



Pan American Health Organization



Regional Office of the
World Health Organization

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 .

Leptospirosis in Rio Grande do Sul, Brazil: An ecosystem approach in the animal-human interface

Joint study: PAHO; Fiocruz; Health State Department of Rio Grande do Sul; Agriculture State Department of Rio Grande do Sul; UFRGS; Univ. Minnesota

Schneider MC, Najera P, Pereira MM, Machado G, dos Anjos CB, Rodrigues R, D, Buss D, Leone M, Munoz-Zanzi C, Cavagni G, Corbelline LG, Aldighieri S, Espinal MA

Accepted for publication in NTD PLOS

Background

- Leptospirosis is an epidemic-prone neglected disease that affects humans and animals, mostly in vulnerable populations in LAC
- Brazil MoH report around 4,000 cases per year
- Rio Grande do Sul has the 5th highest incidence rate in the country
- Different ecosystems and circulation of bacteria in animals (wild and domestic)
- Production processes that include risk factors for leptospirosis (such as rice paddy and livestock)
- Outbreaks in the periphery of big cities
- It is the first state of Brazil that includes leptospirosis as mandatory notification
- Good integration between Health, Agriculture, and Civil Society
- Lack of information in animal prevalence

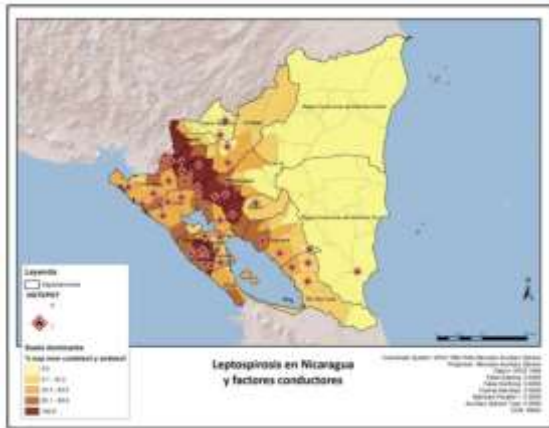


Background

Previous studies with Nicaragua

Leptospirosis Outbreaks in Nicaragua: Identifying Critical Areas and Exploring Drivers for Evidence-Based Planning

MC Schneider, P Najera, S Aldighieri, J Bacallao, A Soto, W Marquino, L Altamirano, C Saenz, J Marin, E Jimenez, M Moynihan, M Espinal. Leptospirosis Outbreaks in Nicaragua: Identifying Critical Areas and Exploring Drivers for Evidence-Based Planning. *Int. J. Environ. Res. Public Health*. 2012; 9(11):3883-3910.



Socioeconomic Factors and Vulnerability to Outbreaks of Leptospirosis in Nicaragua

Bacallao J, Schneider MC, Najera P, Aldighieri S, Soto A, Marquiño W, Sáenz C, Jiménez E, Moreno G, Chávez O, Galan DI, Espinal MA. Socioeconomic factors and vulnerability to outbreaks of leptospirosis in Nicaragua. *Int. J. Environ. Res. Public Health*. 2014, 11(8), 8301-8318.



Objectives of this study

Analyze the distribution of human cases of leptospirosis in the State of Rio Grande do Sul, Brazil, and to explore possible drivers.

Additionally, provide further evidence to support interventions and to identify new research topics at the human-animal-ecosystem interface.

Methodology

- Ecological type study, all state, by second subnational administrative level (496 municipalities)
- Using only secondary data
 - ✓ Cases National Notification System (SINAM)/ Ministry of Health (2008-2012)
 - ✓ Demographic and socioeconomic data from IBGE
 - ✓ Environmental variables from several open access sources
- Created a data base (GIS) by municipality (26 independent variables)

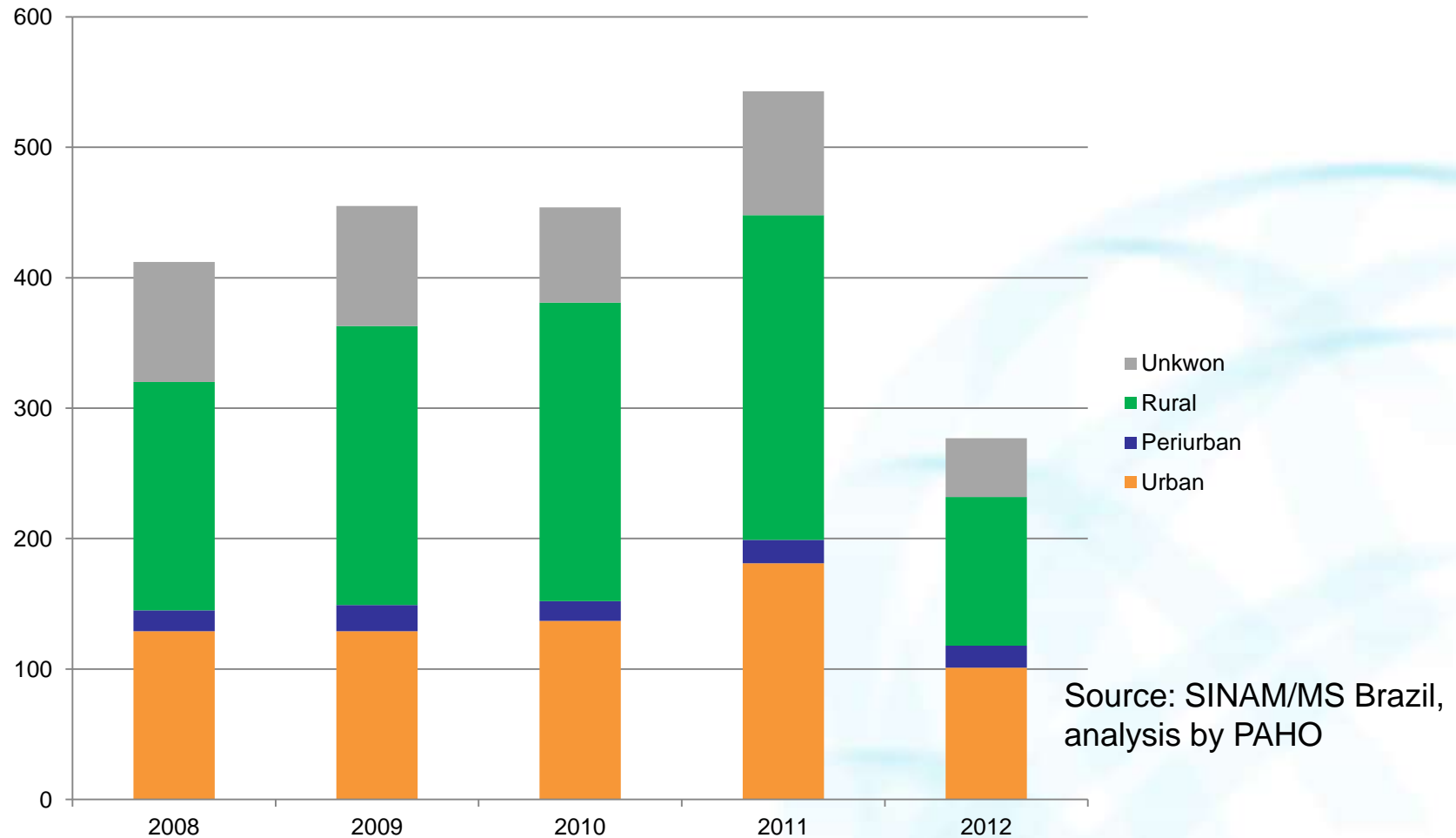
B	C	D	E	F	G	H	I	J	K	L
CNTRY_CODE	ADM1_NAME	ADM1_CODE	ADM2_NAME	ADM2_CODE	Lat	Long	CODE	TotRur	TotUrb	TotCases
BRA	Rio Grande do Sul	BRA043	Andr� da Rocha	BRA430066	-28.59485584530	-51.50356685770	430066	1	0	1
BRA	Rio Grande do Sul	BRA043	Unito da Serra	BRA432235	-28.77237547540	-52.02173580810	432235	1	0	1
BRA	Rio Grande do Sul	BRA043	Engenho Velho	BRA430692	-27.68464414030	-52.90873759080	430692	0	0	0
BRA	Rio Grande do Sul	BRA043	Coqueiro Baixo	BRA430583	-29.16844883660	-52.12593141610	430583	2	0	2
BRA	Rio Grande do Sul	BRA043	Montauri	BRA431235	-28.66976493890	-52.05000848340	431235	0	0	0
BRA	Rio Grande do Sul	BRA043	Vista Alegre do Prata	BRA432360	-28.82082490830	-51.78204835880	432360	0	0	0
BRA	Rio Grande do Sul	BRA043	Tupanci do Sul	BRA432218	-27.93010555520	-51.53788965270	432218	0	0	0
BRA	Rio Grande do Sul	BRA043	Lagoa dos Tr�s Cantos	BRA431127	-28.57084781240	-52.83419576570	431127	0	0	0
BRA	Rio Grande do Sul	BRA043	Guabiju	BRA430925	-28.57809460670	-51.66035602020	430925	0	0	0
BRA	Rio Grande do Sul	BRA043	Carlos Gomes	BRA430485	-27.70425168650	-51.92994676090	430485	0	0	0
BRA	Rio Grande do Sul	BRA043	Linha Nova	BRA431164	-29.46002275560	-51.21567842420	431164	0	0	0

Methodology

- Negative binomial regression was used for multivariable statistical analysis of leptospirosis cases
- Robust variance was used to estimate the relative risk (RR) and 95% confidence interval (CI) of the estimates
- Univariate analyses were first run for each of all 26 variables and 14 were preselected due to $P \leq 0.15$
- Variance inflation factors (VIF) were estimated to verify the relations among all selected independent variables and check for potential collinearity
- Confounding effects were investigated by checking changes in the point estimates of the variables that remained in the model.
- Used deviance performance as a goodness of fit test for the overall model.

Results

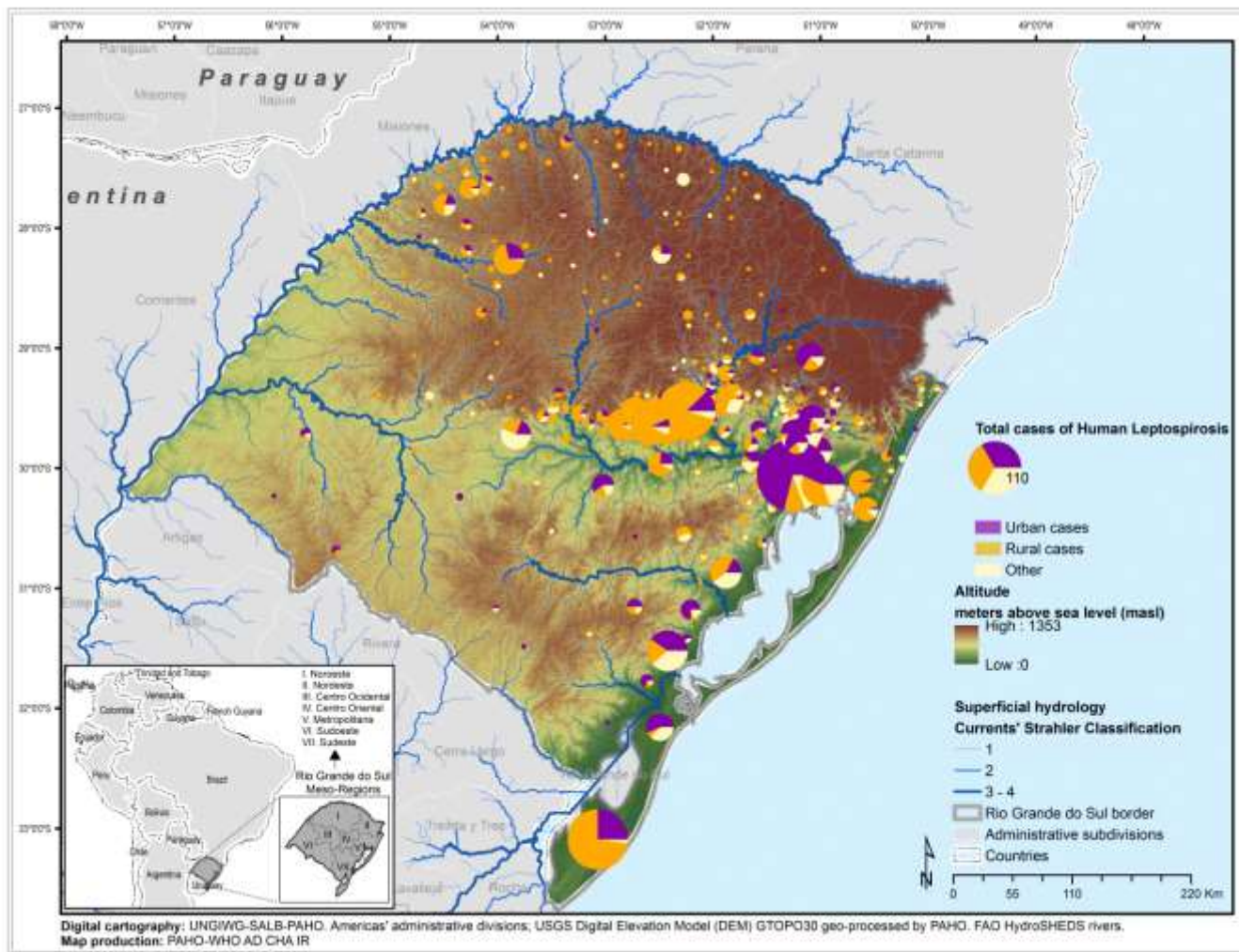
Human cases of leptospirosis by area, Rio Grande do Sul, 2008-2012



Total of cases = 2141; average by year = 428 cases; 46% rural area

Results

Human cases of leptospirosis according to the residence site, by municipality, Rio Grande do Sul, 2008-2012



Source: SINAM/MS Brazil, analysis by PAHO

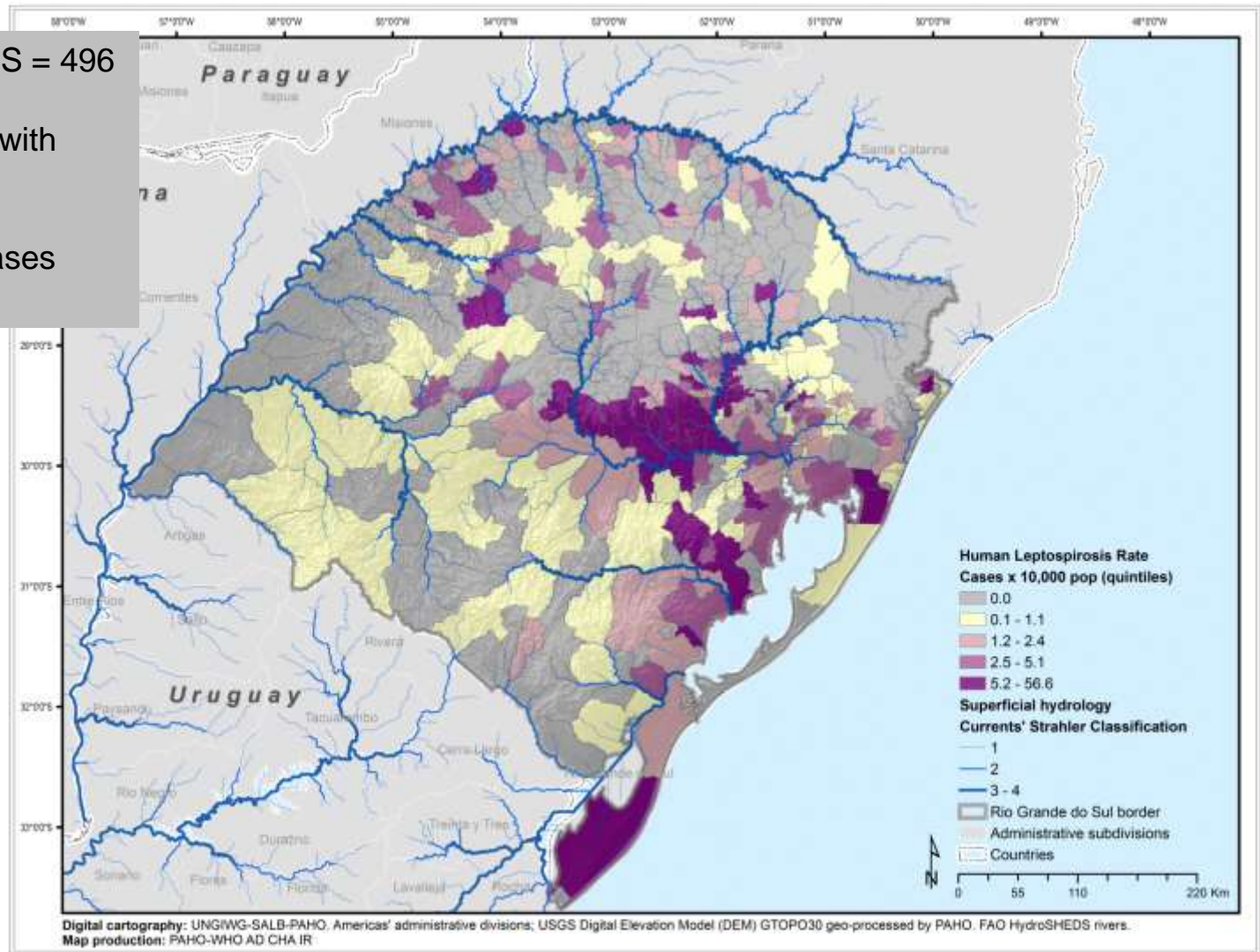
Results

Incidence rate of leptospirosis (10,000 habitants), by municipality,
Rio Grande do Sul, 2008-2012

No of municipalities in RS = 496

No of productive areas (with
reported cases) = 233

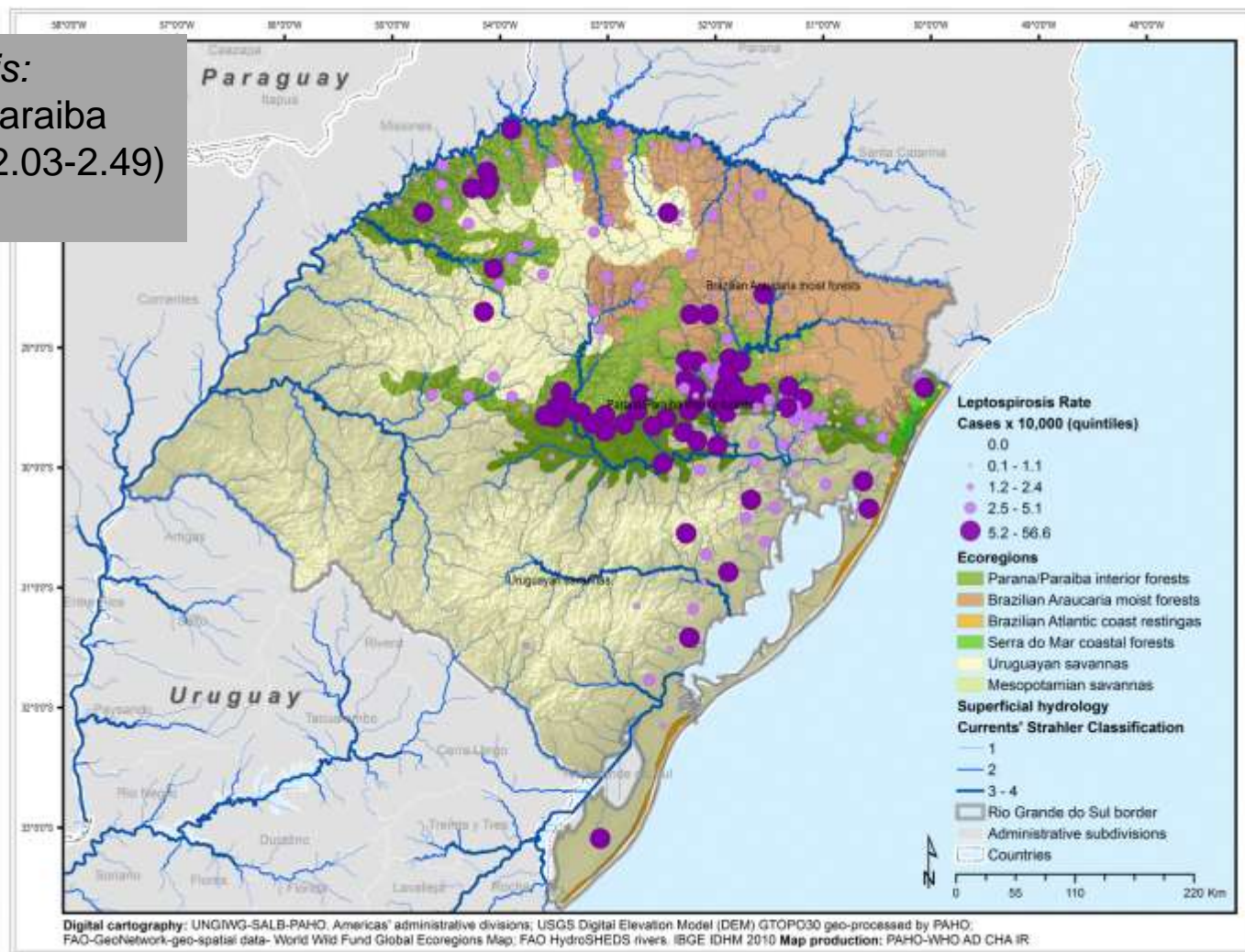
No of silent areas (no cases
reported) = 263 (53%)



Results - Environmental

Incidence rate for leptospirosis and ecoregions, Rio Grande do Sul, 2008-2012

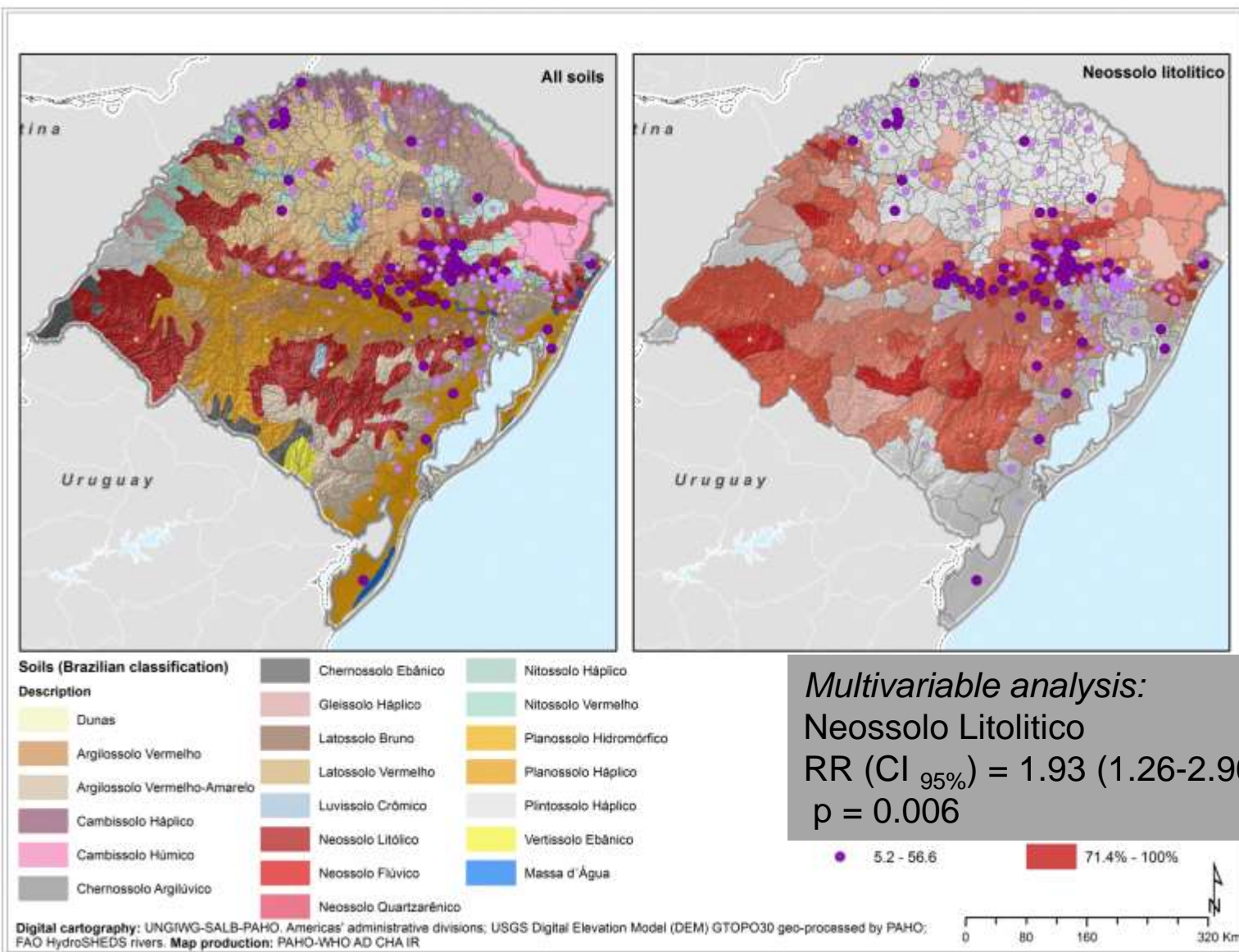
Multivariable analysis:
Ecoregion Parana-Paraiba
RR (CI_{95%}) = 2.25 (2.03-2.49)
p<0.001



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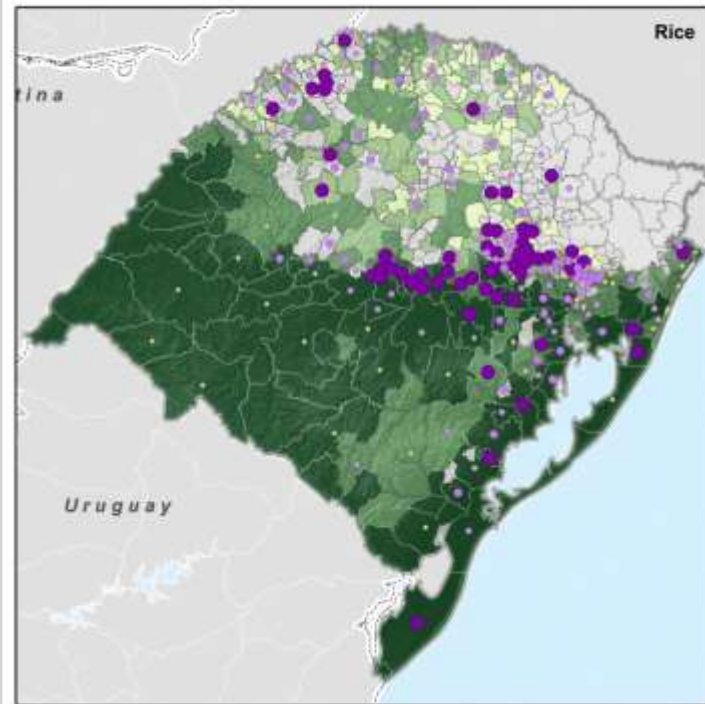
Results- Environmental

Incidence rate for leptospirosis and type of soil, Rio Grande do Sul, 2008-2012



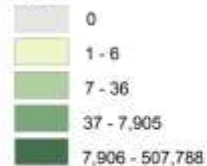
Results- Productive Process

Incidence rate for leptospirosis and rice paddy plantation, and tobacco plantation Rio Grande do Sul, 2008-2012

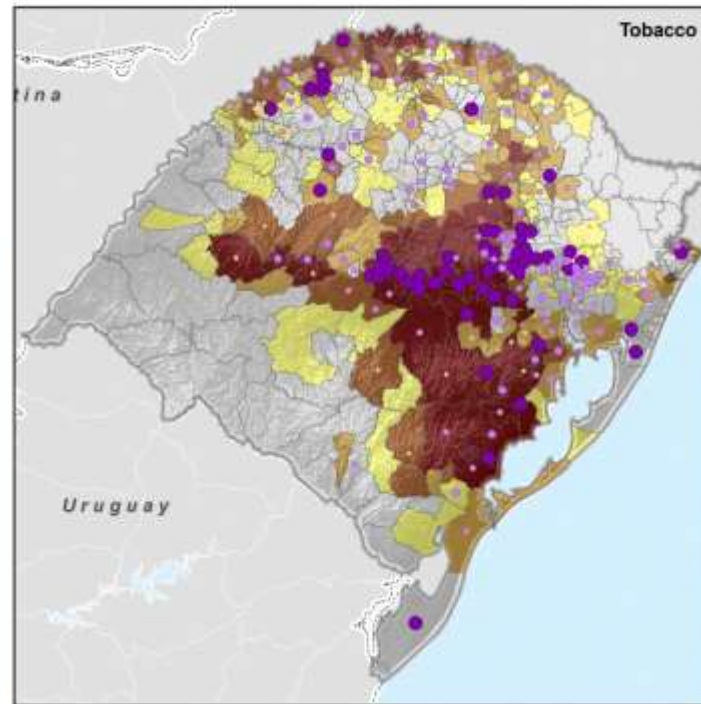


Rice municipal production

Tons

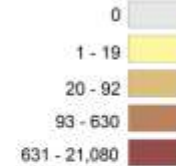


Leptospirosis rate



Tobacco municipal production

Tons



Multivariable analysis:

Productions of rice per **tons**

RR (CI_{95%}) = 1.003 (1.002-1.04), p<0.001

Productions of tobacco per **tons**

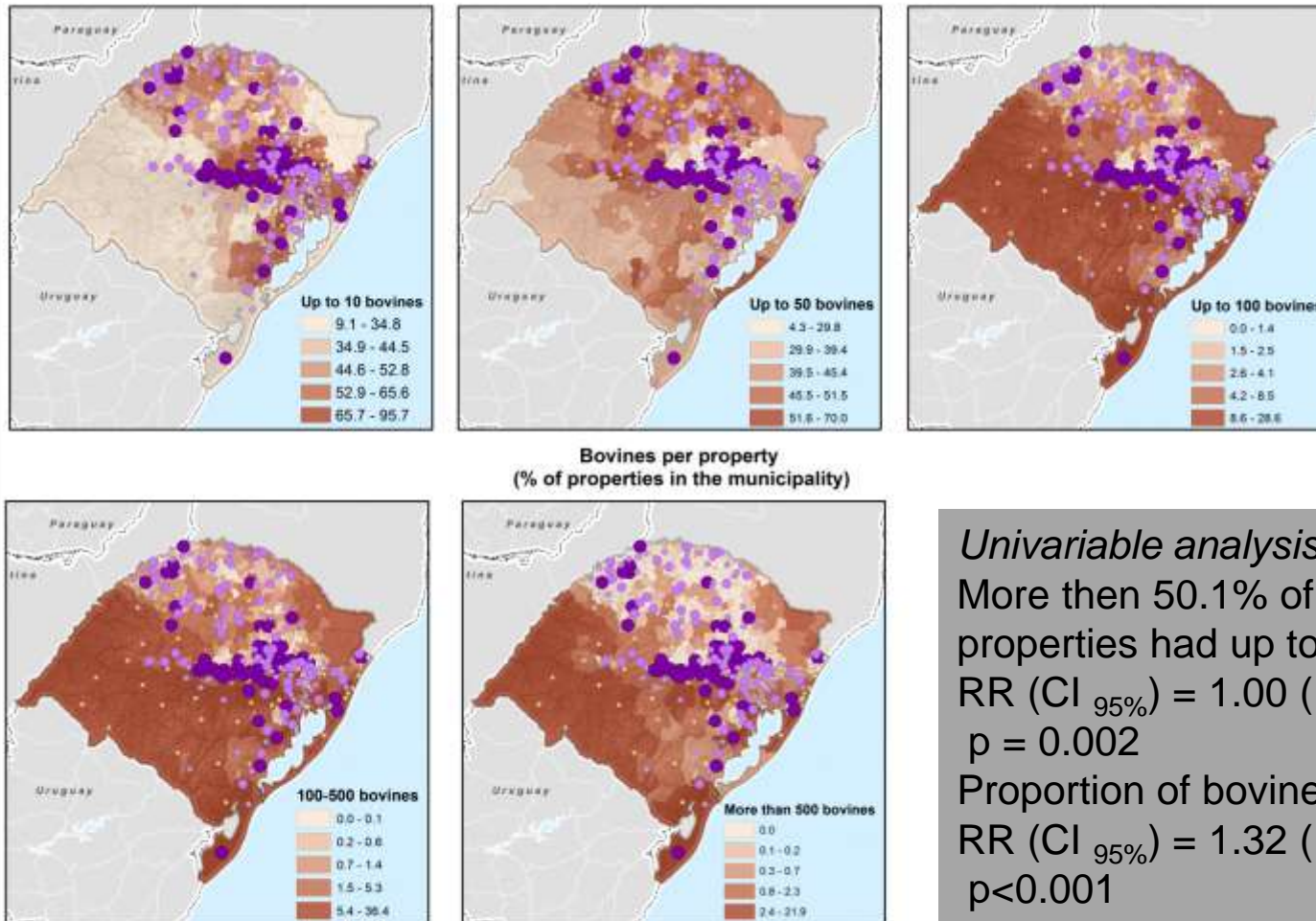
RR (CI_{95%}) = 1.10 (1.09-1.11), p<0.001

Digital cartography: UNGIWG-SALB-PAHO, Americas' administrative divisions, USGS Digital Elevation Model (DEM) GTOPO30 geo-processed by PAHO, FAO HydroSHEDS rivers.
Map production: PAHO-WHO AD CHAIR



Results - Productive Process

Incidence rate for leptospirosis and number of bovines per property,
Rio Grande do Sul, 2008-2012



Univariable analysis:

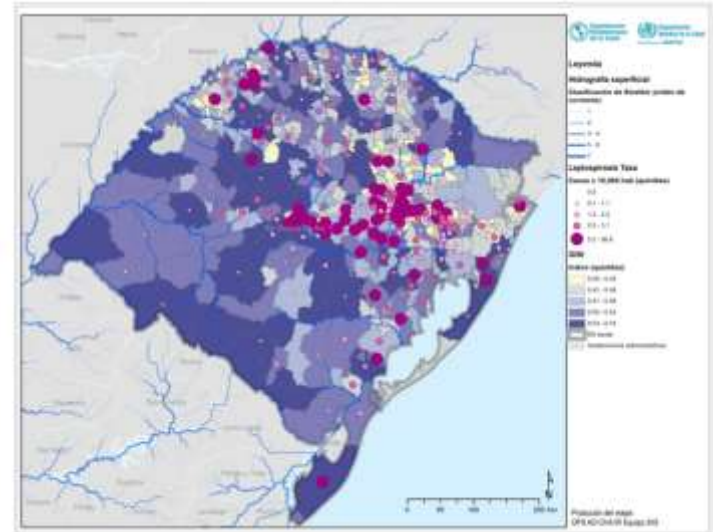
More than 50.1% of municipality's
properties had up to 10 bovine
RR (CI_{95%}) = 1.00 (1.00-1.00)
p = 0.002

Proportion of bovine farms per km²
RR (CI_{95%}) = 1.32 (1.13-1.55)
p < 0.001

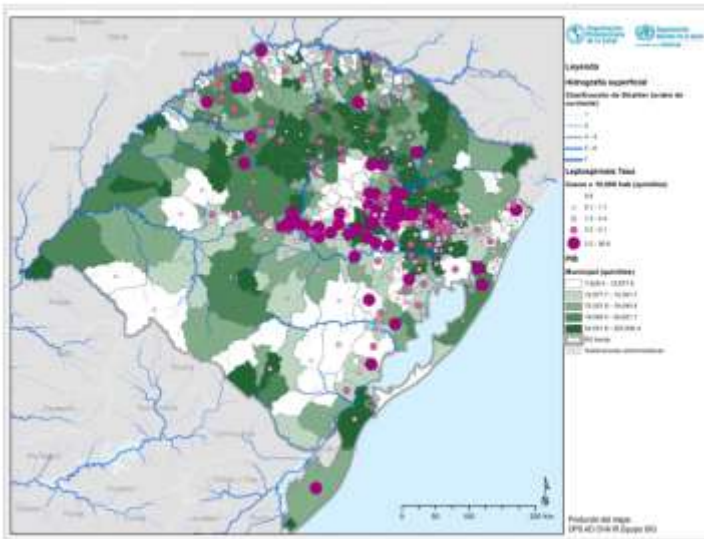
Results- Socioeconomic

Incidence rate for leptospirosis and GINI index, Rio Grande do Sul, 2008-2012

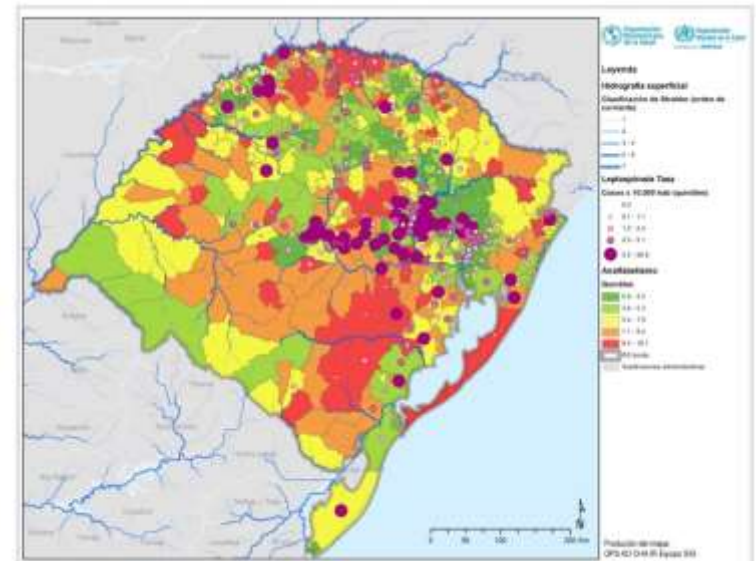
All no significant



Incidence rate for leptospirosis and illiteracy, Rio Grande do Sul, 2008-2012



Incidence rate for leptospirosis and GDP, Rio Grande do Sul, 2008-2012



Conclusions/Recommendations

- Average of 428 human cases of leptospirosis annually
- Risk in rural populations is 8 times higher
- Urban cases are more in the metropolitan region of the state capital
- For this areas save lives and reduce the number of severe cases are the major goal. Collaboration with Civil Defense and Natural Disaster team
- The rural cases are more concentrated in certain type of productive process. Collaboration with Agriculture and civil organization related to rice and tobacco plantation and small farmer is suggested to prevent cases



Conclusions/Recommendations

- Major drivers identified in this study were related to environmental and production processes that will continue to be present in the state
- Development of a vaccine is urgently needed to prevent cases in high risk areas
- Do studies by individual level and occupation
- Support Sect. Agriculture/UFRGS team in the bovine survey
- Support the Health-Animal-Ecosystem Interface Agreement in the State with Fiocruz
- Support Intersectoral Plan



Acknowledgments

- Diego dos Santos Viali, MAPA
- Deise Galan, GW
- Sirlei Famer and others colleagues from CEVS/SES-RS
- Roberto Bazzani, IDRC
- Eduardo Caldas, SVS/MS
- Paulo Buss, FIOCRUZ
- Eric Bertherat, WHO
- Ottorino Cosivi and colleagues from PANAFTOSA
- Anne Roca for editing and reviewing this article





Thank you!