Tularemia Update: Epidemiology and Ecology of The Engimatic Zoonotic Agent

February 2, 2004

SPHVCC

Denver, CO

Where in the world is tularemia?

Diagnostic and Reference Laboratory
Bacterial Zoonoses Branch
Division of Vector-Borne Infectious Diseases
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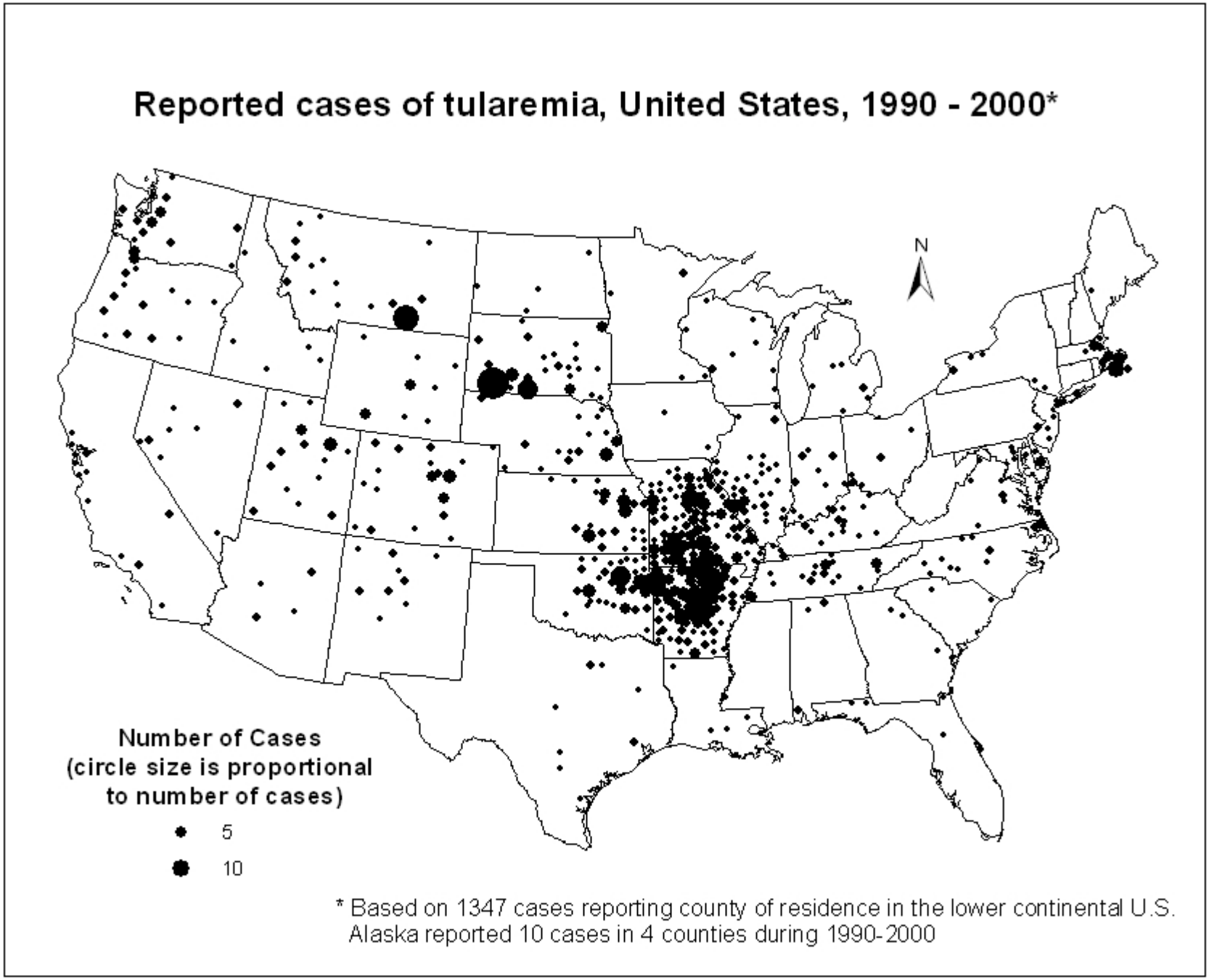
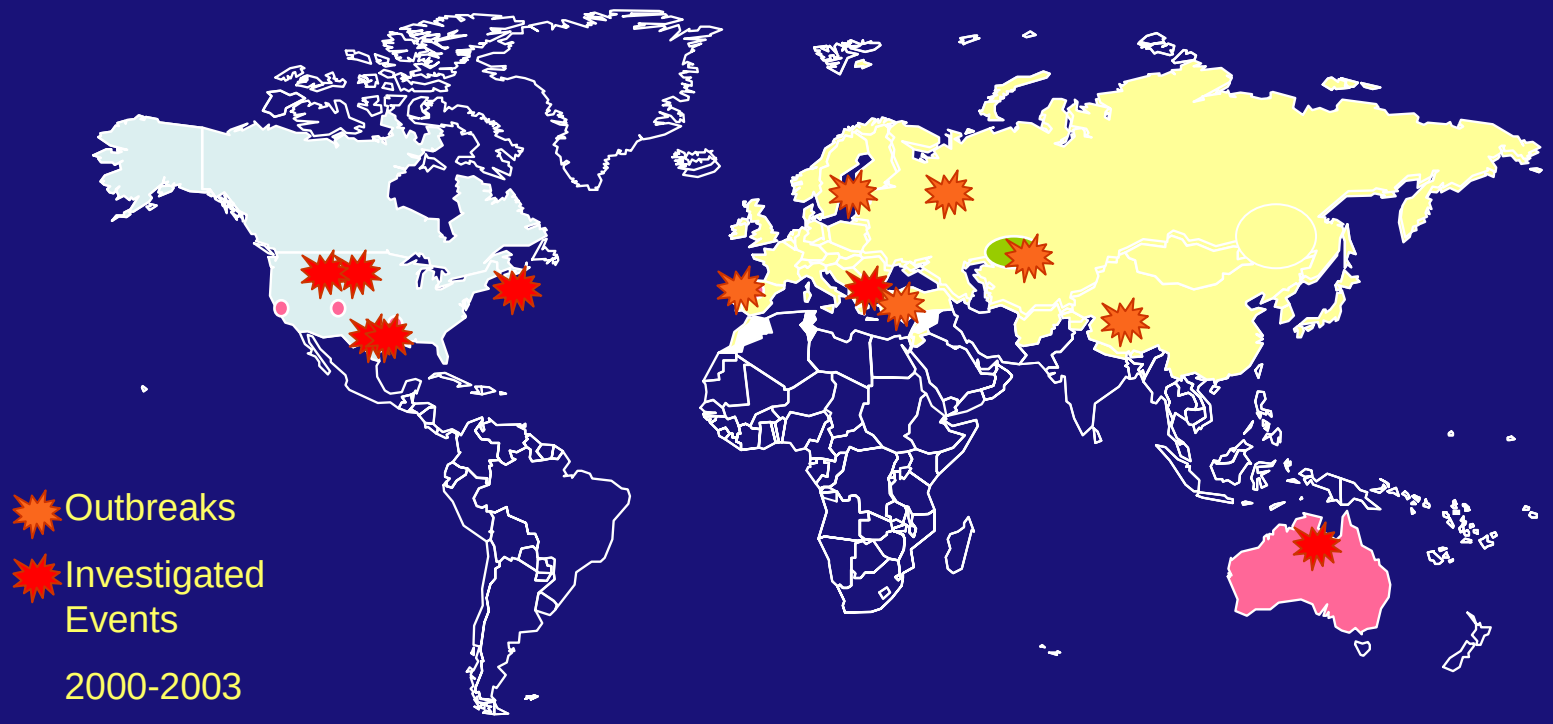
Ft. Collins, Colorado



Reported cases of tularemia, United States, 1990-2000.

GEOGRAPHIC DISTRIBUTION OF TULAREMIA



- ***F. tularensis* v. *tularensis* (TYPE A) and *F.t. holarctica* (Type B)**
- ***F.t. holarctica* (TYPE B)**
- ***F.t. novicida***
- ***F.t. mediaasiatica***

Historical Perspective

Parker *et. al*., NIH Bulletin, No. 193, 1951

- Tularemia in Beavers and Muskrats in Northwestern U.S.
  - 16 month study of water, mud, soil in areas where beaver/muskrats were found dead of tularemia
  - Contamination of water and mud was year round
  - Guinea pigs were used to recover *F. tularensis*, 2,078/5,208 (40%) were positive.
  - Recovery from “fresher” carcasses, but not from decomposed tissues
  - Live animals, bladder taps yielded positive cultures

BADLANDS NATIONAL MONUMENT
South Dakota, 1991

	# Pos	Percent
Badger	5/15	33%
Coyote	9/36	25%
Fox	0/2	0%
Raccoon	4/9	44%
Skunk	7/18	38%

Martha's Vineyard

1978 Pneumonic cases associated with exposure to contaminated water

2000, 2001

•Inhalation cases associated with landscape workers, "Lawnmower tularemia" (n = 22)

•Exposure to contaminated environment

•Type A fatal infection (unknown mechanism to persist in nature ?)


Reno Ditch
West Lake Pit
Kullerstrand School
Applewood Golf Course

Rural Colorado

2001, 2003

Texas and South Dakota 2002

Enigmatic Nature

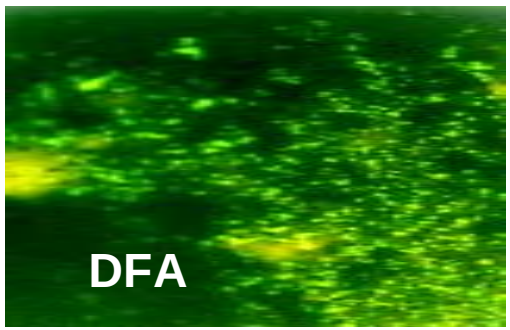
- The environment is quite diverse
- The host mammal species are broad
- The ectoparasite vectors are varied and their infectivity and transmission rates are virtually unknown
- The bacteria can exist in water-related environment for a long-time and associates with protozoans as “endosymbiont”
- The ecological niches occupied by tularemia isolates remains uncharted
- Forensic DNA evidence in the absence of biological activity (BioWatch)

Laboratory Tests

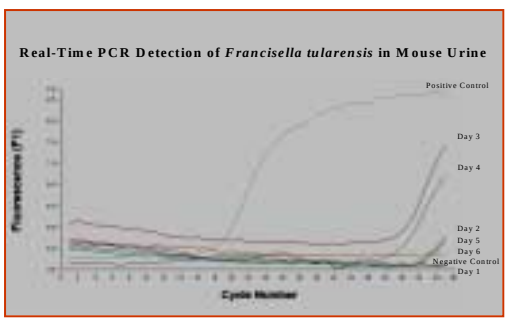
Some tools that can provide answers to some of the questions we have about tularemia

Diagnostic Tests

Presumptive



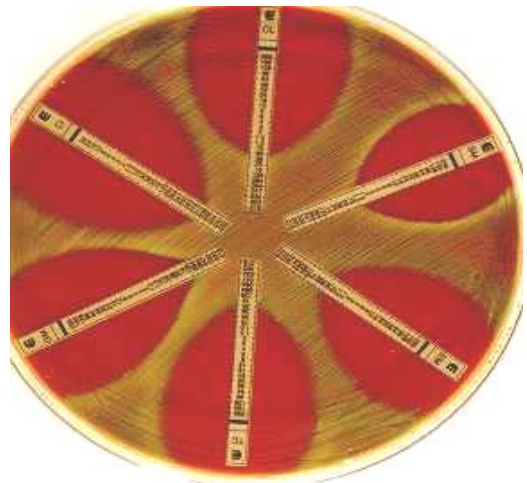
- **Single positive serum**
- **Immunohistochemical staining**
- **Antigen agglutination**
- **Hand-held assay**

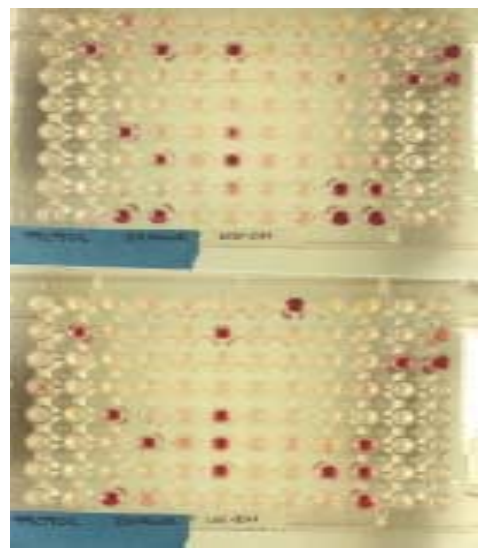


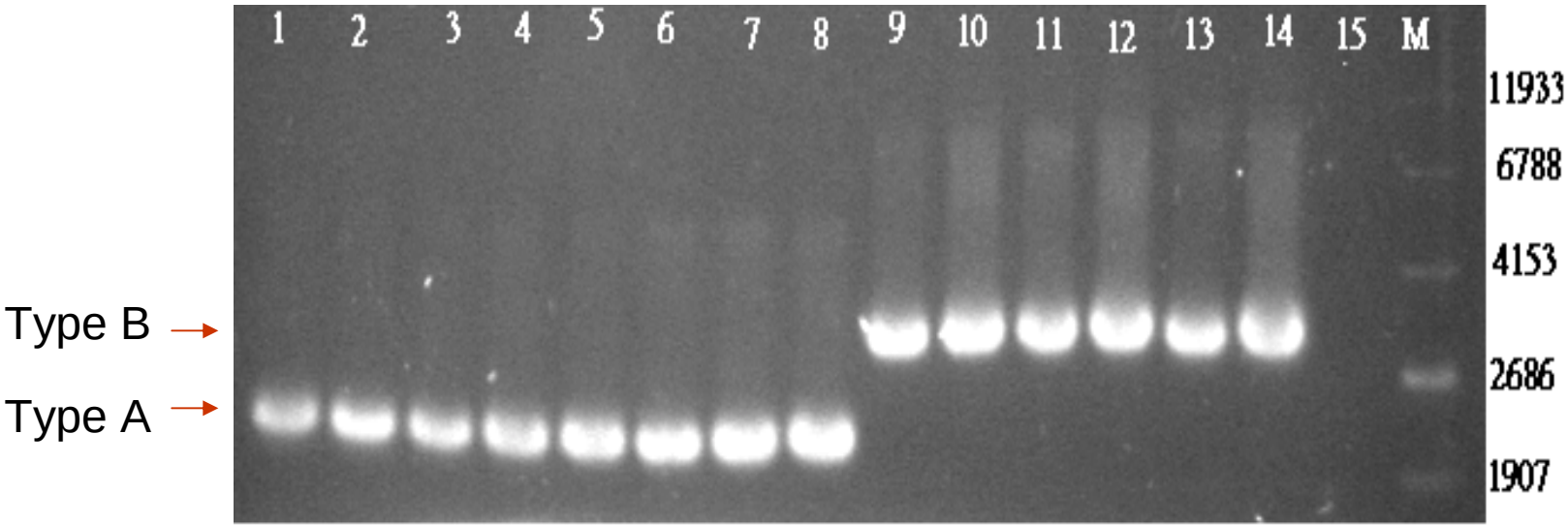
Confirmatory

- **Culture recovery**
- **Paired serum, 4-fold titer difference**

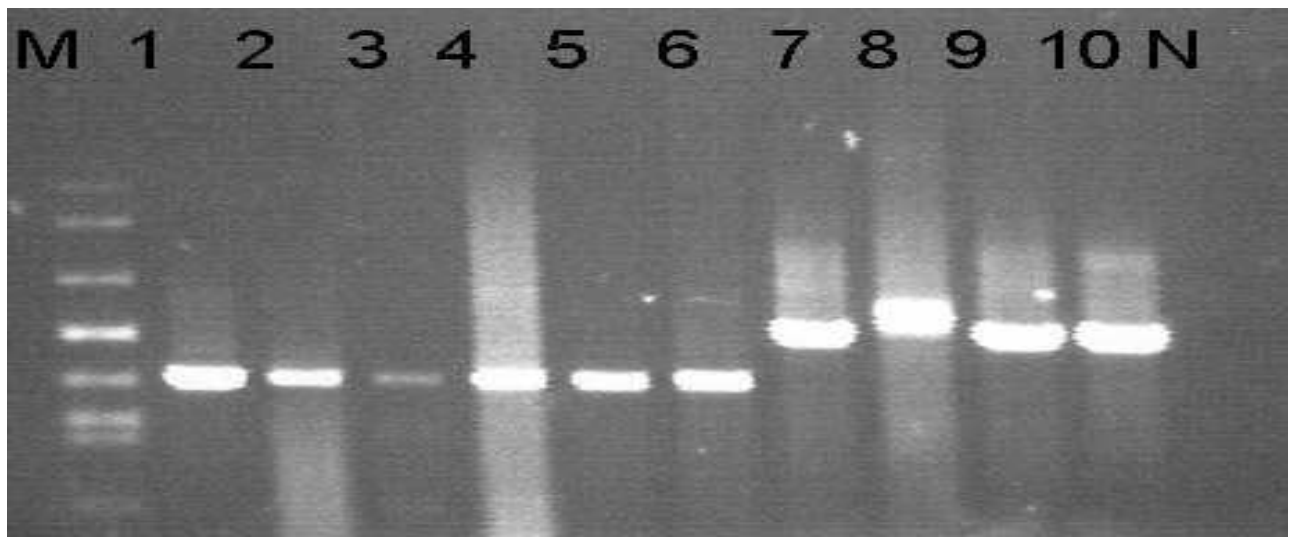
Supportive

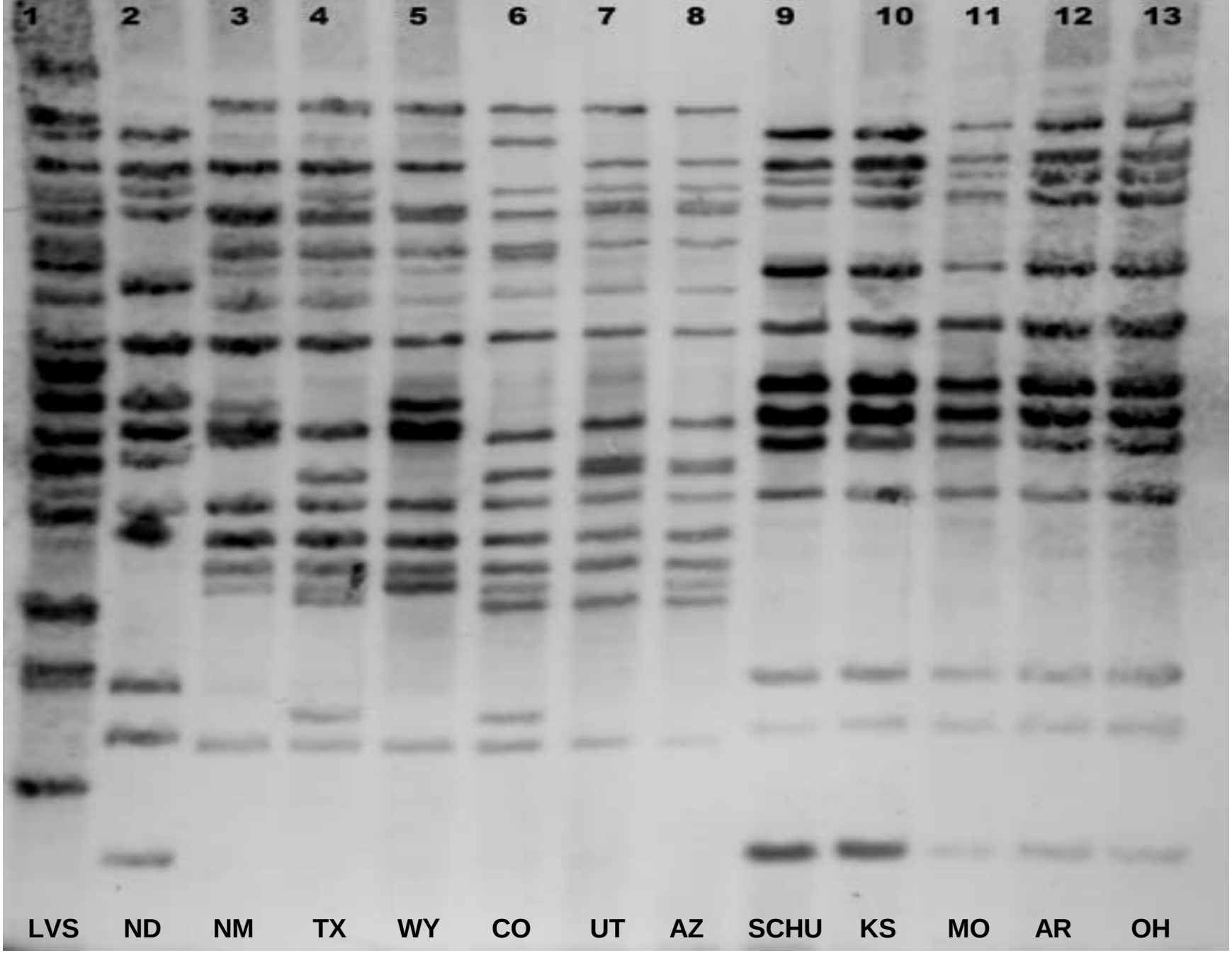




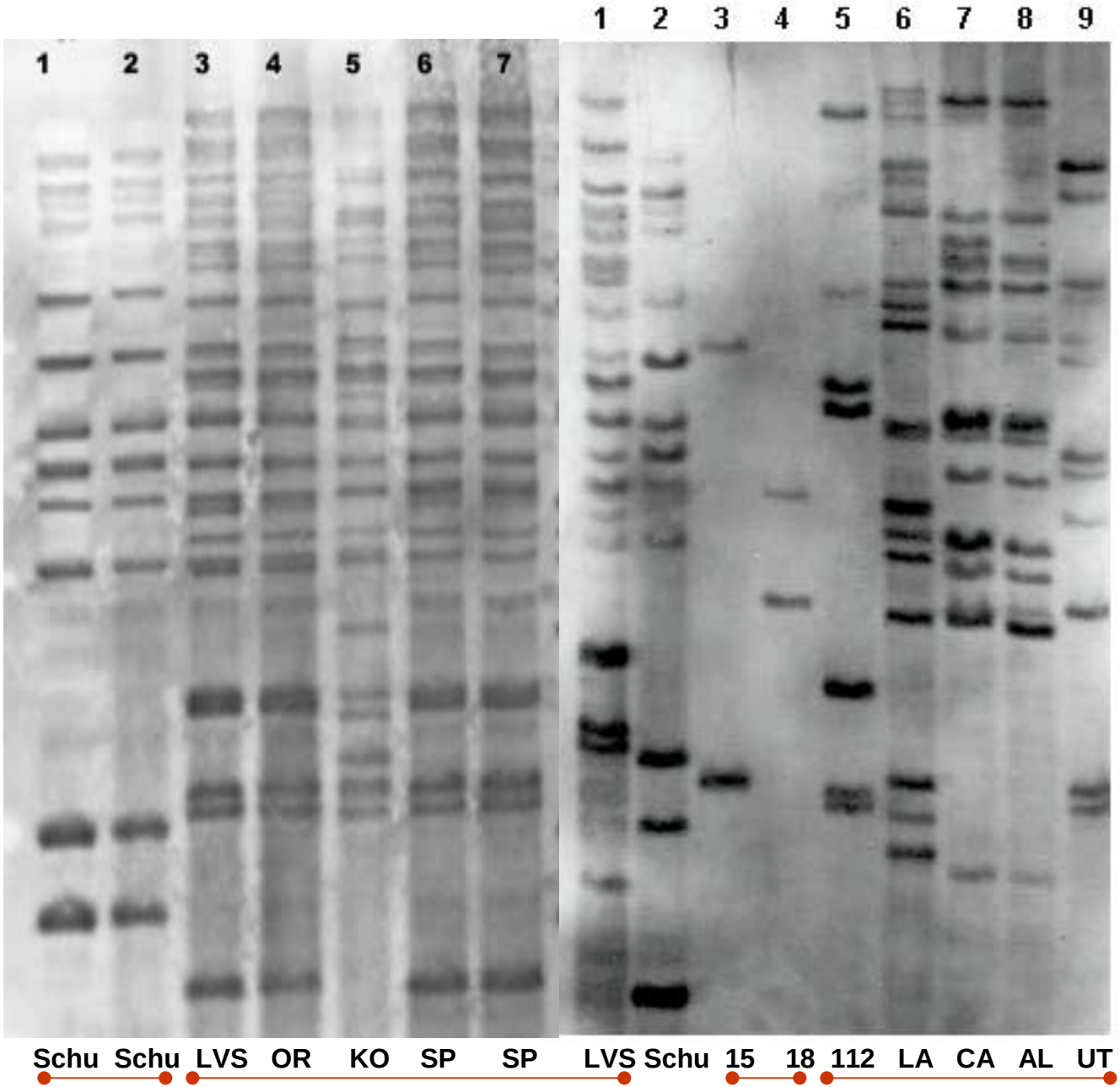


IS*Ftu2*-PCR. Top panel: cultures. Bottom panel: tissues and blood



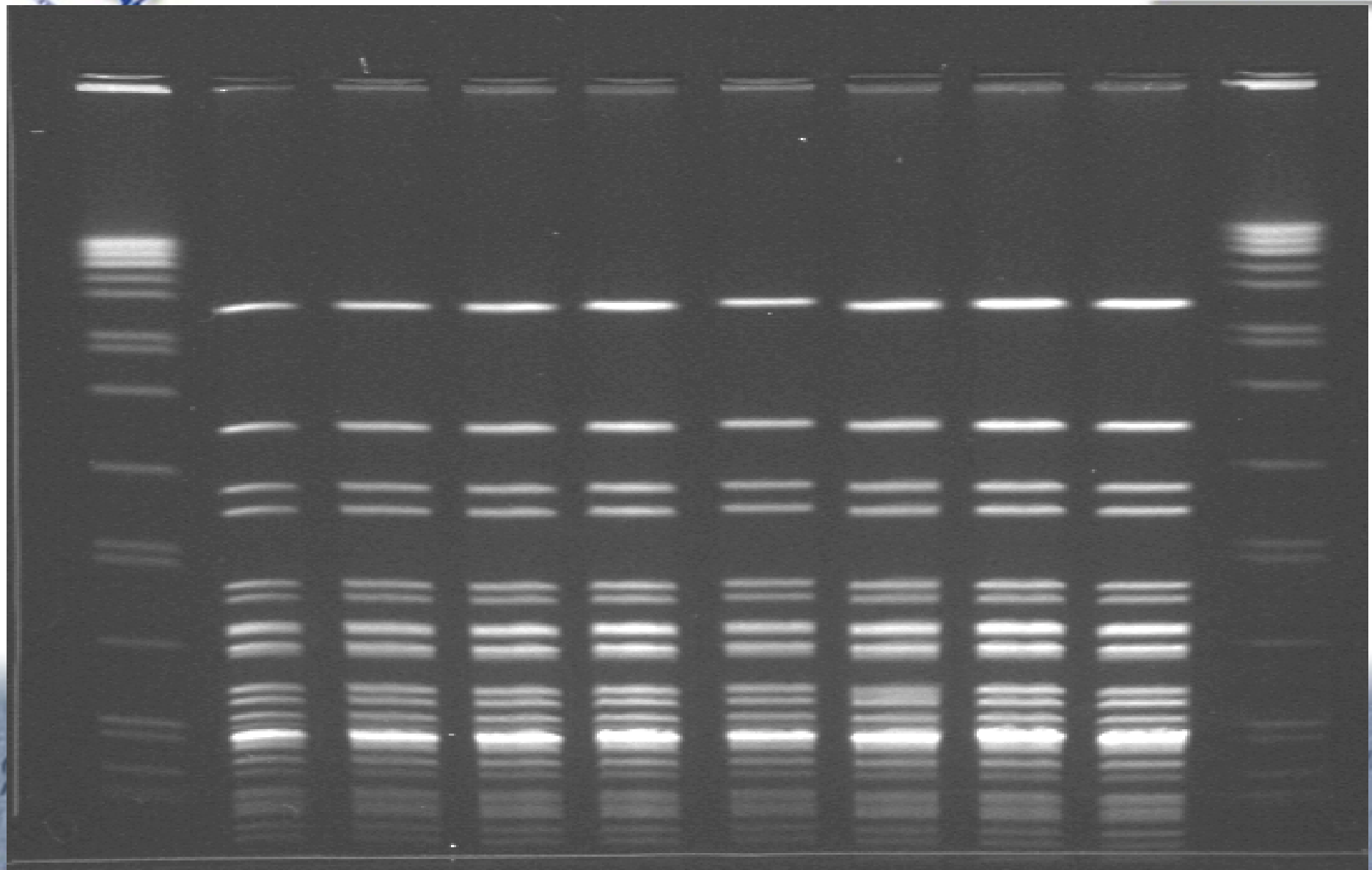


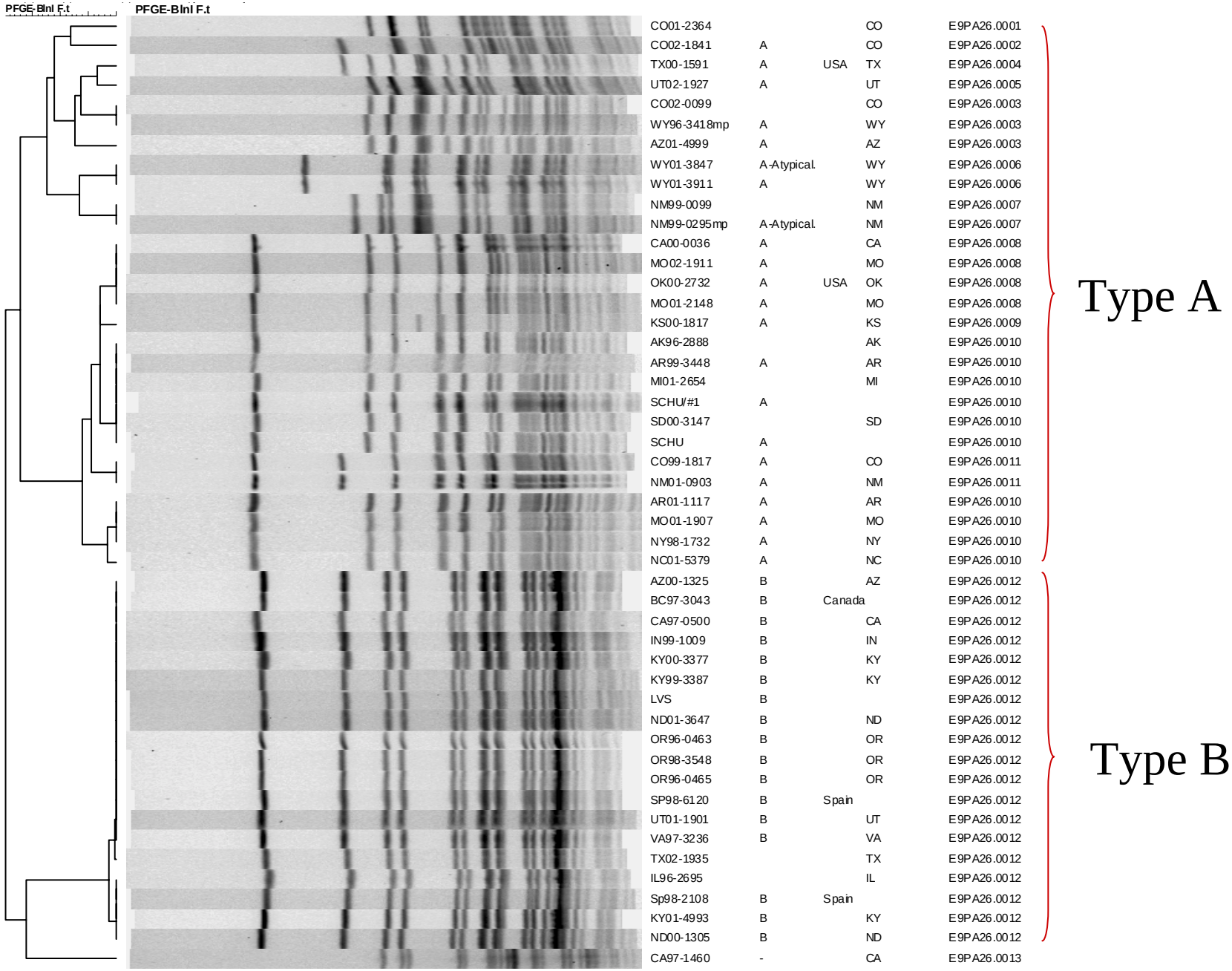
Southern Blot of *Bgl*II-digested Type A DNA probed with IS*Ftu2*



Southern Blot of *Bgl*II-digested DNA probed with IS*Ftu2*

F. tularensis PFGE




PFGE-BInI F.t
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CO01-2364 CO
CO02-1841 A CO
TX00-1591 A USA TX
UT02-1927 A UT
CO02-0099 CO
WY96-3418mp A WY
AZ01-4999 A AZ
WY01-3847 A-Atypical. WY
WY01-3911 A WY
NM99-0099 NM
NM99-0295mp A-Atypical. NM
CA00-0036 A CA
MO02-1911 A MO
OK00-2732 A USA OK
MO01-2148 A MO
KS00-1817 A KS
AK96-2888 AK
AR99-3448 A AR
MI01-2654 MI
SCHU/#1 A
SD00-3147 SD
SCHU A
CO99-1817 A CO
NM01-0903 A NM
AR01-1117 A AR
MO01-1907 A MO
NY98-1732 A NY
NC01-5379 A NC
AZ00-1325 B AZ
BC97-3043 B Canada
CA97-0500 B CA
IN99-1009 B IN
KY00-3377 B KY
KY99-3387 B KY
LVS B
ND01-3647 B ND
OR96-0463 B OR
OR98-3548 B OR
OR96-0465 B OR
SP98-6120 B Spain
UT01-1901 B UT
VA97-3236 B VA
TX02-1935 TX
IL96-2695 IL
Sp98-2108 B Spain
KY01-4993 B KY
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Type A
Type B

What are the questions?

- What is the true distribution of tularemia in the U.S.?
- Do the Type A and Type B biovars share the same niche?
- What is the role of the vectors?
- From the evidence of the RFLP, are there indeed unique cycles of transmission?
- What are the conditions that permit the survival of *F. tularensis* in the environment?
- What "forms" does *F. tularensis* take during quiescent periods in the environment?
- How do you correlate highly sensitive technological detection to risk of infection?

Diagnostic Service

Darcy Baweic

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Linda Chalcraft

Claudia Schneekloth

Sandy Urich

Real-time PCR

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Jessica Versage

Kierstan Meacham

ISFtu2 Typing

Scott Bearden

Yan Zhou

PFGE

Kristy Kubota

Tara Sealy

Miles Stanley

Ecologcial Detection

Tom Burkot

Marty Schriefer

Brook Yockey

Chris Sexton