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Niger

1999-2000

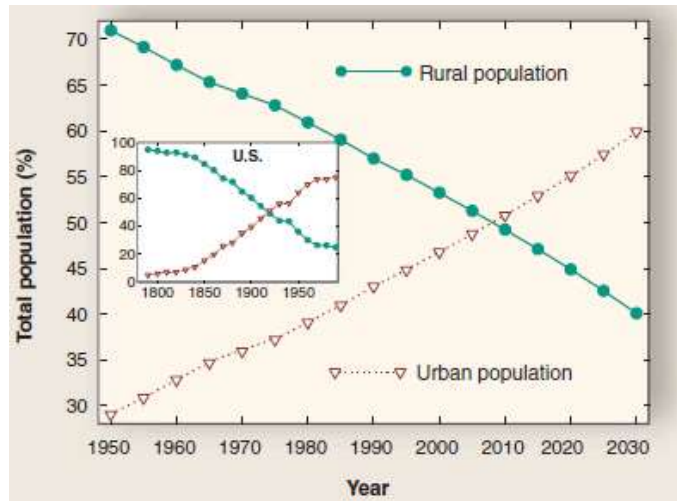
2009-2013

Presentation conducted during the *International Workshop of the Oswaldo Cruz Institute/FIOCRUZ for Leptospirosis Research Based on Country Needs & the 5th Global Leptospirosis Environmental Action Network (GLEAN) Meeting* on November 10-12, 2015, in Rio de Janeiro, Brazil .

Rodents, urban agriculture and *Leptospira* in arid regions

A case study in Niamey, Niger





Human beings have become more urban than rural

Increasing urbanization in Africa



Cities of 1 million habitants and more

(World Bank and UN data, 2014)



Needs for the feeding of a growing urban population (which is mainly non-agricole)

Huge constraints on the development of intensive agriculture in the Sahel

An alternative: urban agriculture (rice culture, market gardening ; irrigation-based production)



Urban ricefields in Niamey

NB: Major source of green vegetables for 22.5 millions inhabitants (FAO 2012) in Dakar, Bangui, Yaoundé, Kinshasa, Brazaville and Ibadan

Urban agriculture and public health

Water exploitation => vectors and parasites

Poor sanitary conditions

Numerous farmers (i.e. small land plots)

Proximity to populated areas



Important human population at risk

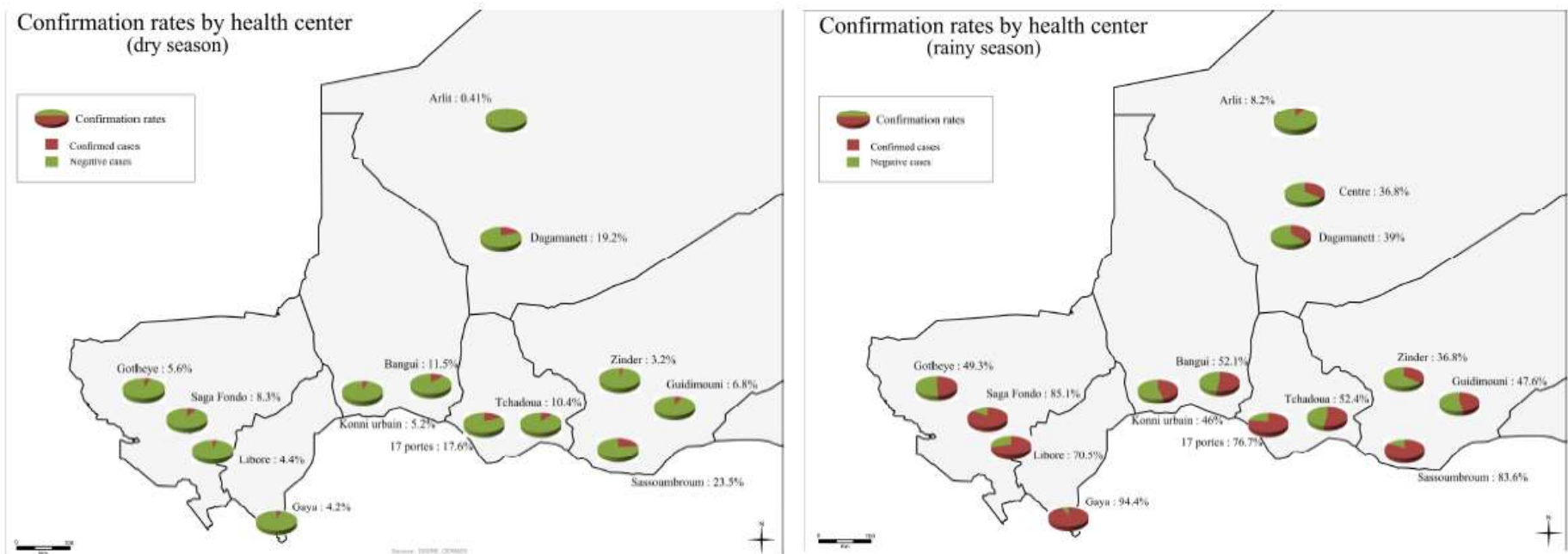


Aim: To take advantage of a Niamey-wide survey of rodent to monitor various zoonotic pathogens, including *Leptospira*

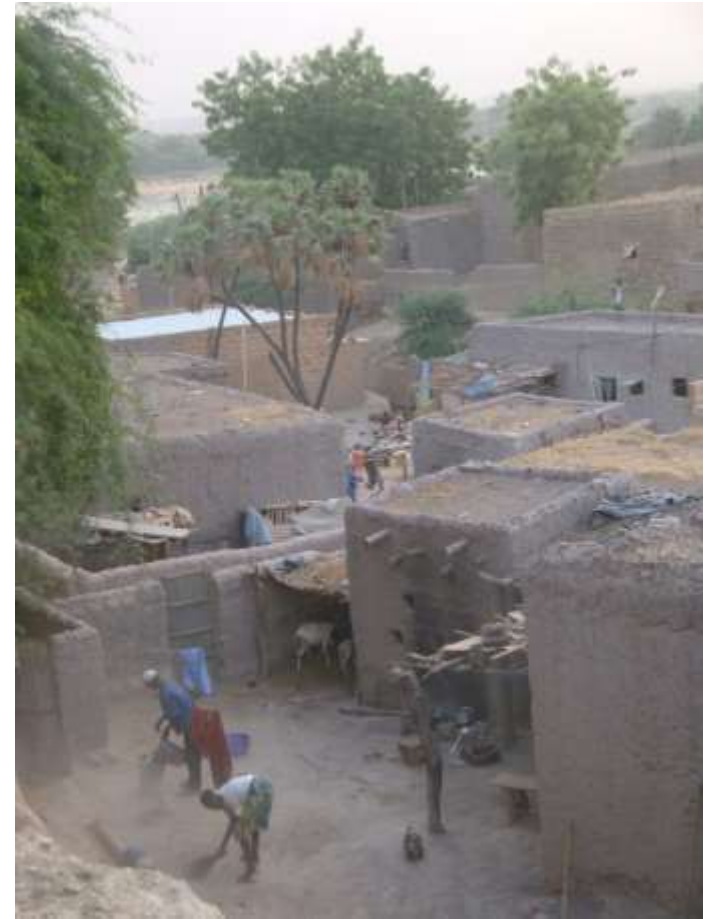
Leptospirosis = water-associated disease ➡ very few data from (semi-)arid zones

No data from Niger (and, more generally, very rare data from Sahel)

~60% of « malaria » fevers are of unknown origin in Niger



(Doudou et al.,2012)

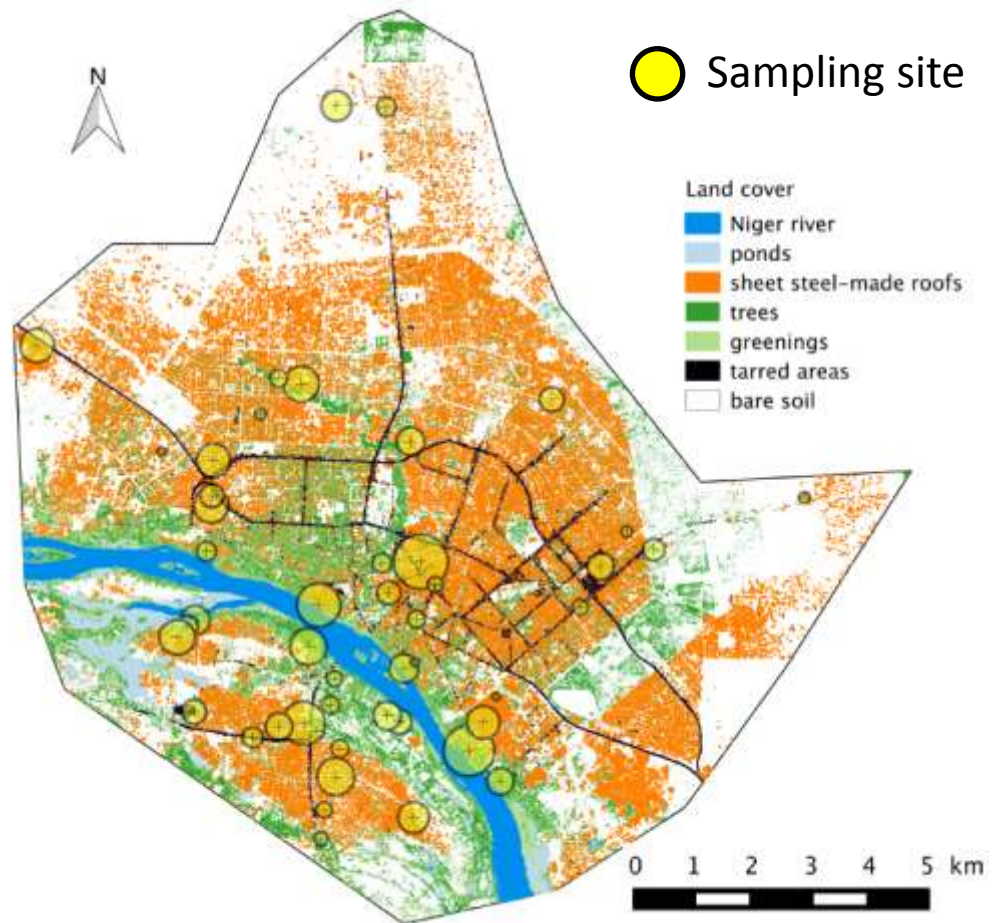


Niamey
ca. 1.2 million habitants

Sampling

578 rodents including:

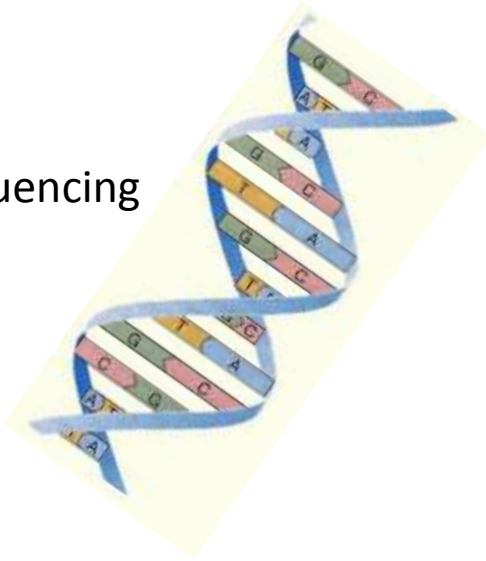
- 12 *C. gambianus*
- 66 *A. niloticus*
- 50 *M. musculus*
- 100 *R. rattus*
- 350 *M. natalensis*



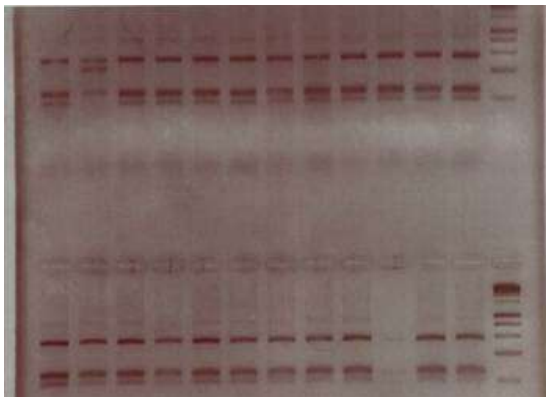
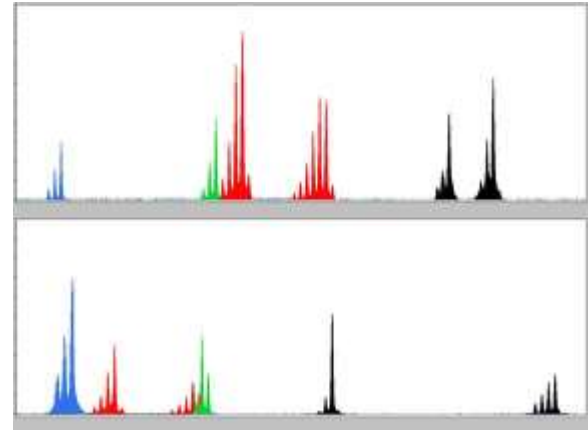


Species-specific identification of rodent hosts

DNA sequencing



Microsatellite genotyping

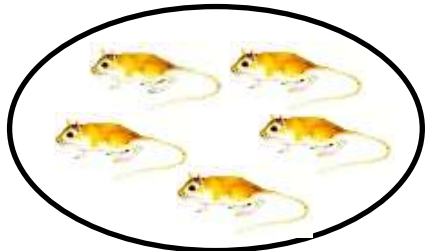


PCR-RFLP profiling



Karyotyping

Leptospira screening



Species-specific pools
of 50 individus

1 pool *Arvicanthis*
7 pools *Mastomys*
2 pools *Rattus*
1 pool *Mus*

x 3

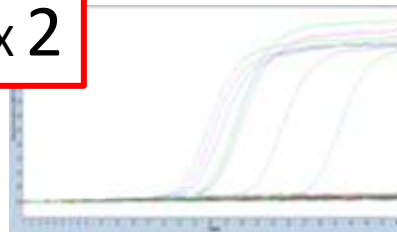


Bacterial metabarcoding
(HiSeq, 16S rRNA, V4)



Individuals from
positive pools
(+ *C. gambianus*)

x 2



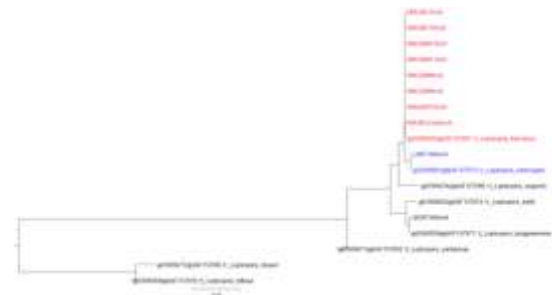
qPCR (lipL32)
(NB: new primers!!!)

Positive
Individuals

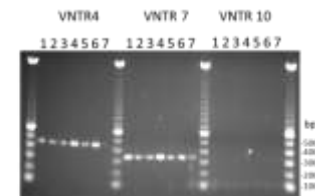


DNA sequencing (rrs)

VNTR profile (coll. M. Picardeau, IPP)



1: NIA66
2: NIAGAM4
3: NIAGAM6
4: NIAGAM11
5: NIAGAM13
6: NIALMO3
7: NIALMO10



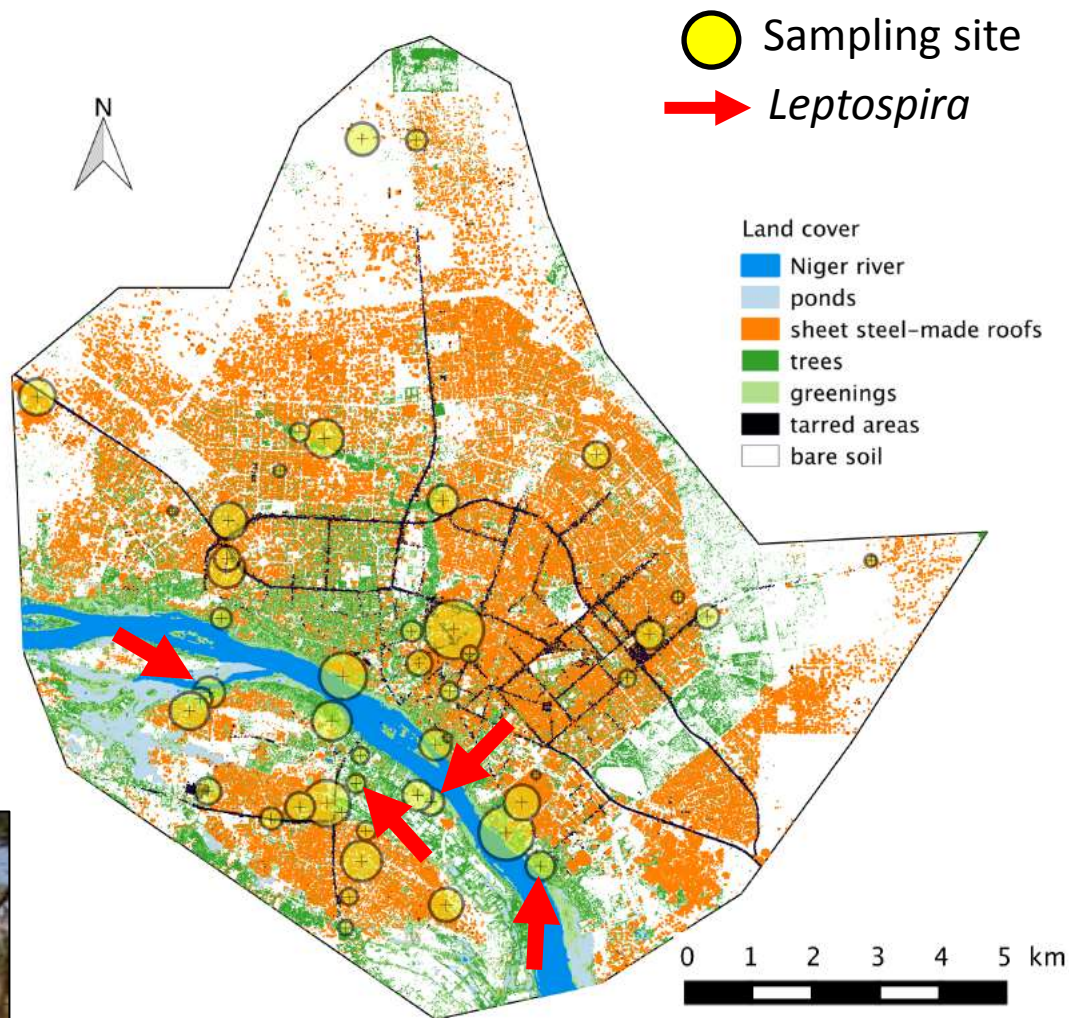
8 positive individuals:

- 7 *Arvicanthis niloticus*
- 1 *Cricetomys gambianus*

L. kirschneri
New serovars

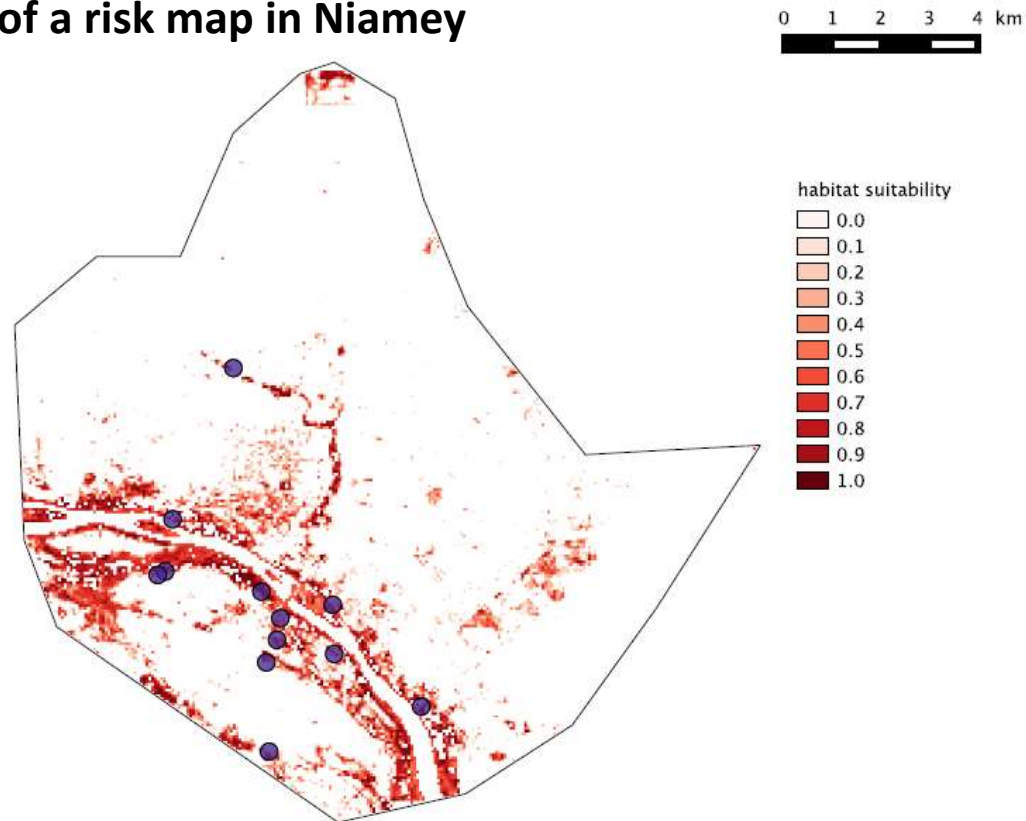
No other positive specimen
(*Rattus*, *Mastomys*)

Urban gardens



10.3% prevalence in rodents inhabiting gardens

GIS-based construction of a risk map in Niamey



Distribution of favorable habitats for
Leptospira rodent reservoir species in Niamey



Riverbanks along the Niger River
Large urban gardening and ricefield areas
Gountou Yéna « wadi »



Leptospirosis is known to be essentially associated with:

- Ricefield cultures
- Floodings
- Slums, poorly sanitated urban areas
- Water-related recreational activities
- Workers in slaughter houses and sewers



Example of a new category of ecological risk associated with urban agriculture in arid and semi-arid zones

First record in Niger

Among the first mentions in Sahel



From there,

what could be the next steps in Niger?

(1) Is there human leptospirosis?

Current attempt to set up a pilot study aiming at the detection of *Leptospira* in patients from hospital/dispensaries, with special emphasis on people at risk in Niamey (e.g., gardeners, riverine areas, etc).

But to enlarge such a survey, Niger faces many difficulties:

Very low medical capacities,
unstable (or absent) power supply,
dust, high temperatures,
poor road infrastructures, etc ...

➡ Need of a simple technology
at least for the most remote areas

➡ Serological strips would be very helpful



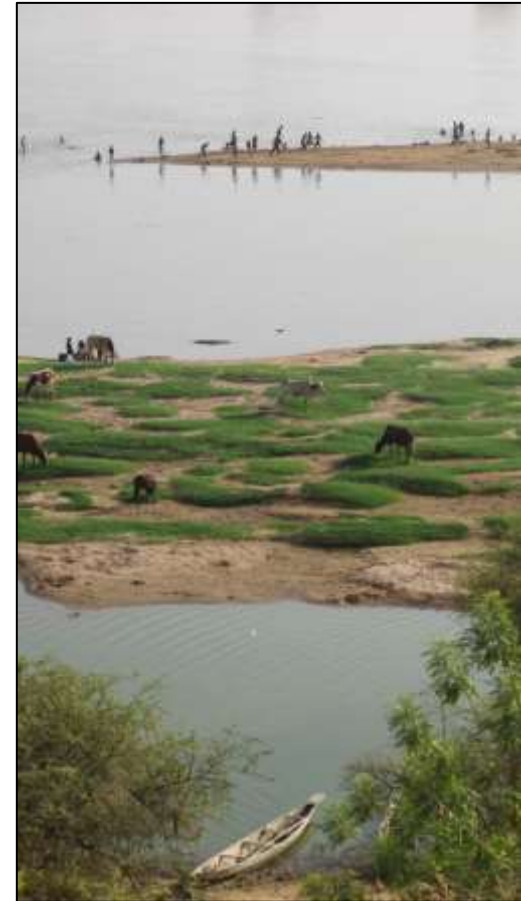
(2) A better understanding of potential sources of infections

➡ Importance of domestic cattle in Sahelian urban settings



(2) A better understanding of potential sources of infections

➡ Screening of water(s) in rural settings



What about *Leptospira* in permanent waterholes and wells?
Potential hotspots of human / cattle transfers of pathogens in arid zones



(2) A better understanding of potential sources of infections

➡ A special attention is to be paid to flooding events
(which now occur on a regular basis in most Sahelian cities!)



Flooded
urban garden

(3) What about the economic impact of *Leptospira*?

~40 millions heads of cattle (ovids, bovids, camelids, etc)

Pivotal economic activity

Major resource for food security

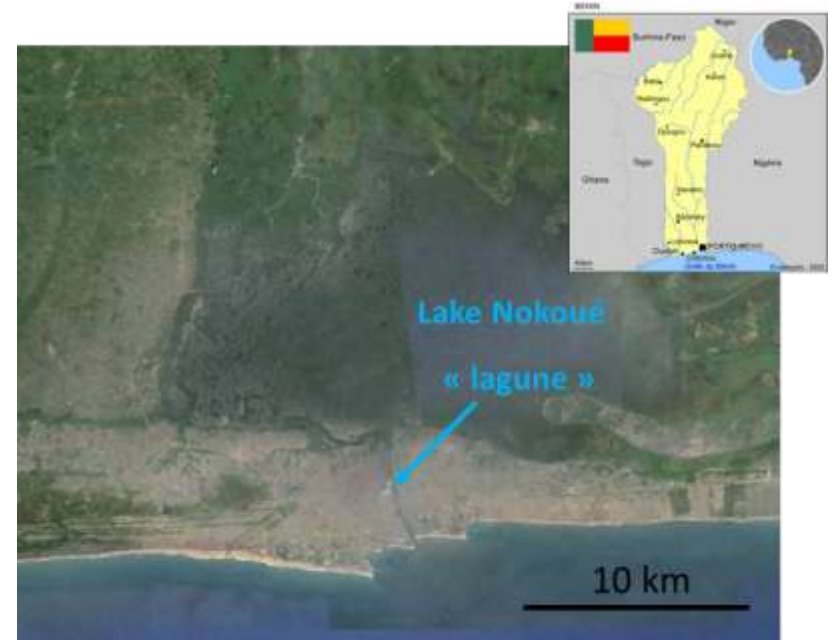
➡ No data about leptospirosis in cattle





**There is an urgent need of data
and awareness in West Africa!!!**

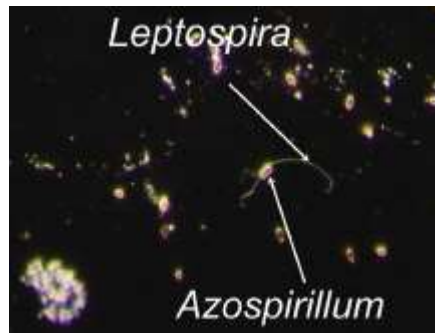




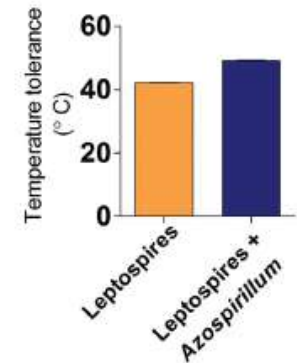
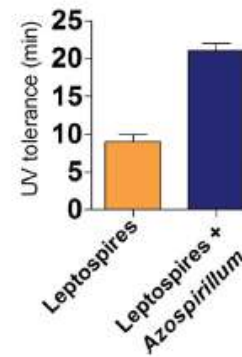
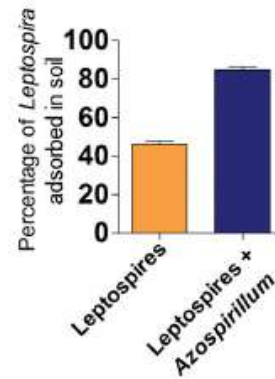
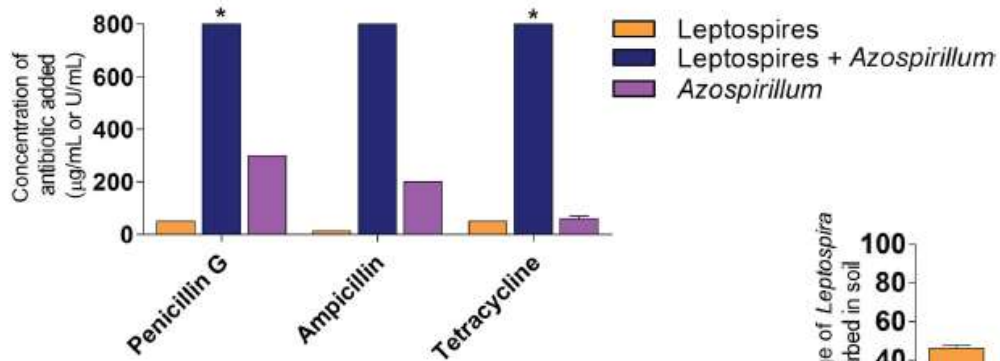
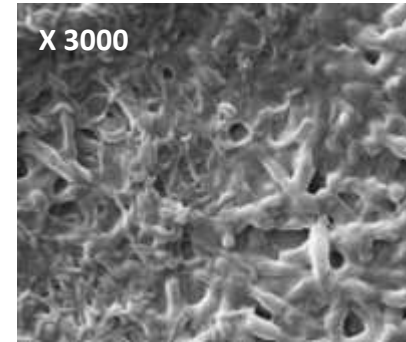
A « One Health » project which includes another West African city: Cotonou, Benin



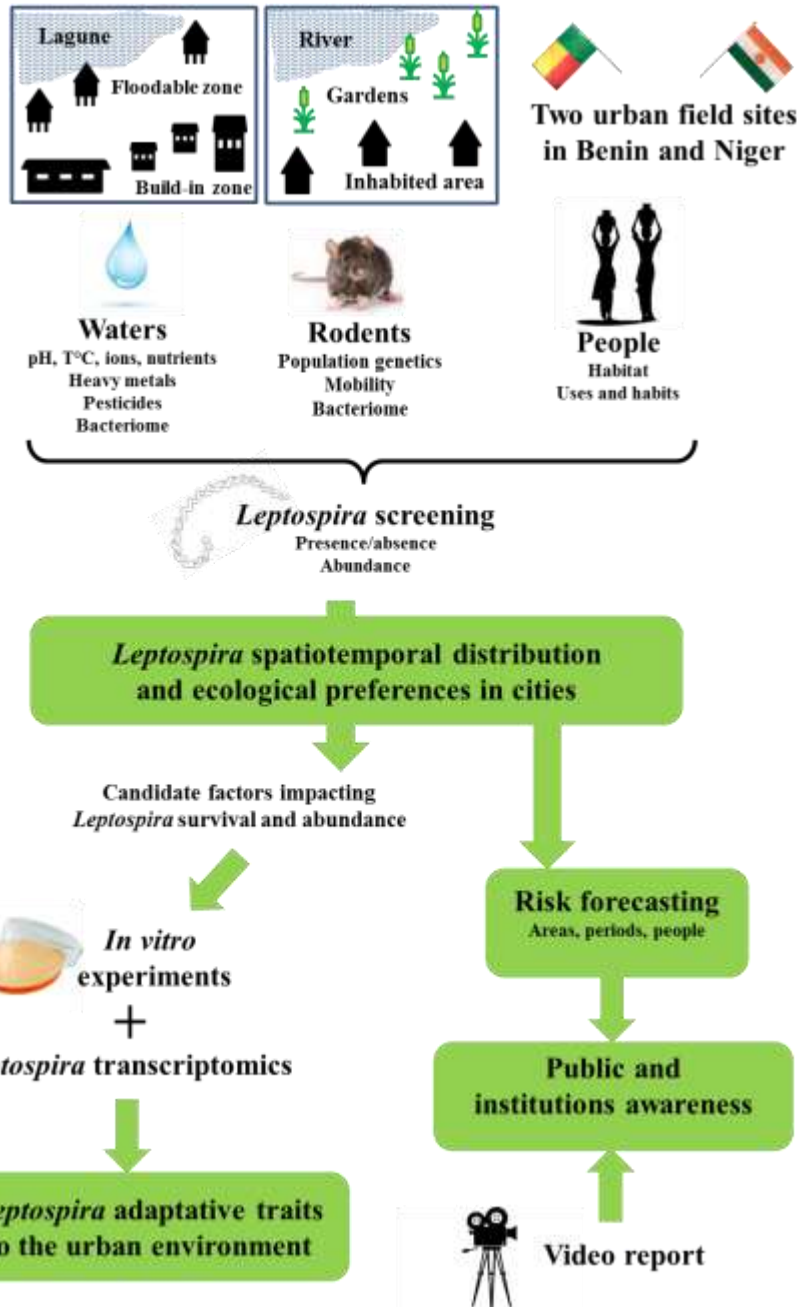
Association *Leptospira* / soil bacteria



Formation
of biofilms



T°C, pH et soil moisture
Organic matter content



Leptospira ecology and adaptation to urban environment

Human, rodents and water at the same time

Diachronic surveys

Leptospira-associated bacteriomes

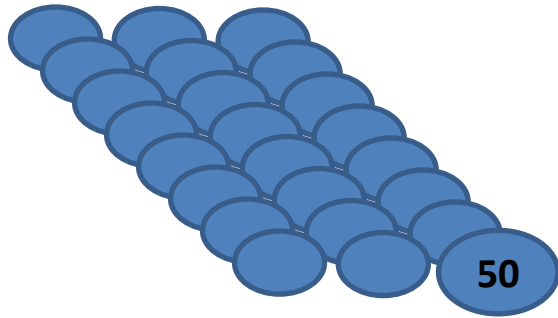
Water quality and dynamics

Surface, domestic and underground waters



Thank you

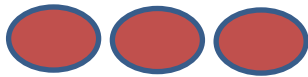
Note on the bacterial metabarecoding of rodent pools (NB: 287,057 bacterial reads)



8 pools (as triplicats)



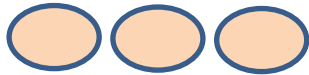
0 read identified as *Leptospira*



1 pool (as triplicats)



3050, 3144 et 3385 reads of *Leptospira*




1 pool (as triplicats)



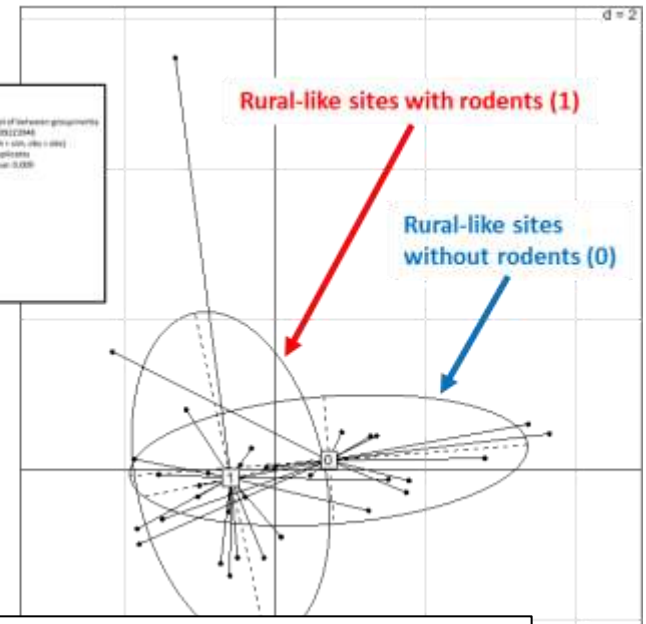
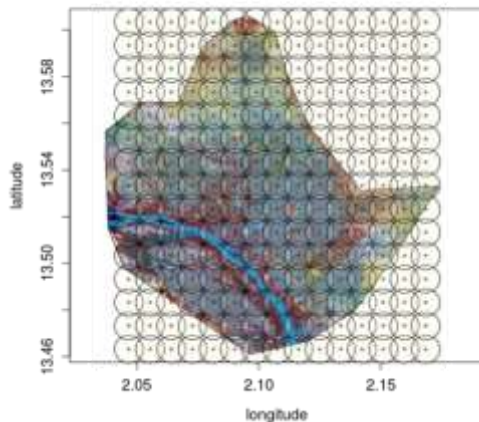
37, 58 et 64 reads of *Leptospira*



One pipeting mistake allows us to confirm that detection of at least 1 positive / 50 individuals is possible.



A diagram showing a curved arrow pointing from the left towards an oval labeled "PCA". Another curved arrow points downwards from the bottom of the "PCA" oval.



Building of a $[0 - 1]$ range of values
that correspond to coordinates along PC1

