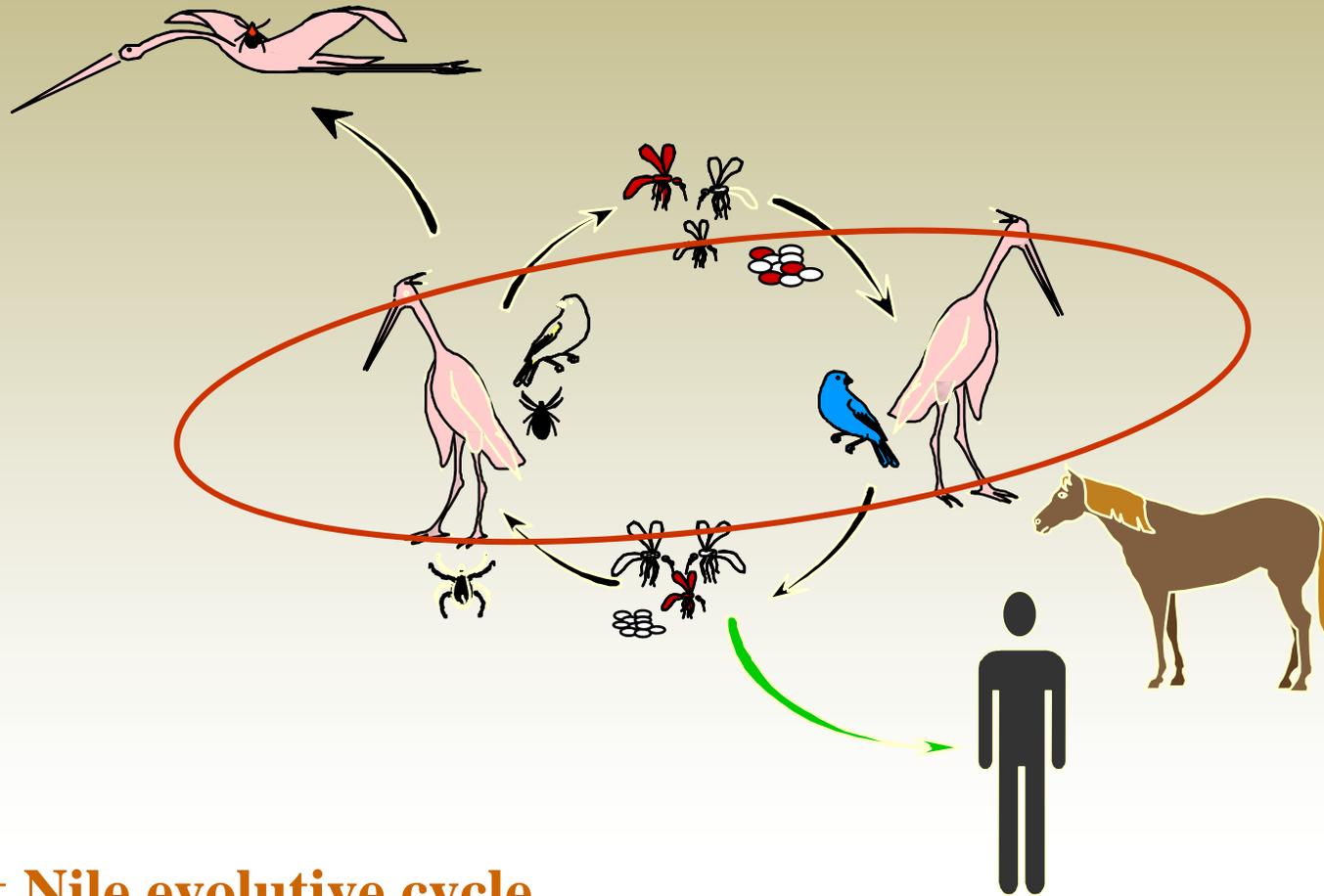
Reservoirs

Identification
Presence/Absence
Quantification
Dynamics



① Case of WN in France

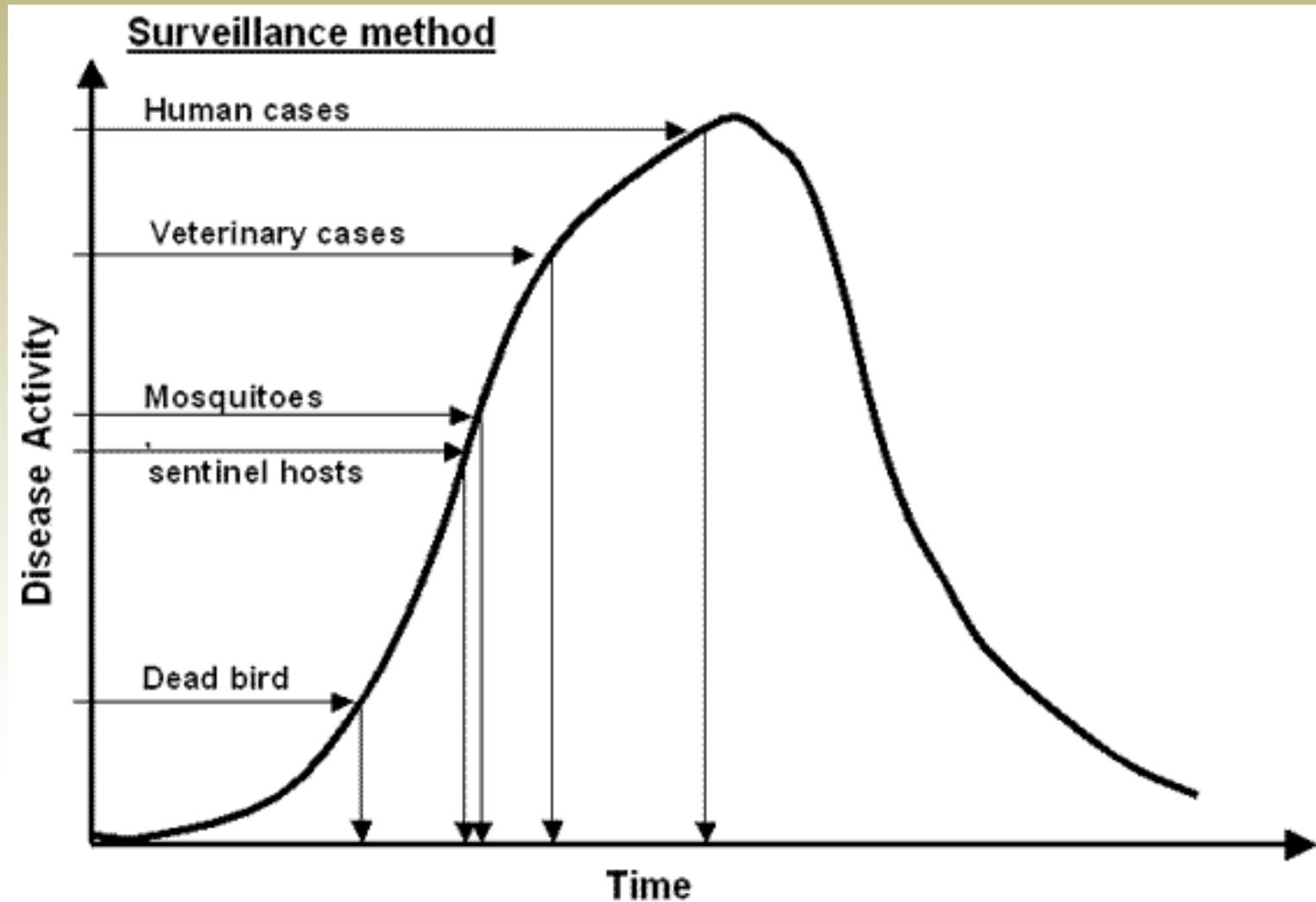
① Pathogen detection in the reservoirs



West Nile evolutive cycle
(Zeller et al., 2001)



Reservoirs surveillance, West-Nile in USA





How to survey wild life fauna

Passive Surveillance

Via the analysis of dead animals



**Network SAGIR,
WNF**

→ Alert



Active Surveillance

Via surveys targeted on hunted animals



**Specific surveillance
contingence plans**

**→ Diseases with zoonotic
and economic impact**





West-Nile fever in avifauna, 2004

Séroconversions

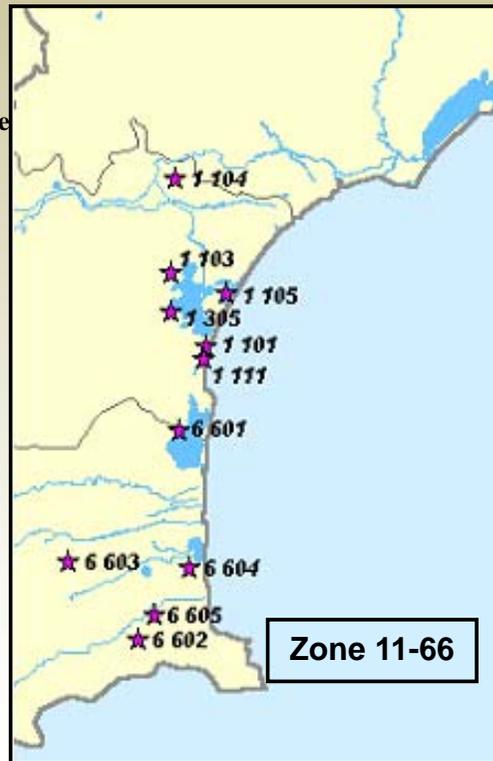
1 seroconversion
saint Just
(3405)

1 seroconversion
St Laurent d'Aigouze
(3001)

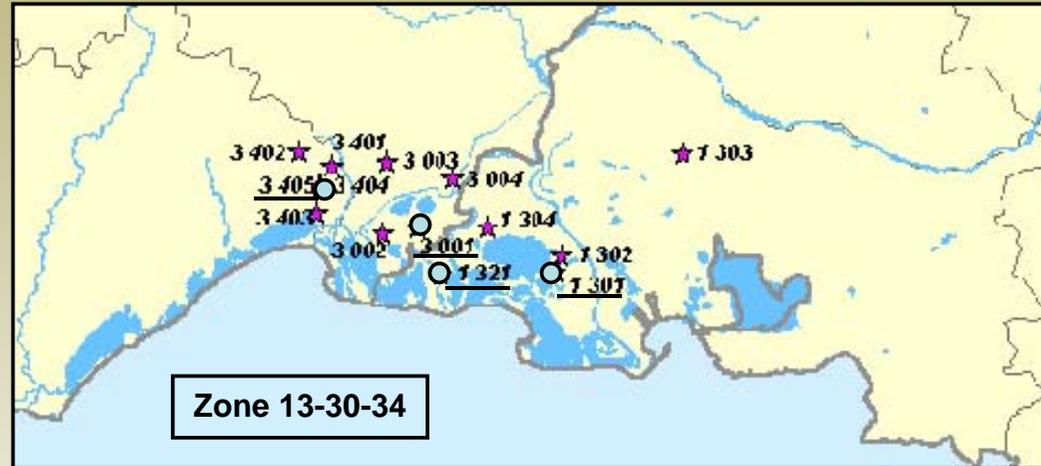
9 seroconversions
Saintes Maries
(1321)

2 seroconversions
Tour du Valat
(1301)

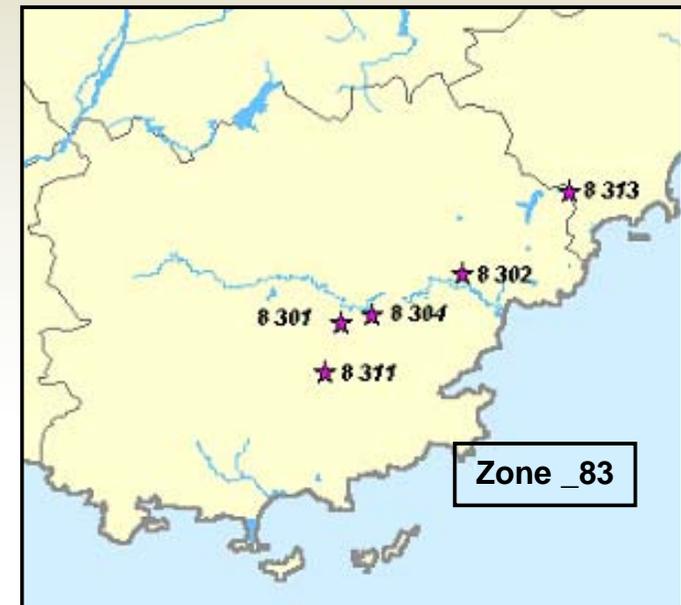
Aucune
mortalité aviaire
rattachée au
virus WN



Zone 11-66



Zone 13-30-34



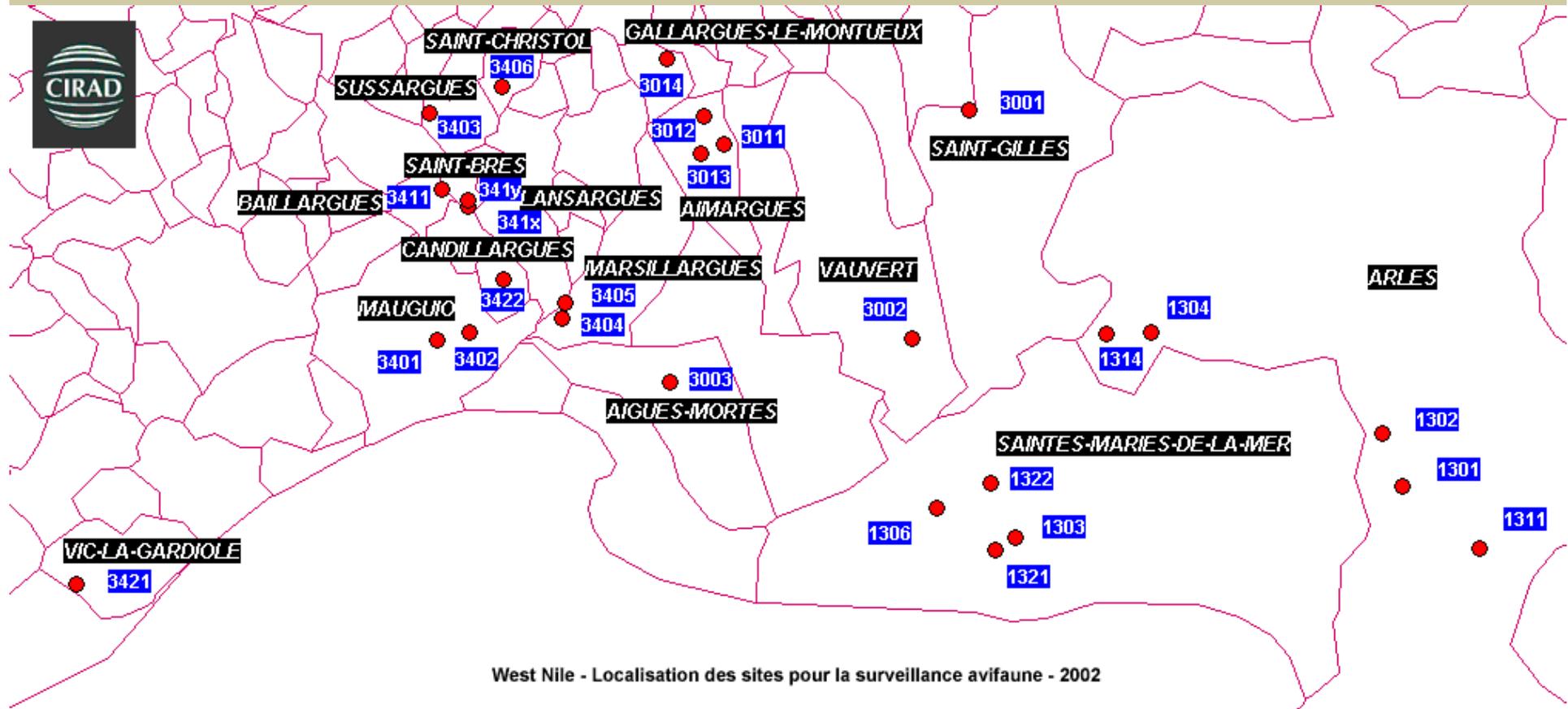
Zone 83

<http://west-nile.cirad.fr>



Sero-Surveillance on sentinel birds

4 controls, 6 weeks apart on 150 ducks and 150 domestic chickens
(anatidae et gallinae)





Duck drawing

Photo Jennifer Pradel

Surveillance de la fièvre de West Nile en France

Accueil

Présentation de la maladie

Historique

Dernières Informations

Partenaires

Liens

Protocole de surveillance 2004

Surveillance des cas humains

Base de données

Résultats de la surveillance

*Une infection des oiseaux
qui peut affecter
le cheval et l'homme.*

Surveillance des oiseaux



La fièvre de West Nile
(fièvre du Nil occidental)

Edition 2004

Bienvenue - Gestion des données

L'accès à la base de données (saisie des informations, correction et administration) est réservé aux partenaires du système de surveillance.

Pour accéder à la base, entrez vos login et mot de passe :

Login Mot de passe

Connexion

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Interrogations - Choix de la requête

Zone 34 - 30 - 13



Code du site sélectionné :

1321 - Croazier

Nombre de prélèvements : **63**

Nombre de positifs : **19**

Détails :

- [Liste des prélèvements effectués](#)
- [Liste des oiseaux positifs](#)

Vous pouvez choisir un autre site en cliquant sur la carte ci - contre.

Zone 11 - 66



Zone 83



Attention

*Positivité ne signifie pas séroconversion.
Une séroconversion est avérée uniquement si un oiseau positif a été trouvé négatif précédemment.*

2004-08-10	1321RV	negatif
2004-09-09	1321B	positif
2004-09-09	1321BB	négatif
2004-09-09	1321J	positif confirmé
2004-09-09	1321JJ	positif
2004-09-09	1321R	positif
2004-09-09	1321RB	positif
2004-09-09	1321RJ	négatif
2004-09-09	1321RR	négatif
2004-09-09	1321RV	négatif
2004-09-09	1321VB	positif
2004-09-09	1321WJ	positif confirmé
2004-09-09	1321W	positif
2004-10-07	1321B	positif
2004-10-07	1321BB	négatif
2004-10-07	1321J	positif

Surveillance de la fièvre de West Nile en France

Accueil

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Historique

Dernières Informations

Partenaires

Liens

Protocole de surveillance 2004

Surveillance des cas humains

Base de données

Résultats de la surveillance

Résultat de la requête "Tous les oiseaux positifs du site 1321 - Croazier "

Code de l'oiseau

1321B
1321J
1321JJ
1321R
1321RB
1321RR
1321VB
1321VJ
1321W

Afin de connaître le commémoratif d'un oiseau trouvé positif, veuillez cliquer sur son code dans le tableau ci - dessus.

Commémoratif de l'oiseau :

Date du prélèvement

Code du prélèvement

Conclusion

Partenaires

Liens

Protocole de surveillance 2004

Surveillance des cas humains

Base de données

Résultats de la surveillance

[1321J](#)

[1321JJ](#)

[1321R](#)

[1321RB](#)

[1321RR](#)

[1321VB](#)

[1321VJ](#)

[1321W](#)

Afin de connaître le commémoratif d'un oiseau trouvé positif, veuillez cliquez sur son code dans le tableau ci-dessus.

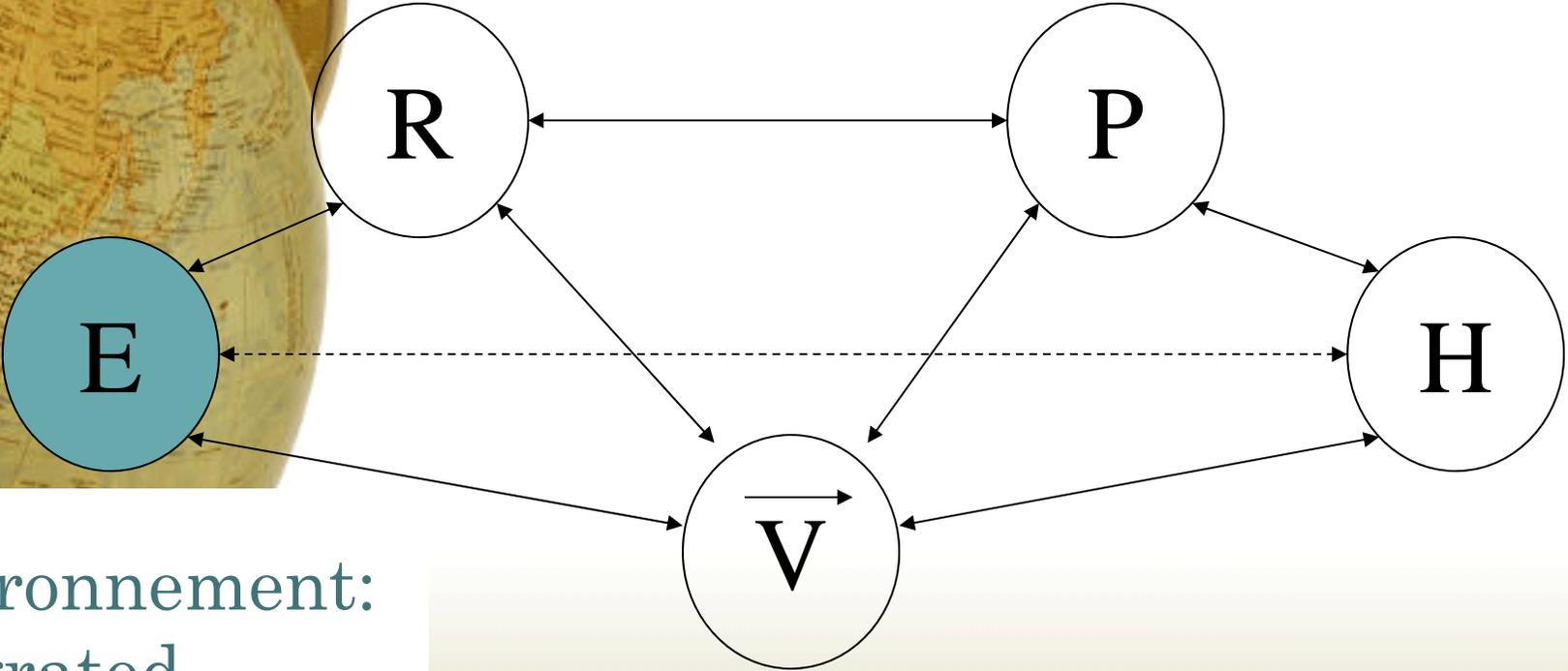
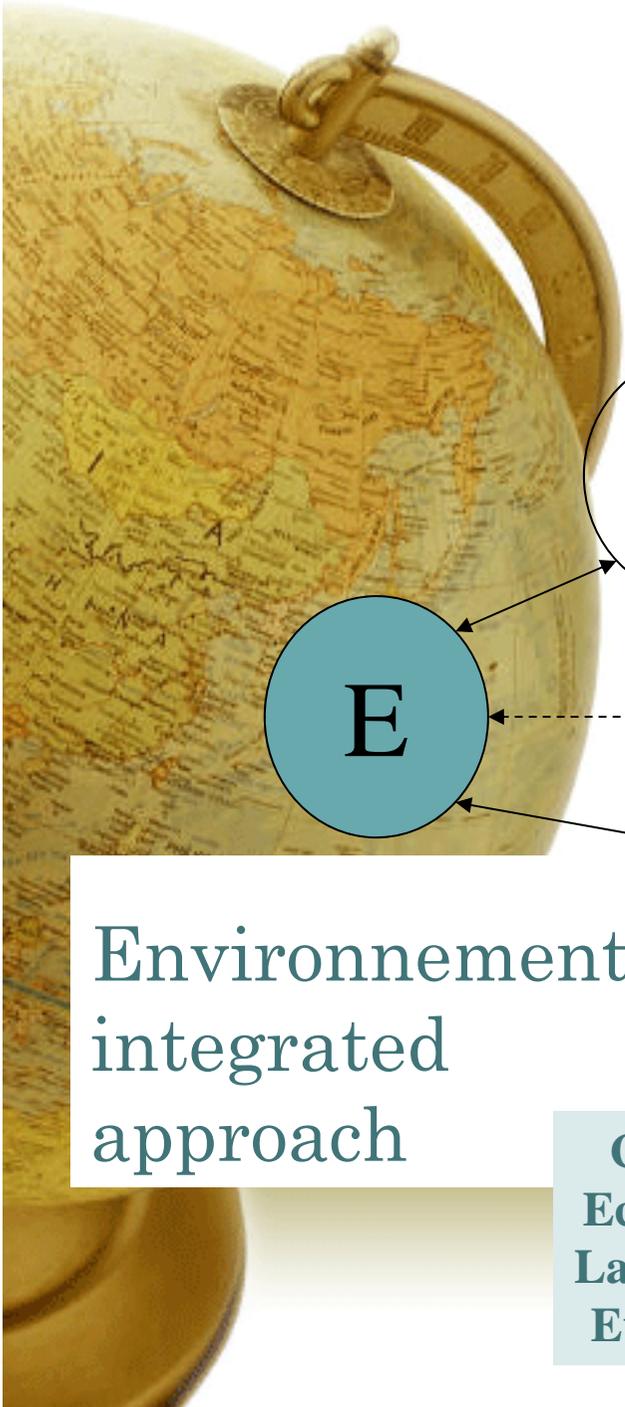
Commémoratif de l'oiseau : 1321VJ

Date du prélèvement	Code du prélèvement	Conclusion
2004-06-04	003346-12	négatif
2004-07-20	003347/7	négatif
2004-09-09	003379/1	positif confirmé
2004-10-07	003388/12	positif
2020-00-04	003386/11	douteux; à reconstrôler



What to conclude on the Reservoir component ?

- **(Bird) Sentinel Surveillance is not any more appropriate, too hard to manage, and does not avoid or predict outbreaks**
- **Need of adapted diagnostic tools (bird serology)**
- **Early warning remains a key point with a rapid lab diagnosis as well as a realtime data management system**



Environnement:
integrated
approach

Climate
Ecosystem
Landscape
Evolution

① Case of BTV in France



The case of BTV and *Culicoides*



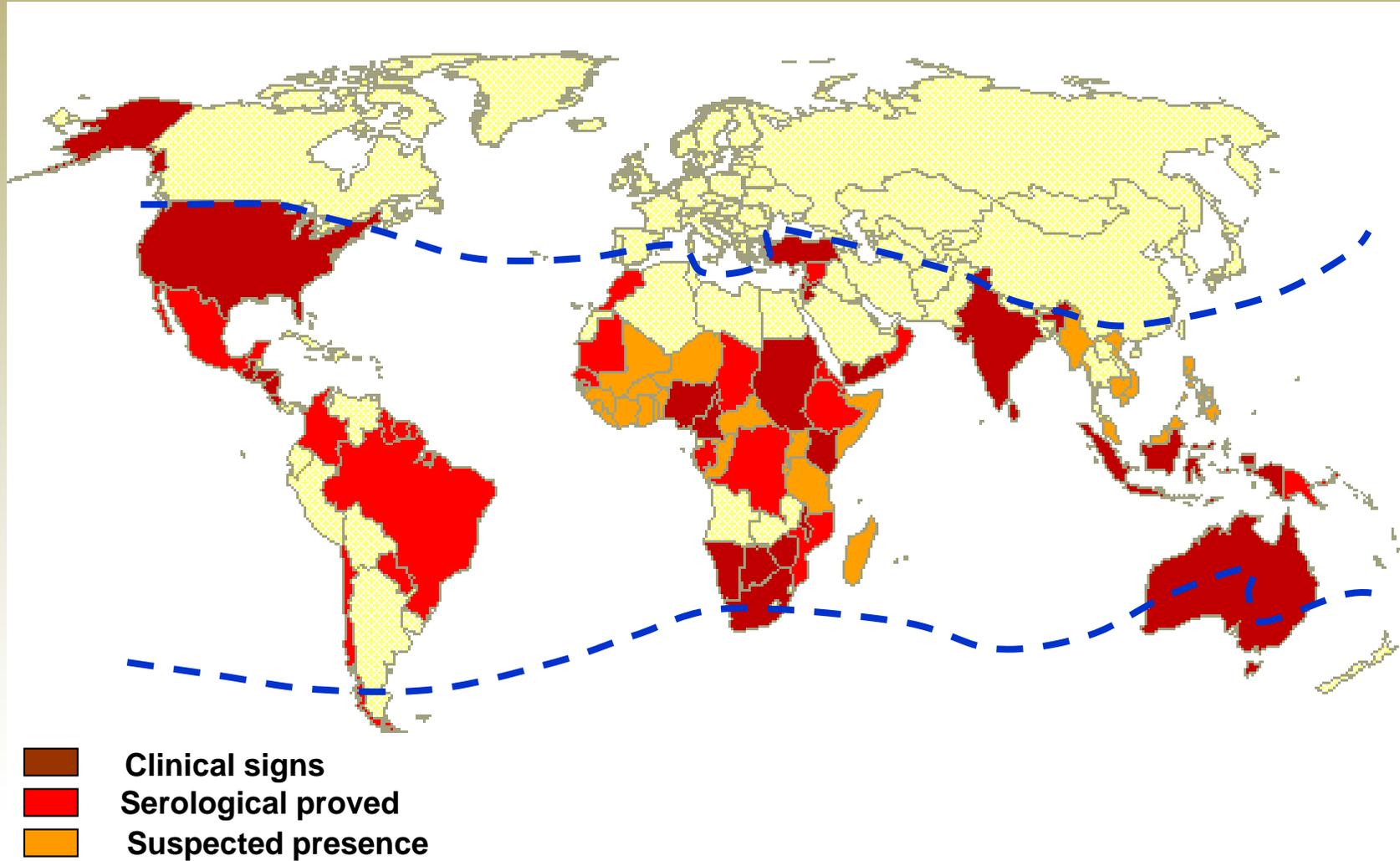
C. imicola

- Maximum Activity around + 24 ° C
- Fly stop around: + 15-18 ° C
- Can resist to short periods at -1,5°C
- Max temperature mean > + 12,5°C (10 following days > 13°C)

- Population dynamics: Presence of *Culicoides* linked to humidity and inversely correlated with heavy rainfalls and wind
- - in dry zones: after rainfalls
- - in temperate zones: at the end of the hot season



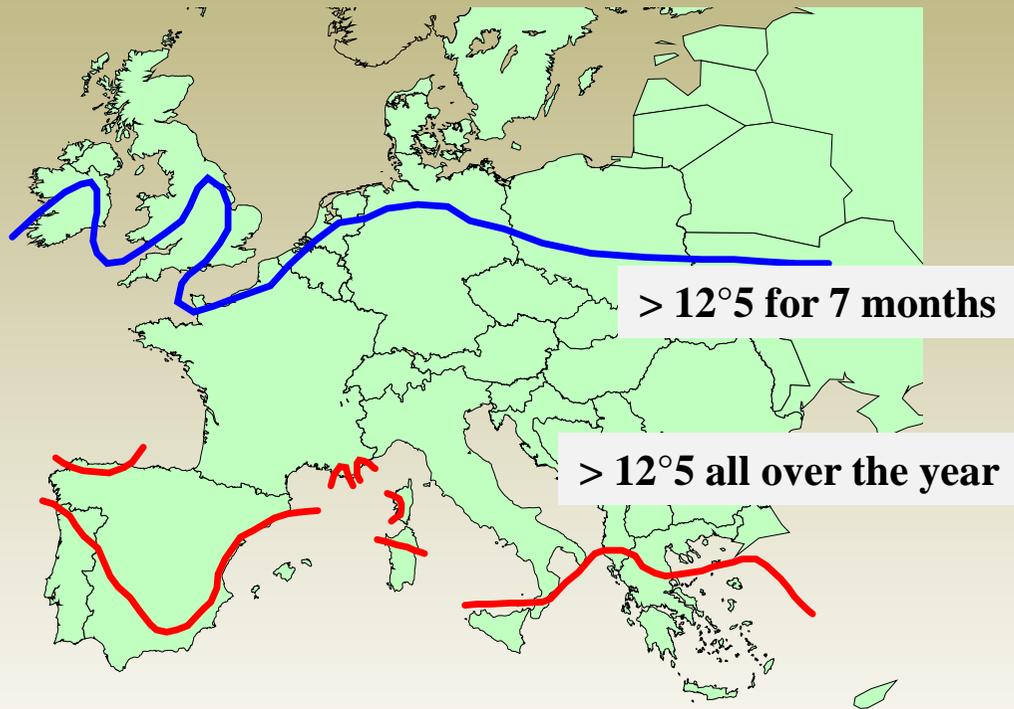
BTV distribution, 1991



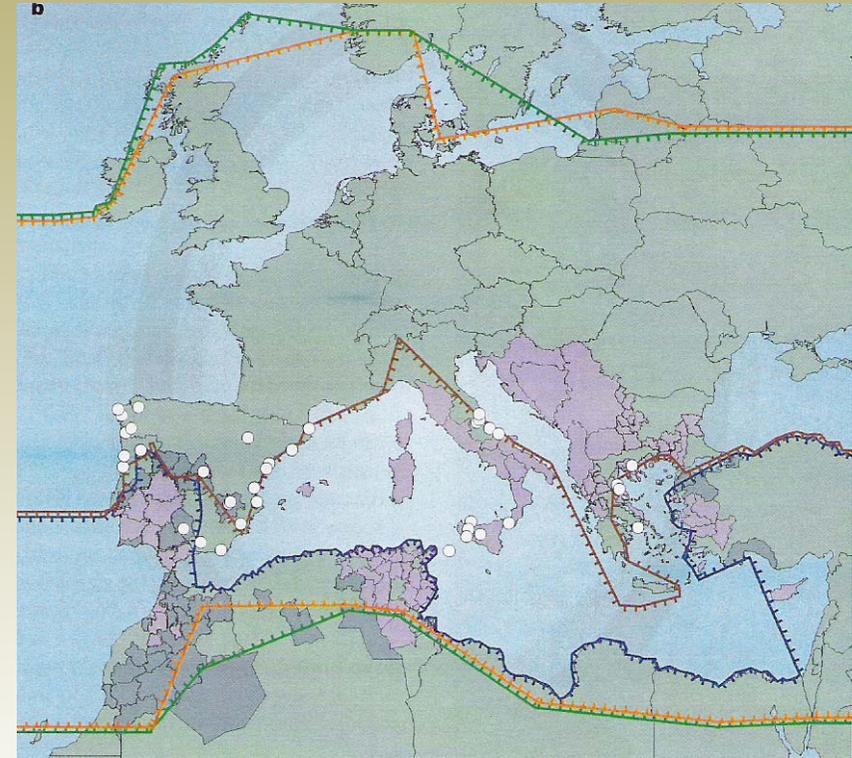
Atlas des maladies infectieuses des ruminants, 1991
P.C. Lefèvre, IEMVT/CTA



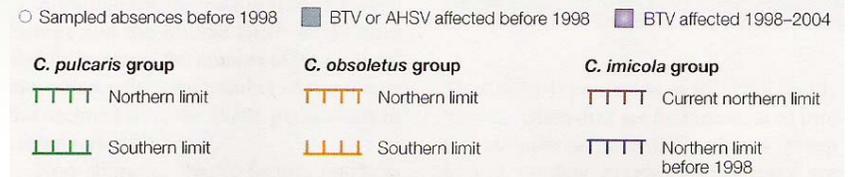
Vector survival



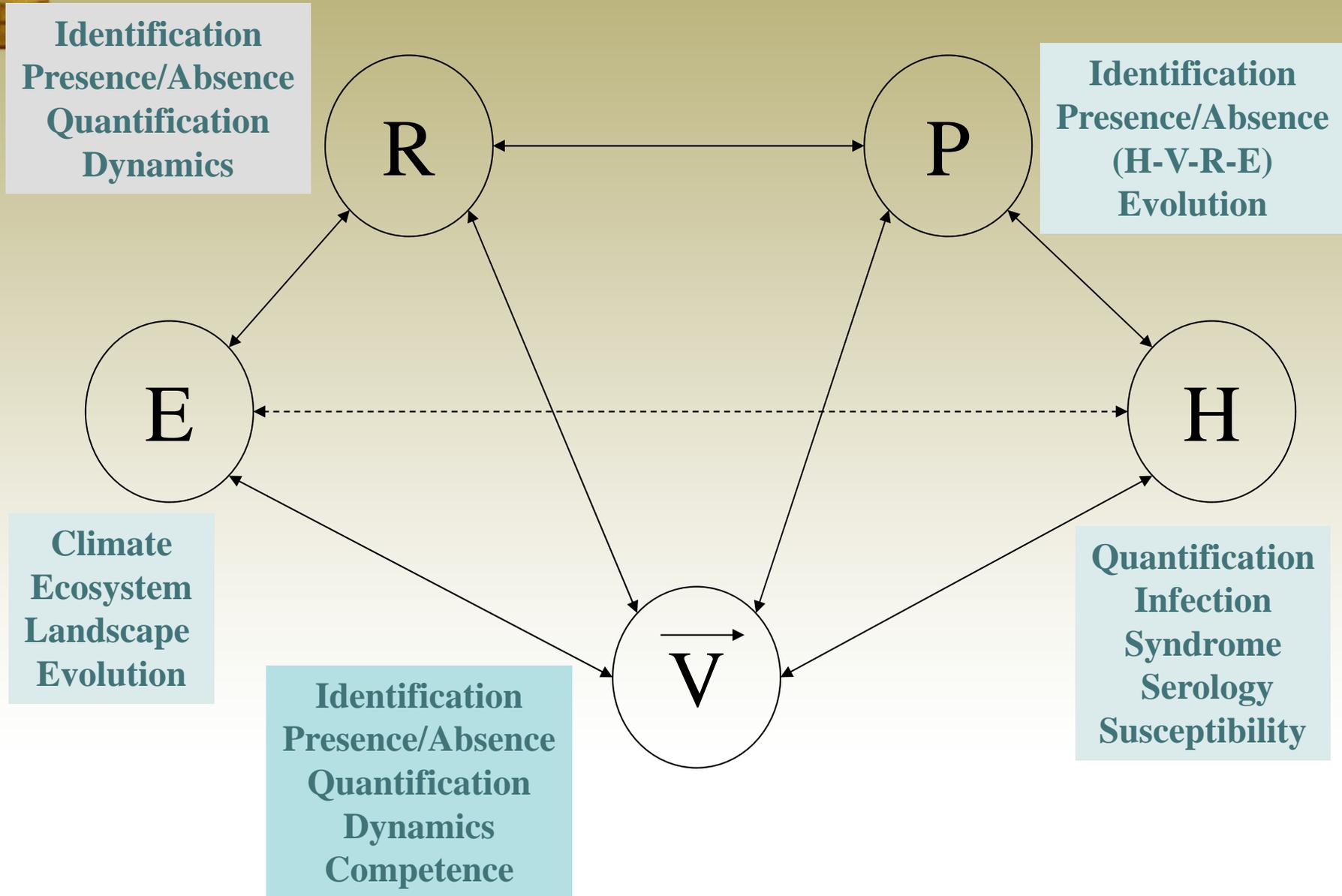
Mellor, 2002



Purse, 2005



Risk mapping



Establishment risk for emerging vector-borne infection: a case study of canine leishmaniasis in southern France

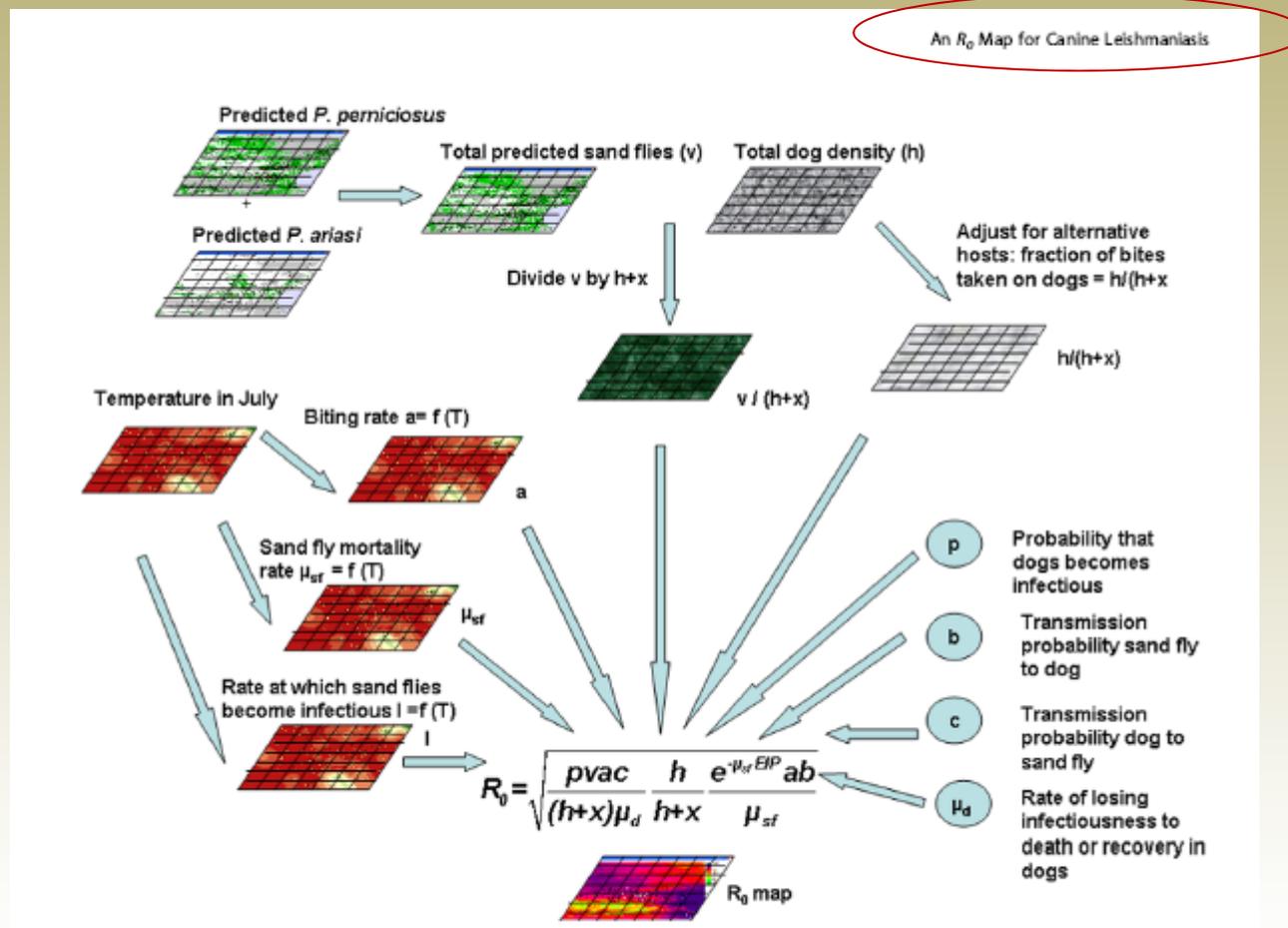
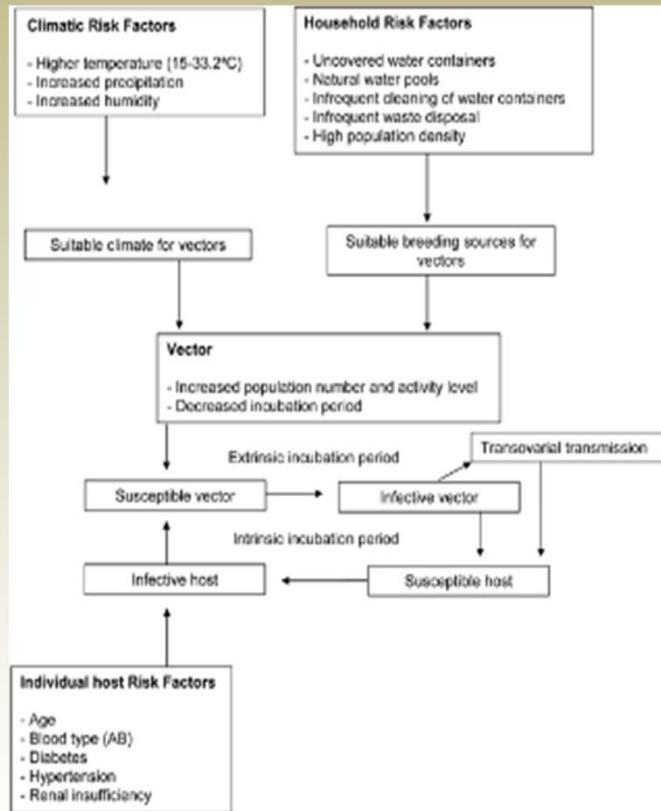


Figure 1. Schematic overview of the approach.
doi:10.1371/journal.pone.0020817.g001

Hartemink et al., 2012



Transmission pathway and risk factors involved in dengue fever outbreaks



Racloz et al., 2012

Multiscale analysis for a vector-borne epidemic model

Souza et al., 2011



Typical timescale for the host and vector are distinct leading to asymptotic dynamics :

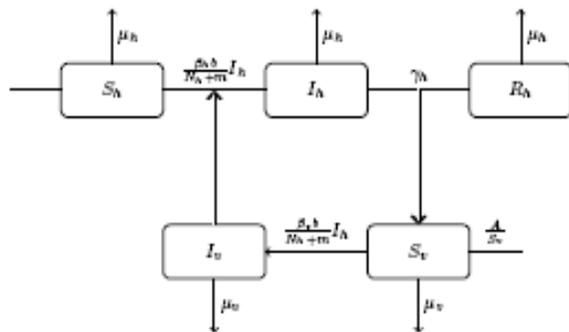


FIGURE 1. Compartmental description of the arbovirus model by [1, 3].

✓ SIR model for the host with a modified incidence rate (vectors disappearing from the model)

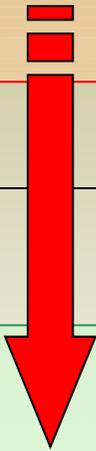
✓ SI model for the vectors with the hosts disappearing from the model

Parameter	Meaning
N_h^* and N_v^*	Number of hosts and vectors
ν_h^* and ν_v^*	birth rate for hosts and vectors
β_h^* and β_v^*	probability of a host being infected by a vector and vice-versa.
γ^*	recovering rate
ω_v^*	Number of alternative blood sources

TABLE 1. Description of parameters meaning in the compartmental model depicted in Figure 1



Infected Zone



Customs

Free Zone



Zone at risk



Infected Zone

Analysis of the risk
of introduction



Customs

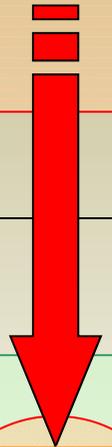
Free Zone

Identification of
the favorable
ecosystem

Zone at risk



Infected Zone



Introduction

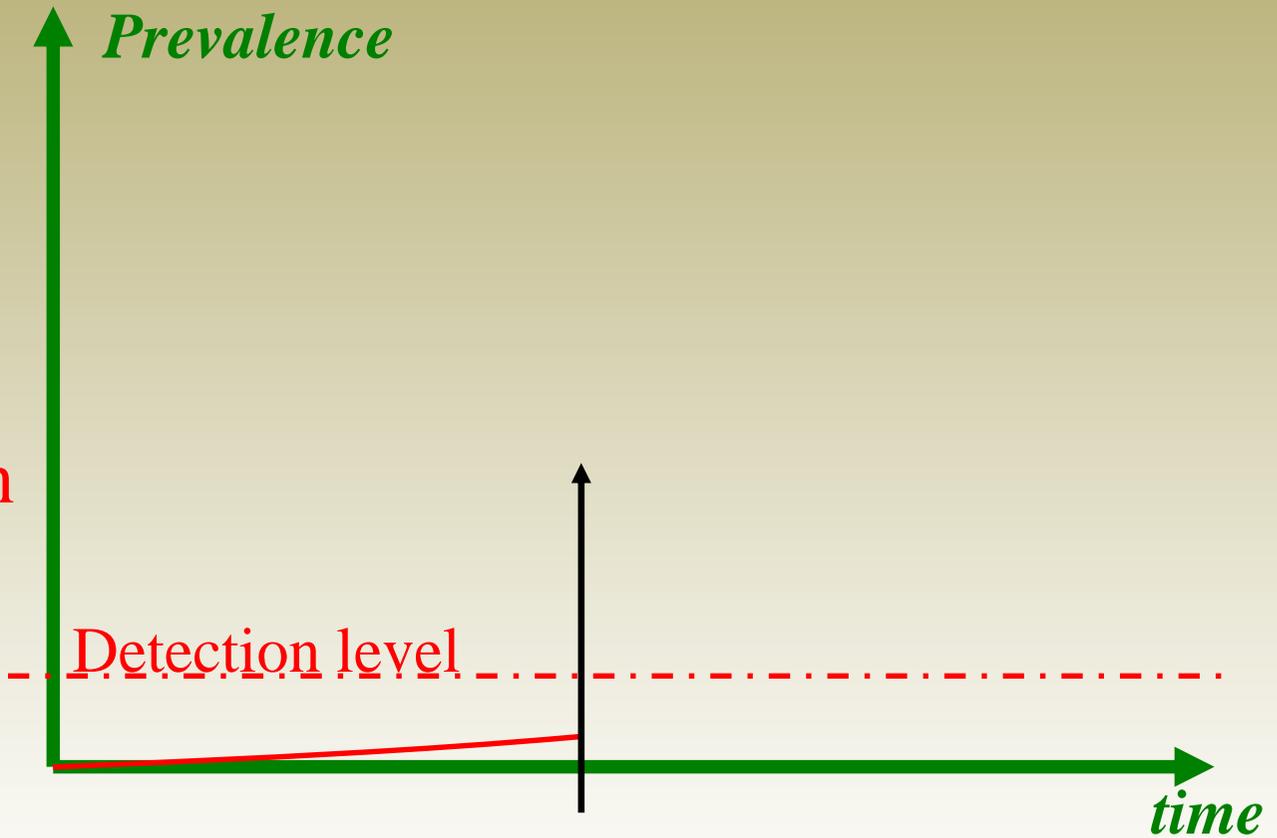
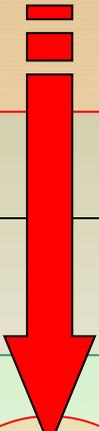
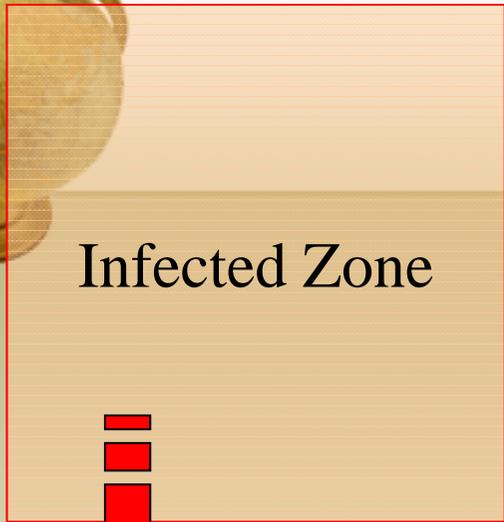
Customs

Free Zone

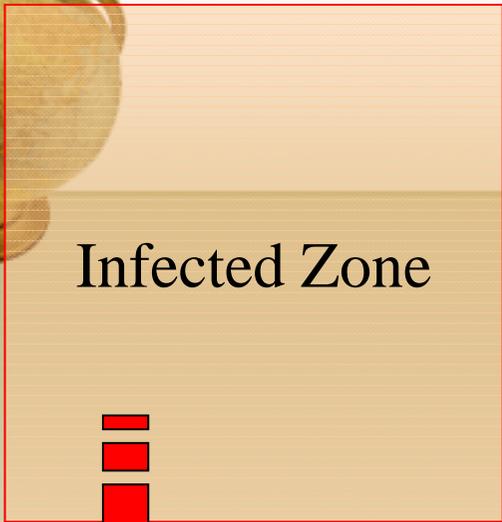
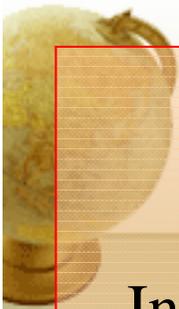


Zone at risk



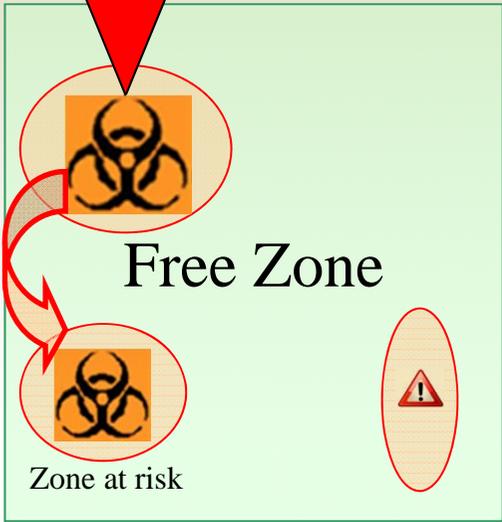


Contingence Plan



Infected Zone

Introduction



Free Zone

Zone at risk



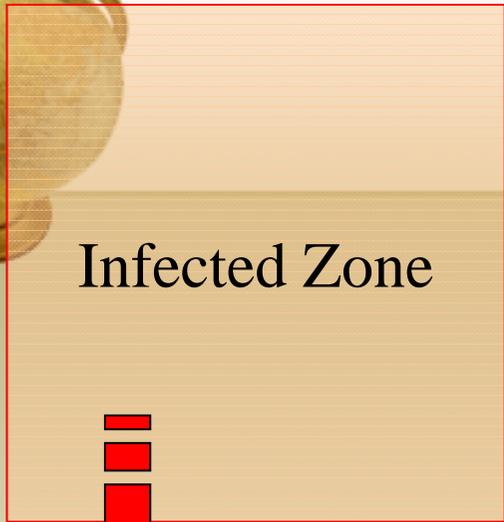
Prevalence

Detection level

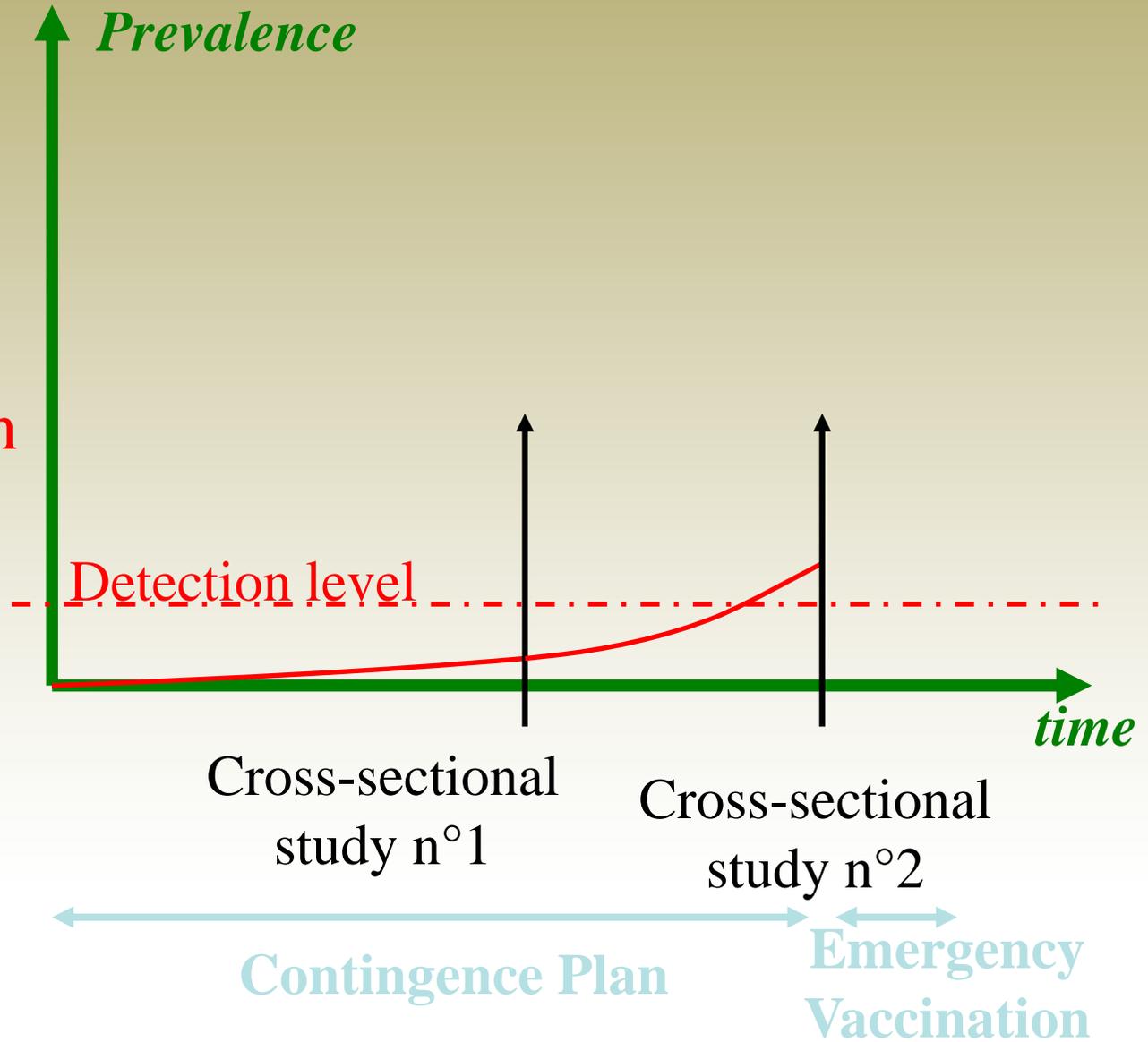
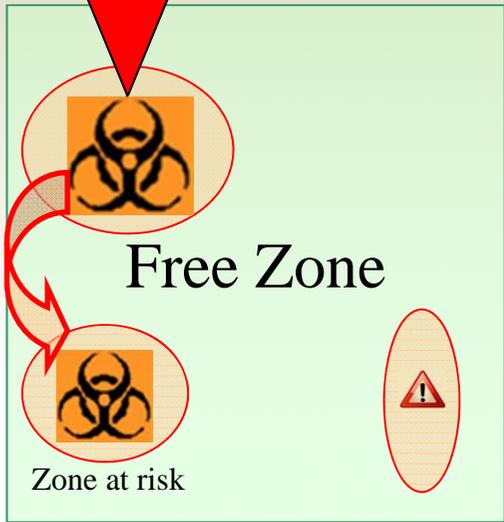
time

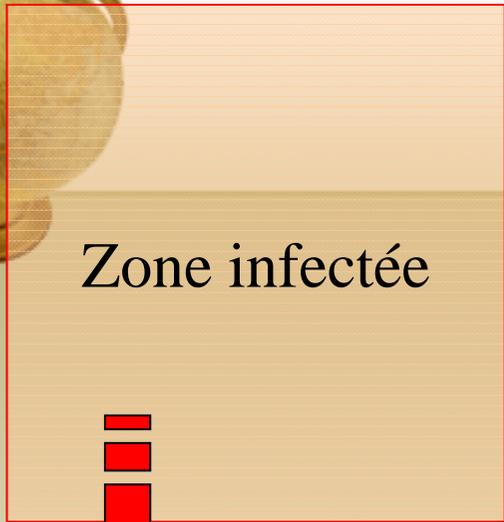
Cross-sectional study n°1

Cross-sectional study n°2

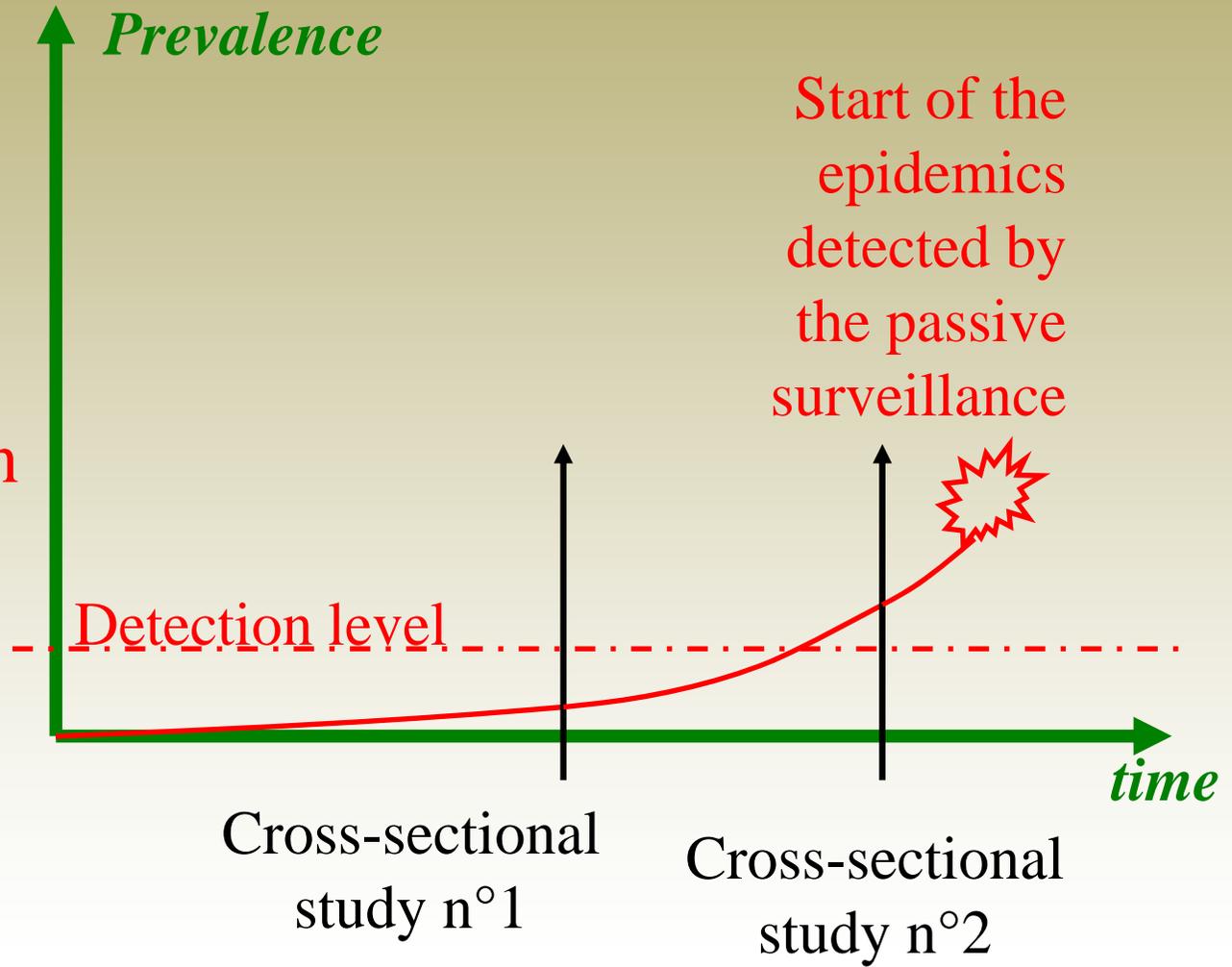
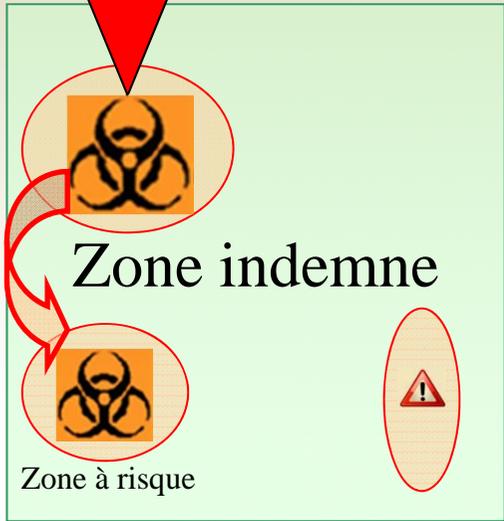


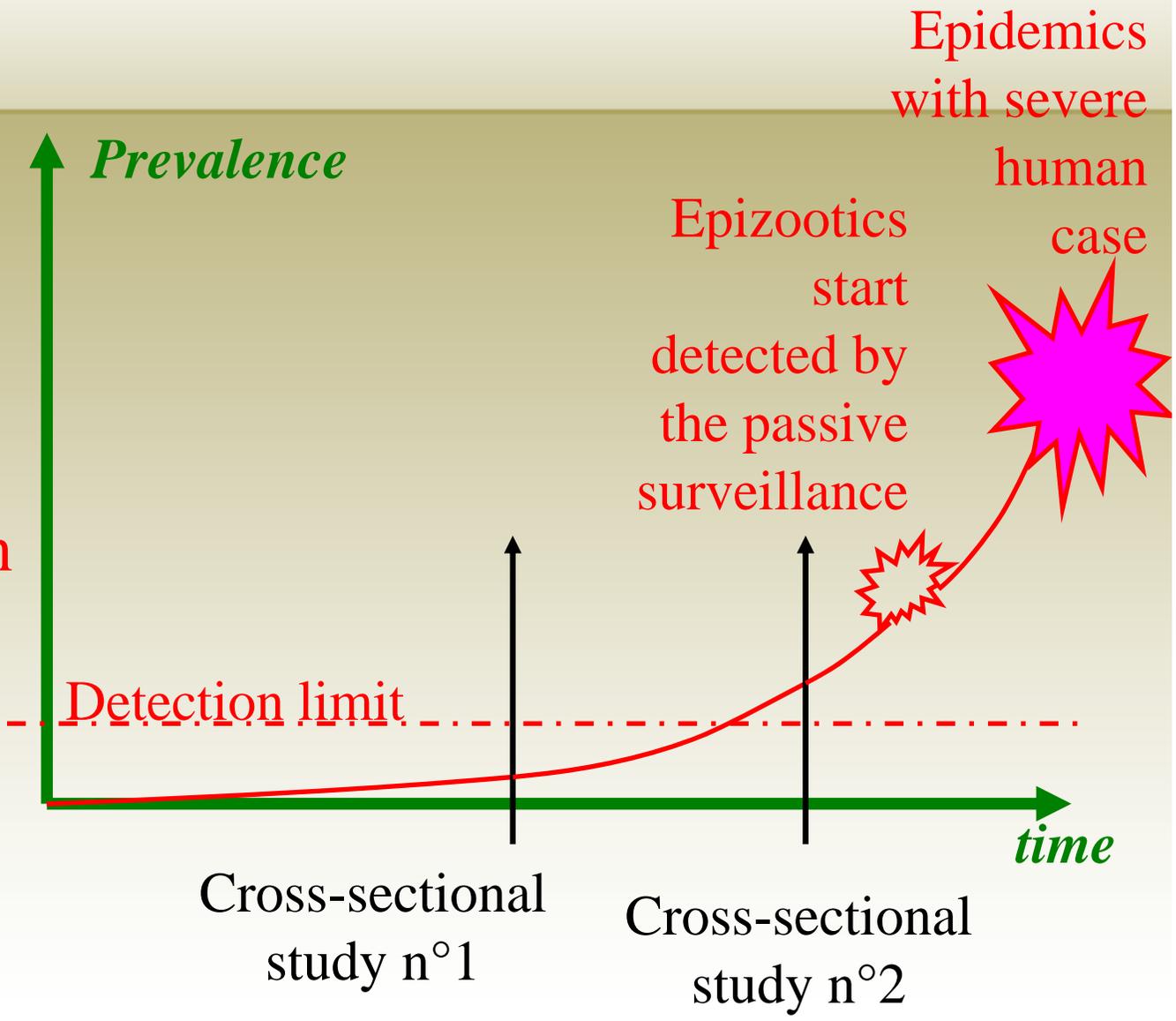
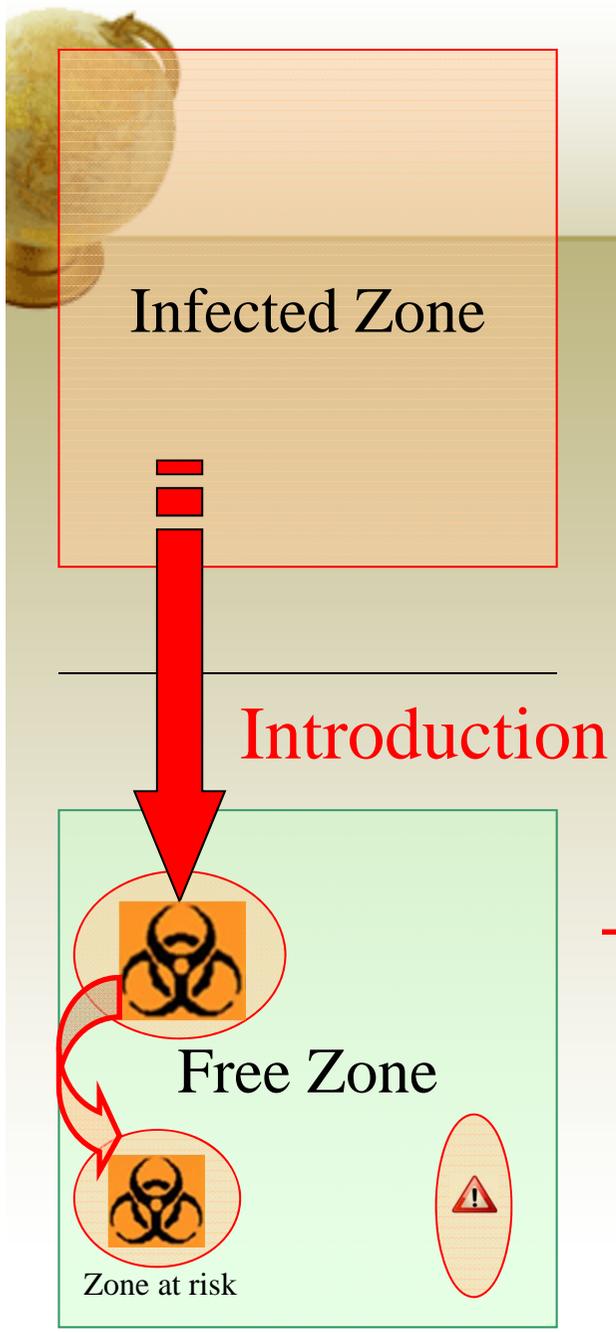
Introduction





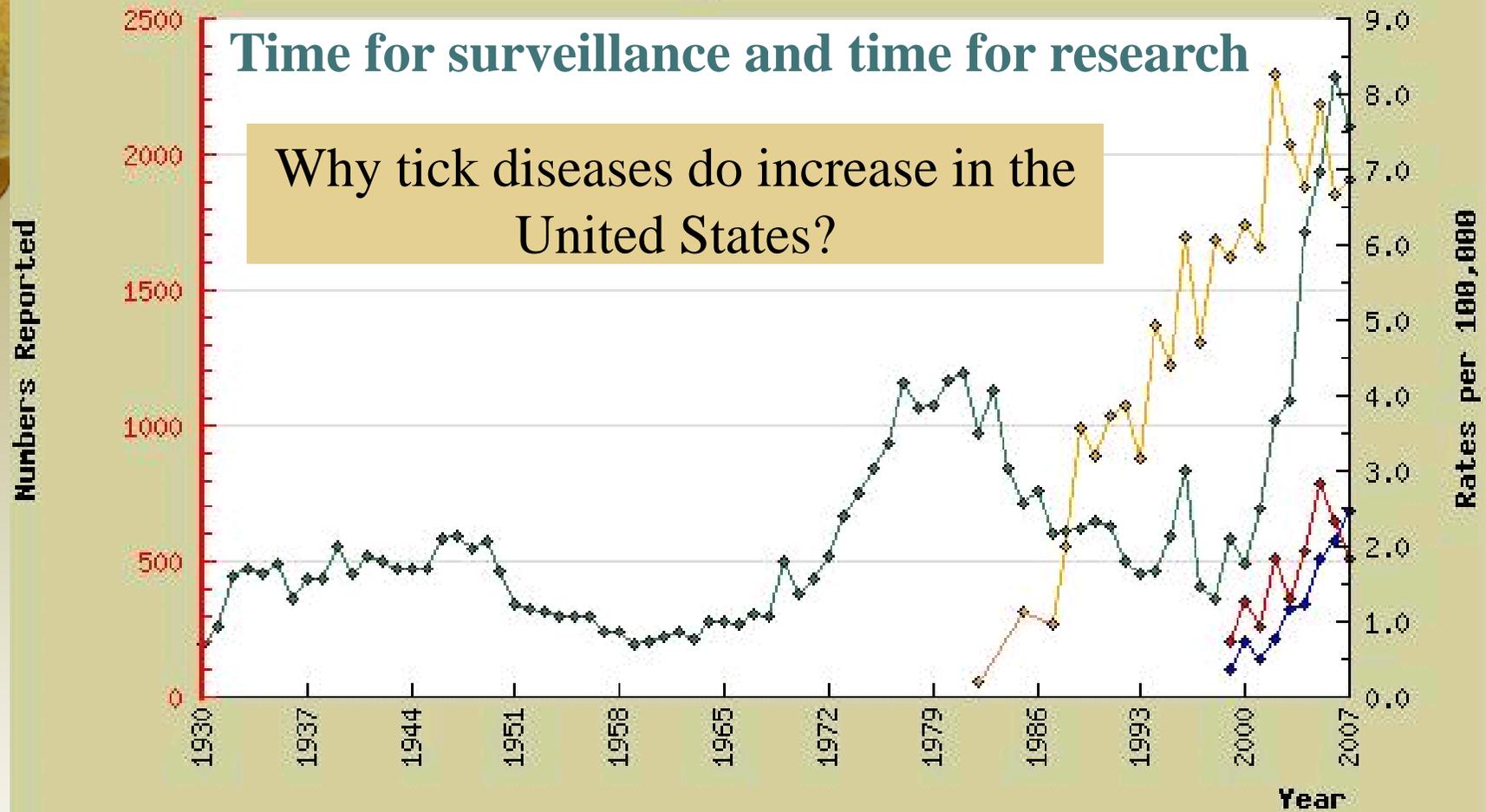
Introduction





Time for surveillance and time for research

Why tick diseases do increase in the United States?



- ◆ United States. Ehrlichiosis - human monocytic, cases
- ◆ United States. Ehrlichiosis - human granuloctytic, cases
- ◆ United States. Rocky Mountain spotted fever, cases
- ◆ United States. Lyme disease, cases (Rates per 100,000)

Special Thanks to

Pascal Hendrikkx



Renaud Lancelot and Eric Cardinale



Michèle Bouloy



Asante Sana





④ BTV surveillance in Mainland France

- ✓ Following the BTV- 2 outbreak in Corsica in 2000, surveillance has been implemented in to Mainland southern France in 2001

