The global distribution, host range and prevalence of *Trypanosoma evansi* causing surra: a systematic review and meta-analysis

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INTRODUCTION

- *T. evansi* spread beyond the tsetse belt in Africa
- Surra affects domestic animals and causes huge economic losses due to mortality and morbidity
- Epidemiology far from completely understood in many countries
- Surra is a neglected veterinary disease
- Funding agencies are blatantly ignorant

OBJECTIVES

General objective

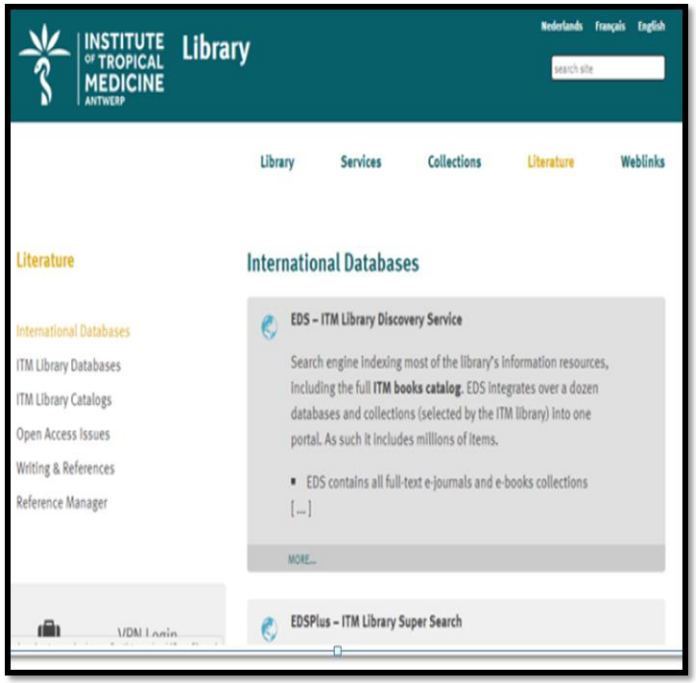
- To provide an updated epidemiological picture of surra world-wide

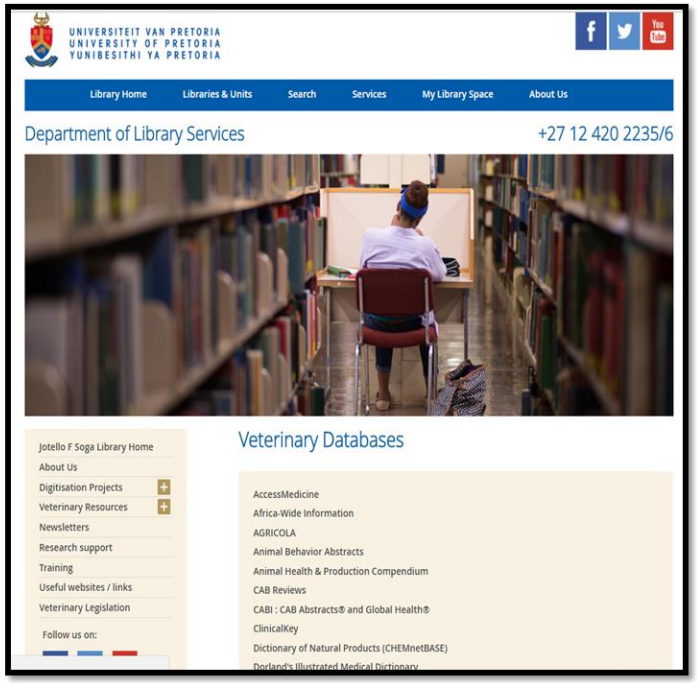
Specific objectives

- To assess the geographical distribution of *T. evansi*
- To identify domestic and wild animals that are naturally susceptible to *T. evansi*
- To estimate global prevalence of *T. evansi* in various animal host species

LITERATURE REVIEW

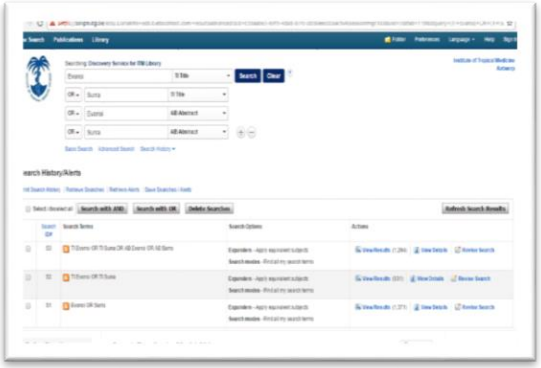
- Electronic library databases of ITM and from the veterinary database of the UP

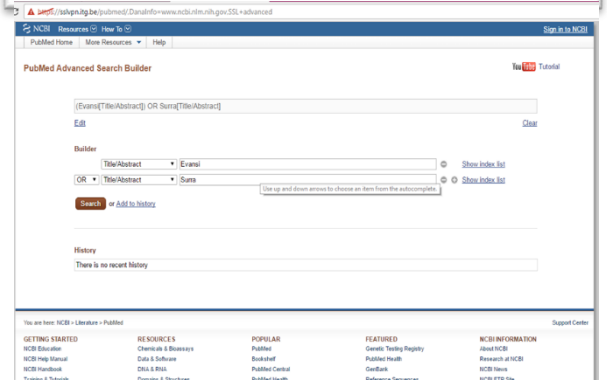


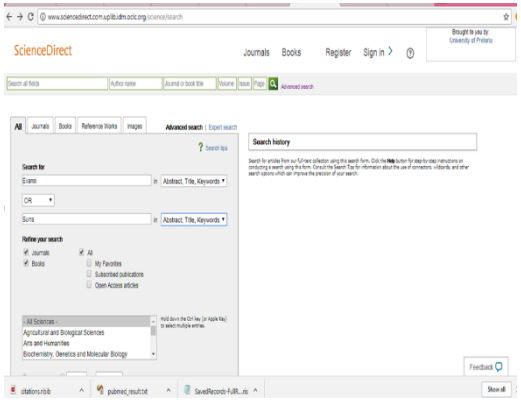


LITERATURE REVIEW

Databases: CAB Direct, EDS-ITM, PubMed, ScienceDirect

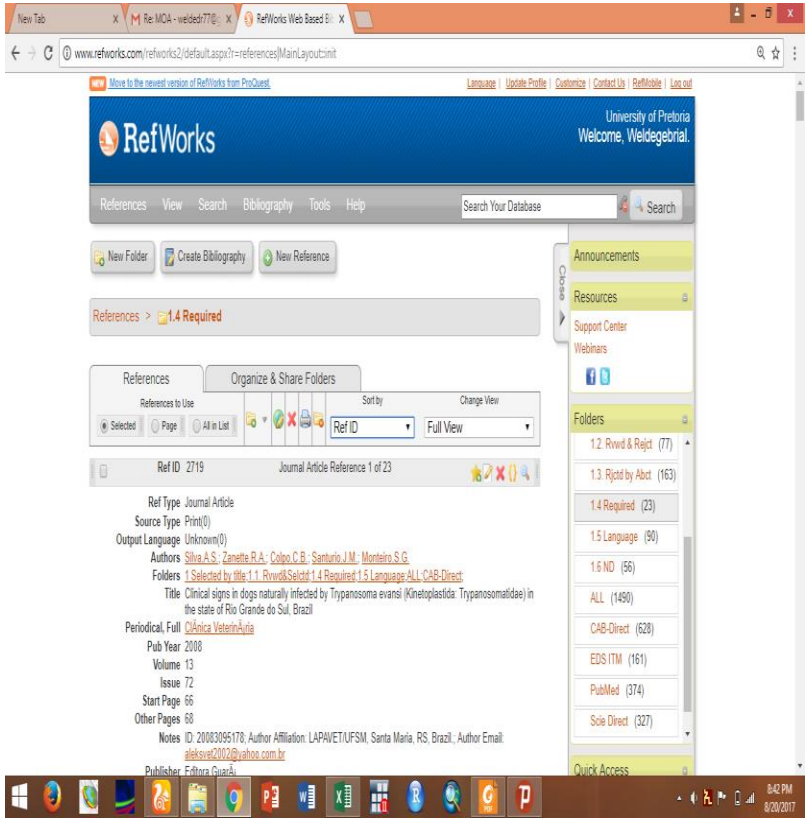






LITERATURE REVIEW

- Search string: "**evansi OR surra"**
- No restrictions on language, location and date of publication (up to 17 August 2017)
- RefWorks used for the management of the retrieved references



SELECTION OF REFERENCES

Phase I

- Duplicates removed
- Titles screened (irrelevant titles and experimental studies removed)

Phase II

- For the qualitative analysis, abstracts and full-text file scanned:
  - **Inclusion**: any positive diagnostic test result for *T. evansi* in any naturally infected host.
  - **Exclusion:** *T. evansi* was not detected, diagnostic test not specified, review article, case reports/outbreak reports without laboratory based confirmation, experimental infection studies

Phase III

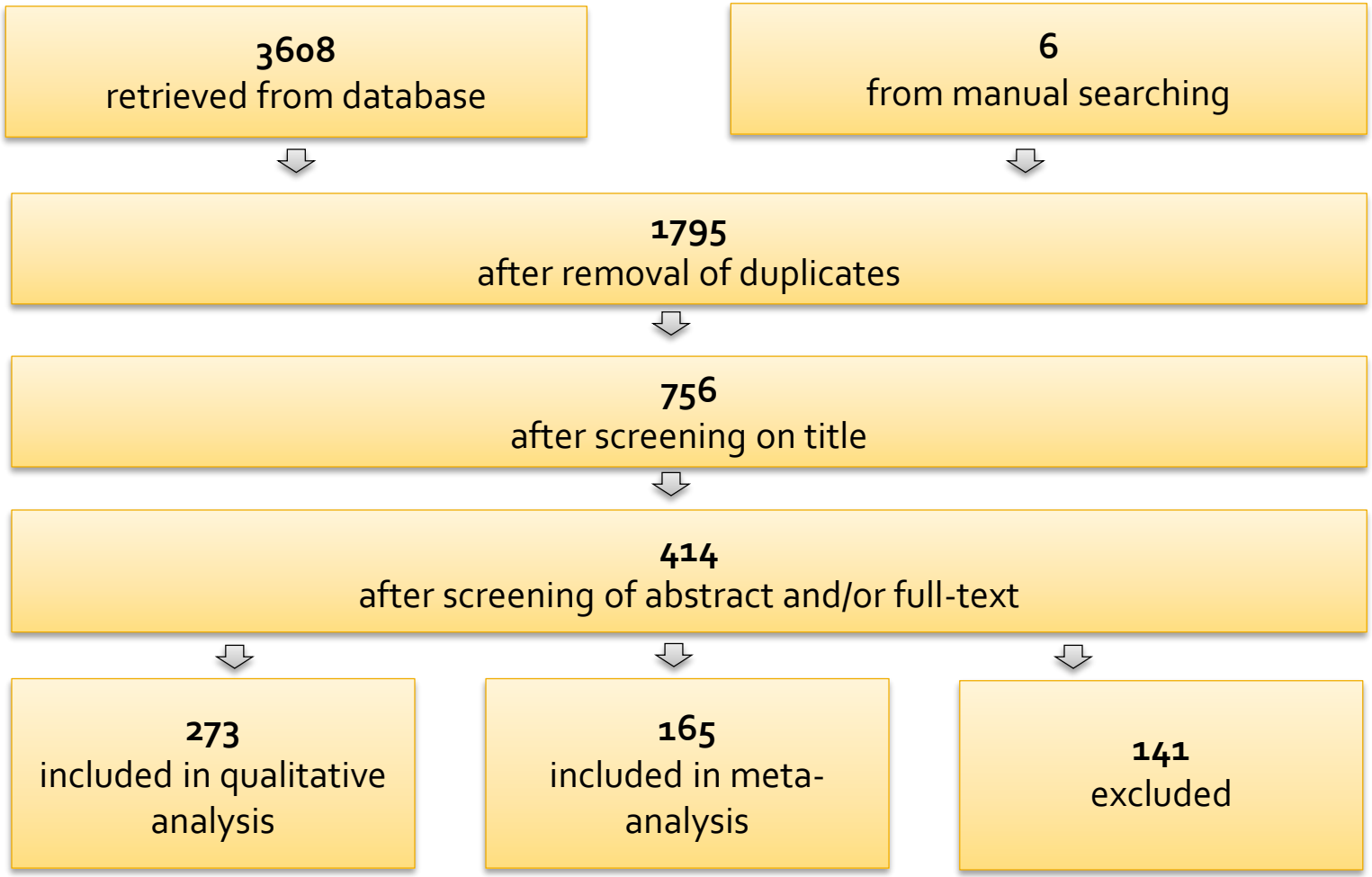
- For the quantitative meta-analysis:
  - **Inclusion**: contained information such as host species, sample size, diagnostic method and prevalence
  - **Exclusion:** case reports, samples from outbreak or clinically sick animals, non-representative sample, unclear report of sample size

DATA EXTRACTION

- Country and study area
- Duration of sample collection
- Host species
- Number of samples analysed
- Type of samples collected
- Diagnostic methods
- Number positives
- Prevalence or percentage

S.N.	Country	Districs [Number]	Duration (season/s)	Host species	Number of animals	Sample type	Diagnostic method (Specific)	No. positive	Prevalence (%)	Refw ID	RefW SN	Year of pub	Author	Comments
1	Egypt	Assiut city (3 Abbattoir	May 2011 to Oct 2012	Camel	198	Blood	Giemsa	5	2.5	2879	1	2016	Elmaleck, 2016	
2	Argentina	Los Charruas (1)		Dog	1	Blood	Giemsa	1	Case report	3938	5	2016	Bono Battistoni et al. 2016	A case report confirmed by real time PCR by two di
	Argentina				1	Blood	PCR (ITS1-TeRT)	1	Case report			2016	Bono Battistoni et al. 2016	TS1-TeRT are derived from the T. evansi ITS1 seque
	Argentina				1	Blood	PCR (TeRoTat)	1	Case report			2016	Bono Battistoni et al. 2016	
3	Brazil	São Paulo (SE Brazil)		Capybara	172	Serum	CATT	17	9.9	4950	7	2016	Da Silva et al., 2016	
4	Saudi Arabia	Al-jouf	Feb to Oct 2011	Camel	194	Blood	PCR (TBR1/2)	49	25	2779	9	2016	El-Wathig, 2016	
	Saudi Arabia				118	Serum	ELISA	4	3			2016	El-Wathig, 2016	
5	Malaysia			Cattle	1	Blood	Giemsa	1	Case report	2973	10	2016	Jesse et al. 2016	Friesian Sahiwal dairy cow
	Malaysia				1		HCT	1	Case report			2016	Jesse et al. 2016	
6	Brazil	Soure, Santa, Cruz do Arari, Cachoeira do Arari, Salvaterra,	Nov to Dec 2013	Horse	243	Blood	PCR (RoTat 1.2)	20	8.23	5953	11	2016	Silva et al., 2016	Sample collected after two outbreaks of equine tryp survey carried out to determine the reemergence o
7	India	Shimoga	Apr 2012 to March 201	Cattle	215	Blood	Giemsa	15	6.9	4917	12	2016	Krishna Murthy et al., 2016	
	India			Buffalo	85	Blood	Giemsa	3	3.5			2016	Krishna Murthy et al., 2016	
8	Brazil	Amapá and Pará	Feb 2012 to Aug 2013	Coatis	51	Blood	PCR (RoTat 1.2)	8	15.7	2712	15	2016	Magalhães-Matos et al., 2016	
	Brazil			Raccoon	2	Blood	PCR (RoTat 1.2)	2	100			2016	Magalhães-Matos et al., 201	This is the first molecular detection of T. evansi in
9	India	Bikaner (Rajasthan Stat		Camel	24	Blood	Giemsa	17	70.8	4939	17	2016	Narnaware et a. 2016	The study conducted on organized farm comprizing
	India				24	Blood	PCR	19	79.2			2016	Narnaware et a. 2016	Sampled animals are selected based on the occurre
	India				24	Blood/tissue c	PCR	16	66.7			2016	Narnaware et a. 2016	Sample collected from 24 aborted and still birth fet
10	Vietnam	South Vietnam	Mar 15/2015	Human	1	Blood	Giemsa	1	Case report	2793	18	2016	Van Chau et al. 2016	Case report of Human trypanosomosis
	Vietnam					Serum	CATT	1				2016	Van Chau et al. 2016	
	Vietnam					Blood	PCR	1				2016	Van Chau et al. 2016	

LITERATURE SEARCH RESULTS



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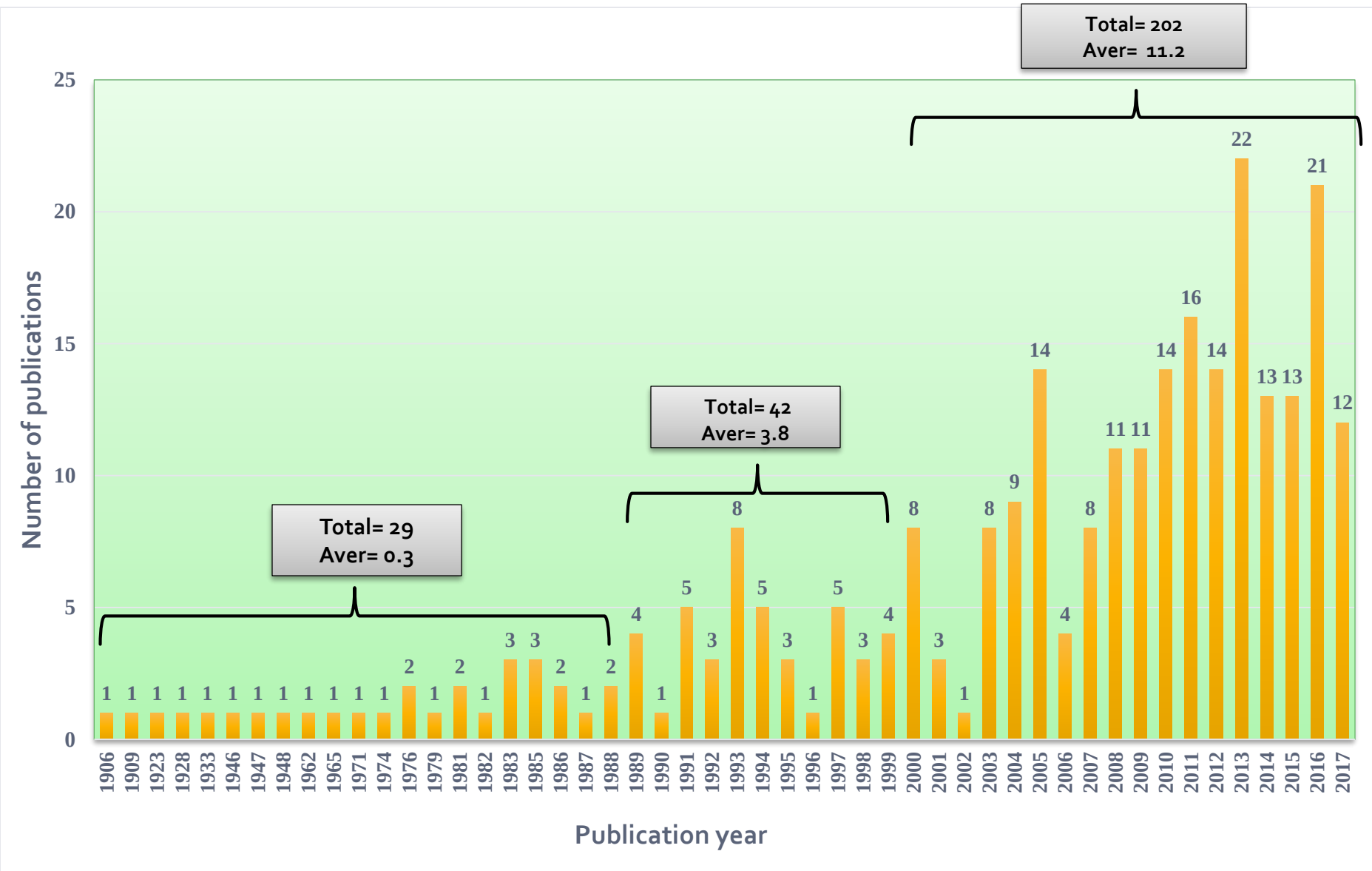
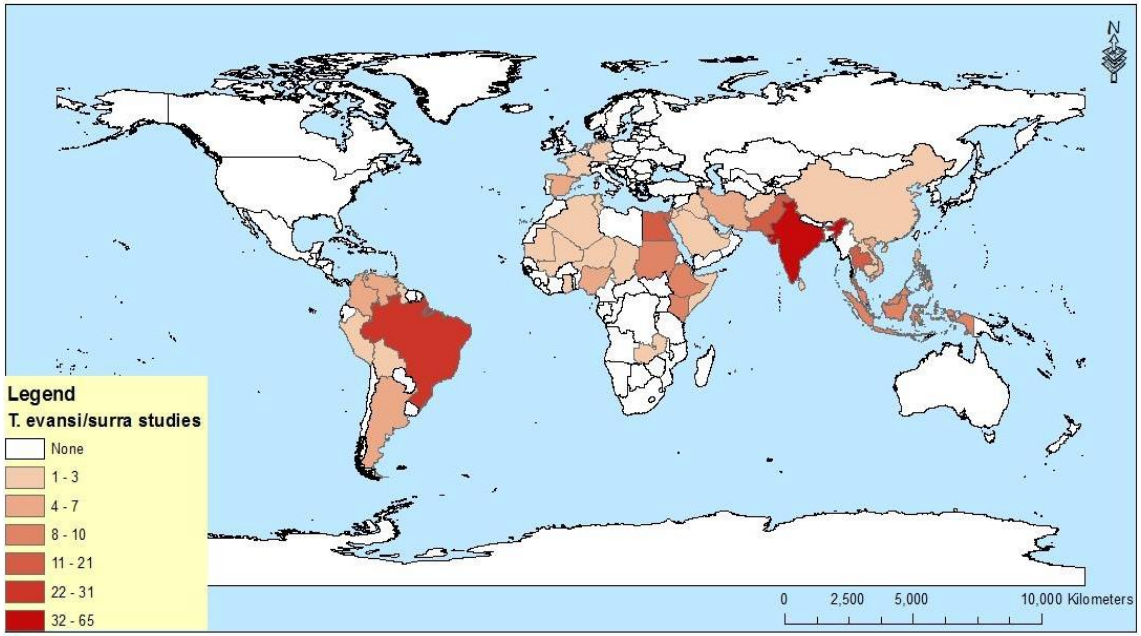


Number of included publications on surra or *T. evansi* in function of the year

GEOGRAPHIC DISTRIBUTION

- *T. evansi* reported from **48** countries
  - 20 in Asia
  - 17 in Africa
  - 7 in Southern America
  - 4 in Europe



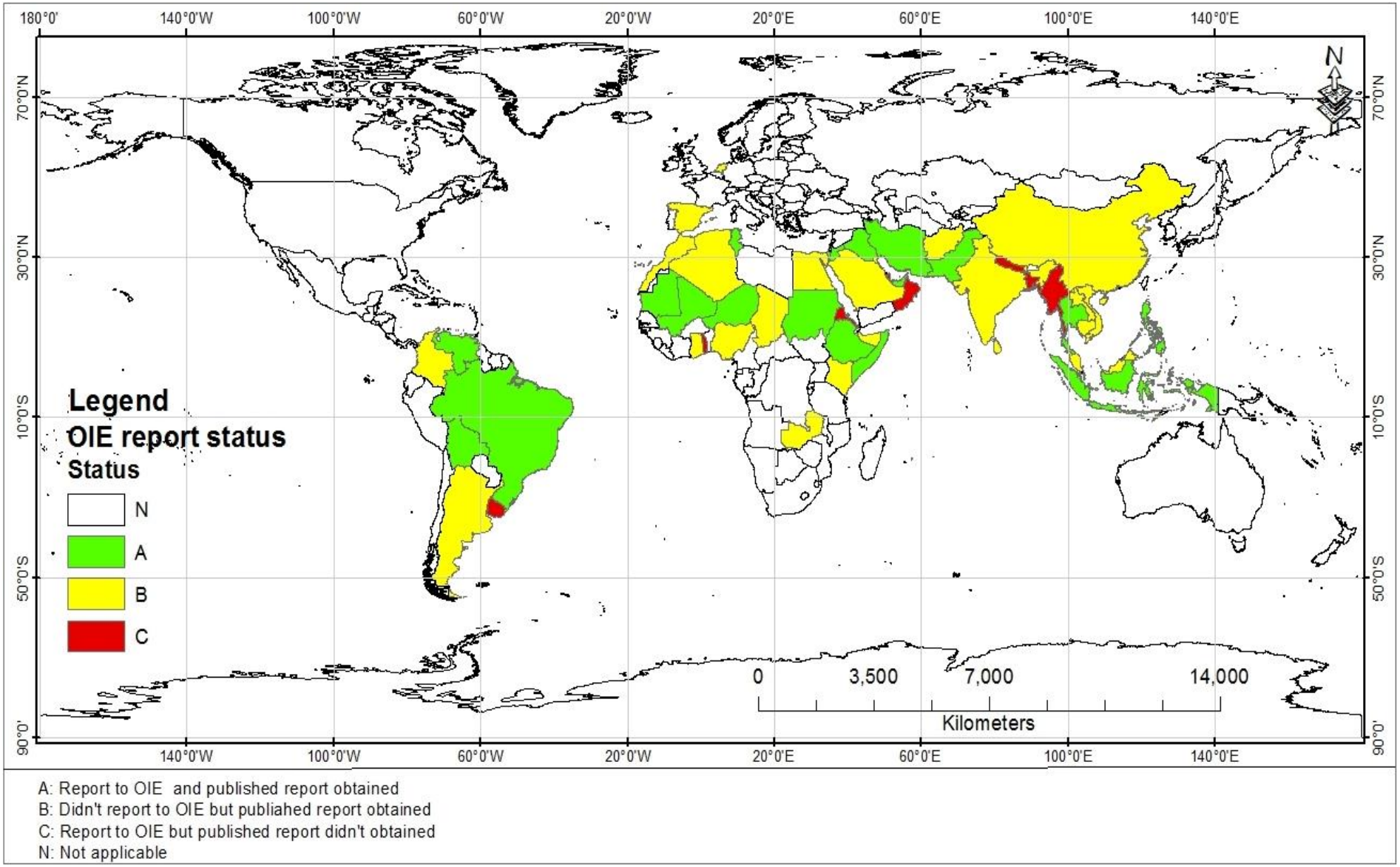
DISCORDANCE WITH INFO AT OIE

Reported to OIE

- Since 2009, **27** countries reported *T. evansi* at least once
  - 14 in Asia
  - 9 in Africa
  - 4 in Southern America
- **Eight** countries not represented in retrieved publications

Reviewed articles

- **48** countries with at least one *T. evansi* infection detected
  - 20 in Asia
  - 17 in Africa
  - 7 in Southern America
  - 4 in Europe
- **19** countries reported to OIE
- **29** didn't reported to OIE



Comparison of countries with published reports on *T. evansi* and countries reporting to OIE

Host range: naturally infected domestic animals

Host	No of studies	No of countries
Buffalo	37	9
Camel	83	23
Cattle	57	16
Dog	37	13
Donkey	4	4
Pig	3	3
Goat	5	5
Horse	37	13
Mule	3	3
Pony	1	1
Sheep	6	6

- **In Africa**: mainly reported from camels
  13 of the 17 African countries reported surra from camels
- **In Asia**: reported from all domestic involved in this review
- **In South America**, acute form of the disease observed in horses and dogs.

Host range: naturally infected wild animals

Host	No of studies	No of countries
Armadillo	1	1
Bats	5	3
Bear	2	1
Capybara	12	5
Cerdocyon thous	1	1
Coatis	5	1
Peccaries	3	3
Deer	7	4
Elephant	2	2
Feral pig	2	1
Gray brocket	1	1
Jaguar	1	1
Ocelot	1	1
Marsupials	3	1
Raccoon	1	1
Rhinoceros	1	1
Rodents	10	4
Tiger	2	1
Wallaby	1	1

- *T. evansi* in wild animals reported almost exclusively from Asia and South America.
- **In Asia,** *T. evansi* is a potential threat to the wildlife
  - different deer species
  - Asian or Himalayan black bear
  - Asian elephant,
  - leopard, tigers
  - Sumatran rhinoceros.
- **In South America,** *T. evansi* detected in a variety of wild mammals
  - coati (*Nasua nasua)*
  - capybara (*Hydrochoerus hydrochaeris*).
- Role of wild animal species in *T. evansi* epidemiology remains uncertain.

Pooled global prevalence of *T. evansi*

Species	Detection method	No of data sets	No of animals examined	No positive	Estimated prevalence (%)
Buffalo	Parasitol.	16	10325	474	4
	Ab-based	10	4425	1001	28
	Molecular	13	2917	379	28
Camel	Parasitol.	73	37565	2704	9
	Ab-based	32	24930	7069	31
	Molecular	15	6093	1582	23
Cattle	Parasitol.	19	13078	253	4
	Ab-based	15	7981	1693	19
	Molecular	23	6860	851	16
Equine	Parasitol.	10	2772	67	2
	Ab-based	17	7397	1123	19
	Molecular	10	2190	165	6

Pooled global prevalence of *T. evansi*

Species	Detection method	No of data sets	No of animals examined	No positive	Estimated prevalence (%)
Dog	Parasitol.	12	8118	89	2
	Ab-based	5	376	78	21
Small ruminant	Ab-based	5	3059	458	14
Wild-life	Parasitol.	18	1426	201	15
	Ab-based	17	2265	588	22
	Molecular	29	2102	205	13

CONCLUSIONS

- *T. evansi* has a wide geographic distribution
- Detected in a large host range
- Prevalence varies among the different diagnostic tests, host species and geography
- Underestimated and neglected disease
- No planned campaign to control the disease using modern approaches

RECOMMENDATIONS

- Extensive study to identify reservoir hosts and their role in epidemiology
- Implementation and support of worldwide projects for control and surveillance of *T. evansi*,
- Adoption of integrated approaches being used for the control of tsetse transmitted trypanosomiasis
- Experiences on the eradication of surra from the Canary Island for endemic regions
- Sanitary and surveillance measures for disease free countries

ACKNOWLEDGEMENTS

- Prof. Philippe Büscher
- ITM Library
- DGD

THANK YOU
for your
ATTENTION!

Distribution of *T. evansi* in Africa

Countries (17/7)	Studies (63)	Host
Algeria	2	Camel, Horse
Chad	1	Camel
Egypt	13	Buffalo, Camel, Cattle, Goat, Sheep, Human
Ethiopia[a]	8	Camel, Cattle, Donkey, Goat, Horse, Mule, Sheep
Ghana[b]	1	Tsetse fly
Kenya	9	Camel
Mali[a]	2	Camel
Mauritania[a]	2	Camel
Mauritius	1	Deer
Morocco	1	Camel
Niger[a]	1	Camel
Nigeria	6	Camel, Cattle, Horse
Somalia[a]	3	Camel
Somaliland	1	Camel
Sudan[a]	10	Camel, Goat, Sheep
Tunisia[a]	1	Dog
Zambia[b]	1	Tabanids

Eritrea
Togo

Distribution of *T. evansi* in Asia

Countries (20/9)	Studies (148)	Host
Afghanistan	1	Dog
Cambodia	1	Rodents
China	1	Buffalo
India	65	Buffalo, Camel, Cattle, Dog, Donkey, Elephant, Goat, Horse, Human, Leopard, Mule, Pig, Pony, Sheep, Tiger
Indonesia[a]	10	Buffalo, Cattle, Horse
Iran[a]	6	Camel
Iraq[a]	1	Cattle
Israel[a]	1	Horse
Jordan[a]	2	Camel, Horse
Kuwait	1	Camel
Laos	2	Rodents
Malaysia	9	Buffalo, Cattle, Deer, Dog, Horse, Rhinoceros
Pakistan[a]	14	Bear, Buffalo, Camel, Dog, Horse
Palestine	1	Camel, Mule
Philippines[a]		Buffalo, Cattle
Saudi Arabia	3	Camel
Sri Lanka	1	Dog
Thailand[a]	21	Buffalo, Cattle, Deer (hog & rusa), Dog, Elephant, Horse, Mule, Pig, Rodents
United Arab Emirates[a]	1	Camel
Vietnam	4	Buffalo, Human

Bangladesh, Myanmar, Nepal, Oman, Qatar

Distribution of *T. evansi* in South America

Countries (7/3)	Studies (53)	Host
Argentina	4	Capybara, Dog, Horse
Bolivia[a]	3	Cattle
Brazil[a]	31	Armadillos, Bats, Buffalo, Capybara, Cattle, Cerdocyon thous (crab-eating fox), Coatis, Deer, Dog, Gray brocket (Mazama gouazoubira), Horse, Leopardus pardalis, Marsupials, Peccaries (white-lipped & collared), Pig (feral), Raccoon, Rodents
Colombia	7	Bat (vampire), Capybara, Cattle, Dog
Guyana	1	Sheep
Peru	2	Capybara, Cattle
Venezuela[a]	5	Bat (nectar-feeding), Capybara, Cattle, Donkey, Horse

Urugay

Occurrence of *T. evansi* in Europe

Countries (4)	Studies (9)	Host
France	1	Camel
Germany	1	Dog
The Netherlands	1	Dog
Spain	6	Camel, Cattle, Donkey, Goat, Horse, Sheep

- Detection associated with import of infected animals from endemic regions.
- Outbreak in Spain and France
- Eradicated