

PPR emergence in Europe: insights from viral genetic investigations

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EU Reference laboratory for Peste des Petits Ruminants



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WOAH Reference Laboratory
for peste des petits ruminants

Reference Centre



World Organisation
for Animal Health
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Peste des Petits Ruminants (PPR)

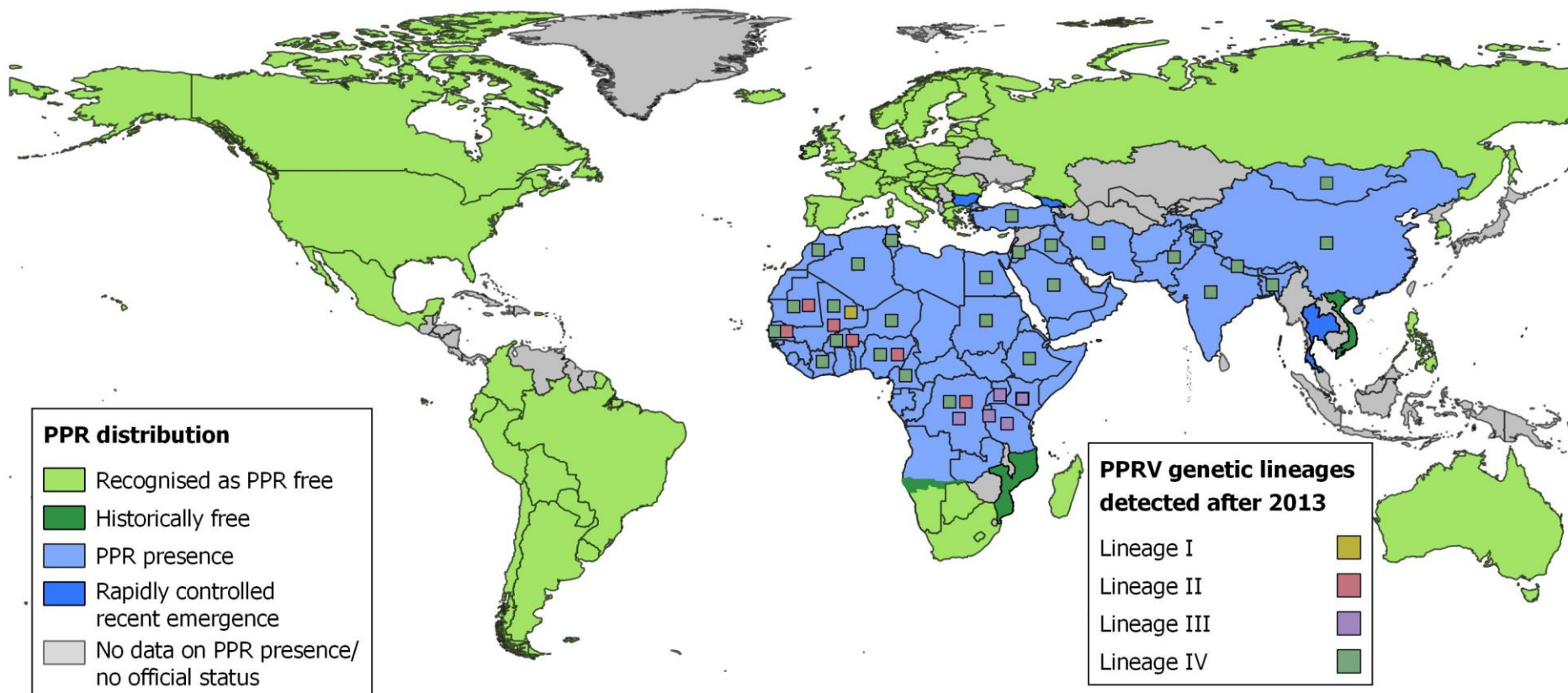
- Most widespread and devastating infectious disease of domestic small ruminants (goats, sheep), with on-going global eradication effort
- Virus of genus *Morbillivirus*, transmitted by contact (excretions, droplets)
- Mucopurulent ocular and nasal discharges, erosion of the mucosa, acute diarrhoea (mortality up to 70-90%)
- Camels, suids and some wild Artiodactyls also susceptible, but exact role in PPR epidemiology unknown (main hypothesis: spill-over from livestock)



Pictures 1-3: H. Salami

PPR distribution

- Widespread in Africa, Middle East and Asia
- Four distinct phylogenetic lineages with lineage IV most widely distributed but one serotype (vaccines available protect against all strains)

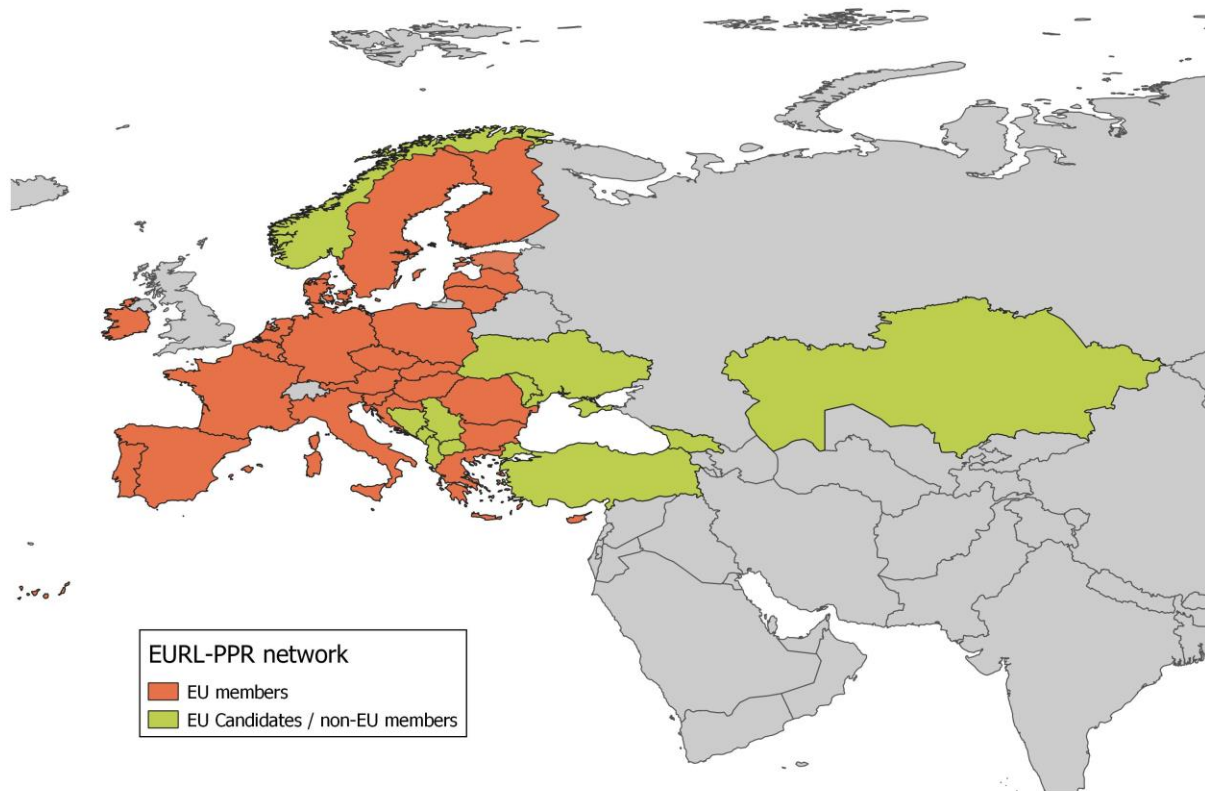




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Supporting a network of NRLs from 27 EU member states and 14 non-EU states





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To ensure availability and use of high quality methods and high quality performance by NRLs

- Distribution of Standard Operating Procedures, Production and supply of reference materials
- Organisation of Proficiency Tests annually

To provide scientific and technical assistance to NRLs

- Training course on PPR diagnostic methods
- Organisation of annual workshop

To provide scientific and technical assistance to the European Commission and other organisations

- Availability of trained staff for emergency situation (all skills)
- Active assistance in the diagnosis of PPR outbreaks
- Implementation of full quality control of the EU PPR vaccine bank every three years



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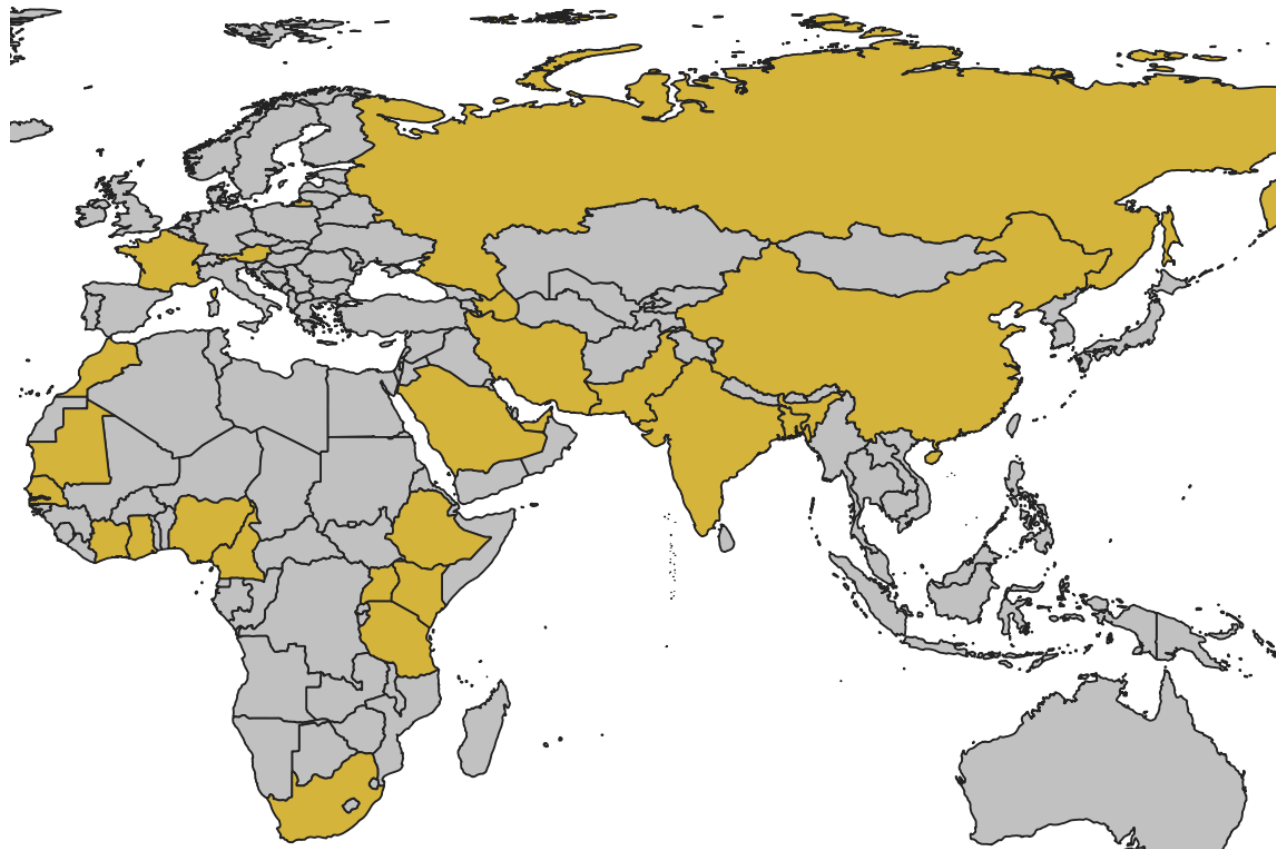
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WOAH network reference laboratories for PPR, with all WOAH ref labs, IAEA, AU-PANVAC, labs from Africa (13), Middle East (3), and Asia (7)



Pan African Veterinary Vaccine Center of African Union
AU-PANVAC



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Activities of CIRAD

- Annual PT and training, access to reference material
- Confirmatory diagnosis
- Genomic sequencing
- Workshops and webinars
- Maintain the seed strain of Nigeria 75/1 vaccine strain, providing it to vaccine producers

Info on all protocols, reference material, training, PT, vaccines available through the network

<https://www.ppr-labs-oie-network.org/>



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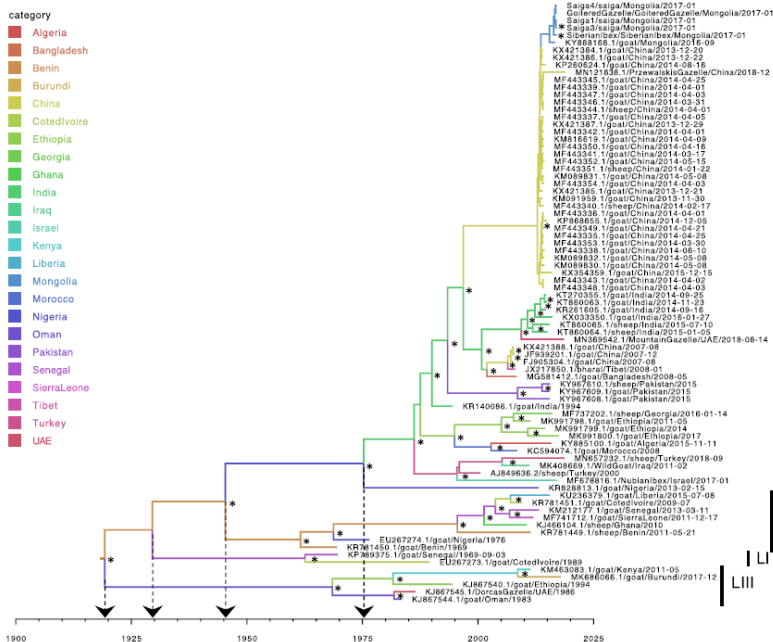
About Activities Materials and protocols Vaccines Expertise resources News



The WOAH PPR Reference Laboratory Network, officially launched by the WOAH in December 2020, aims at building strong partnerships between the WOAH Reference Laboratories and national reference laboratories throughout the world, improving links between recognised experts from national reference laboratories and from PPR diagnostic laboratories in low- and middle-income countries, in addition to the current three WOAH

Research on PPR molecular epidemiology

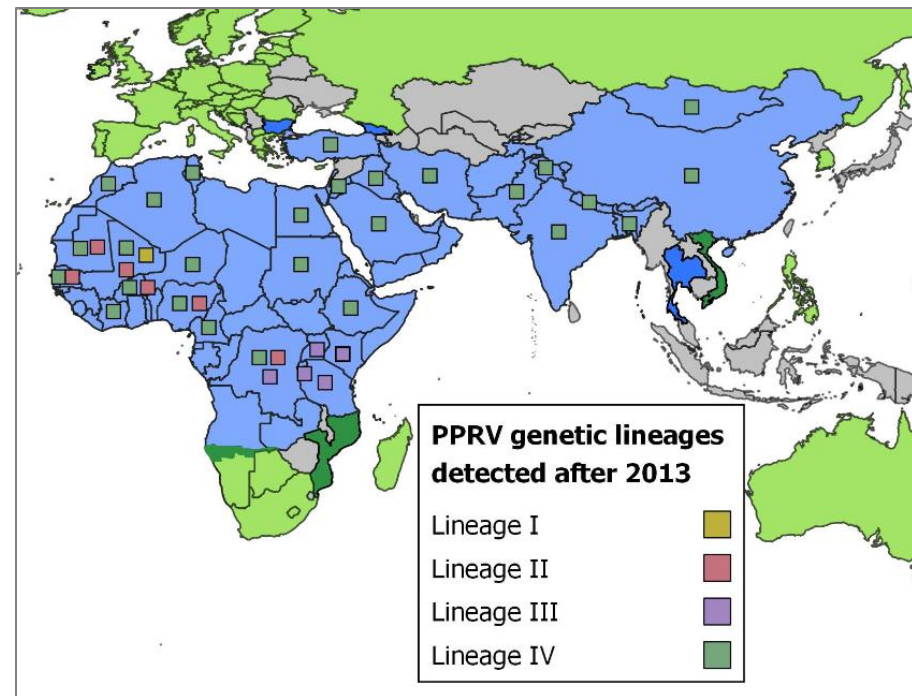
- Based on full genome sequencing of PPRv samples in collaboration with many partners internationally
- Important information on distribution of lineages and possible effect of mutations on their capacity of spread and virulence



LIV

LII

LIII



PPRVV Phylogeny

Lineage IV

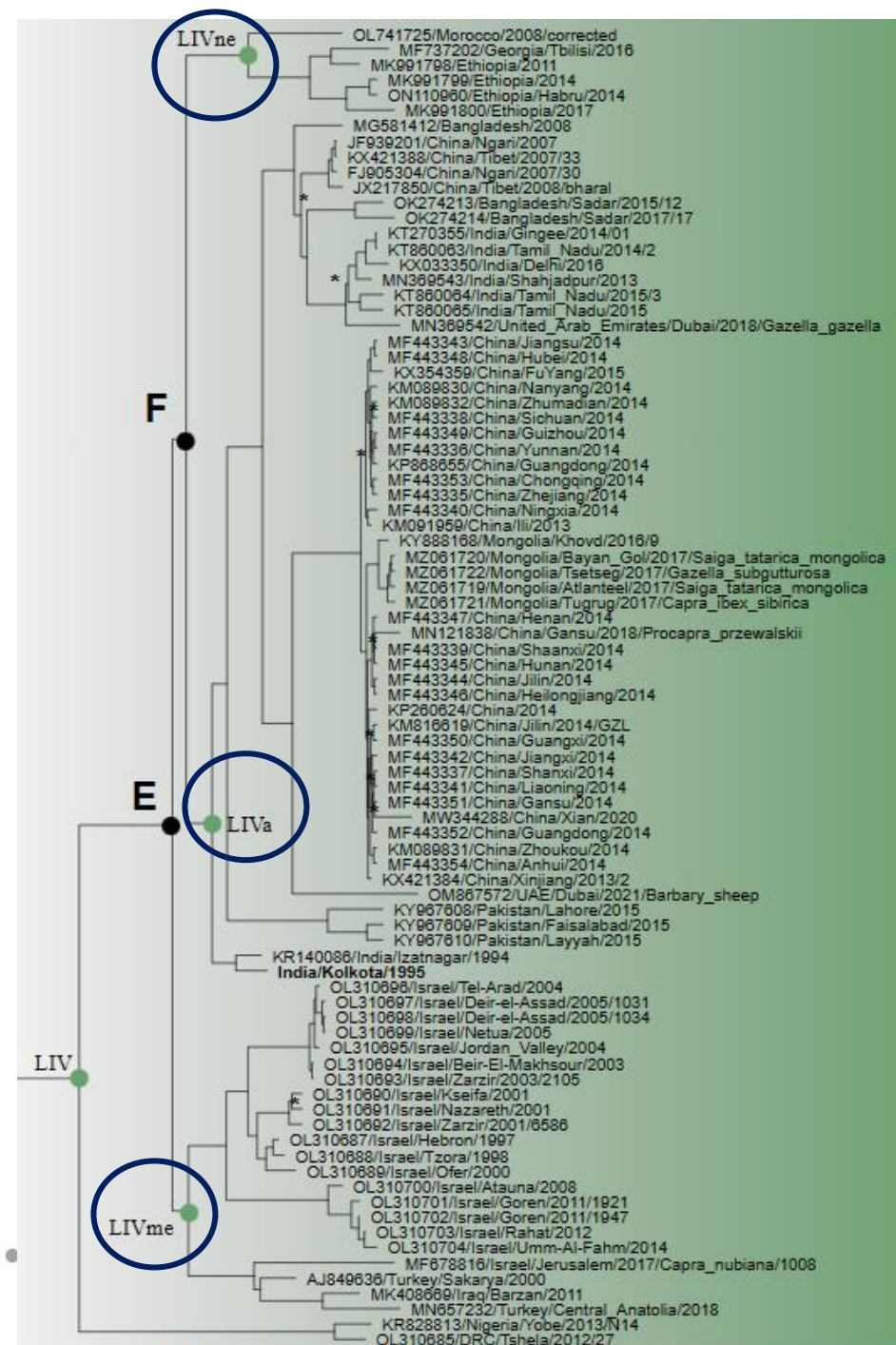
- Geographically defined clusters: North-East Africa (LIVne), Asia (LIVa), Middle East (LIVme)

Full study available at:



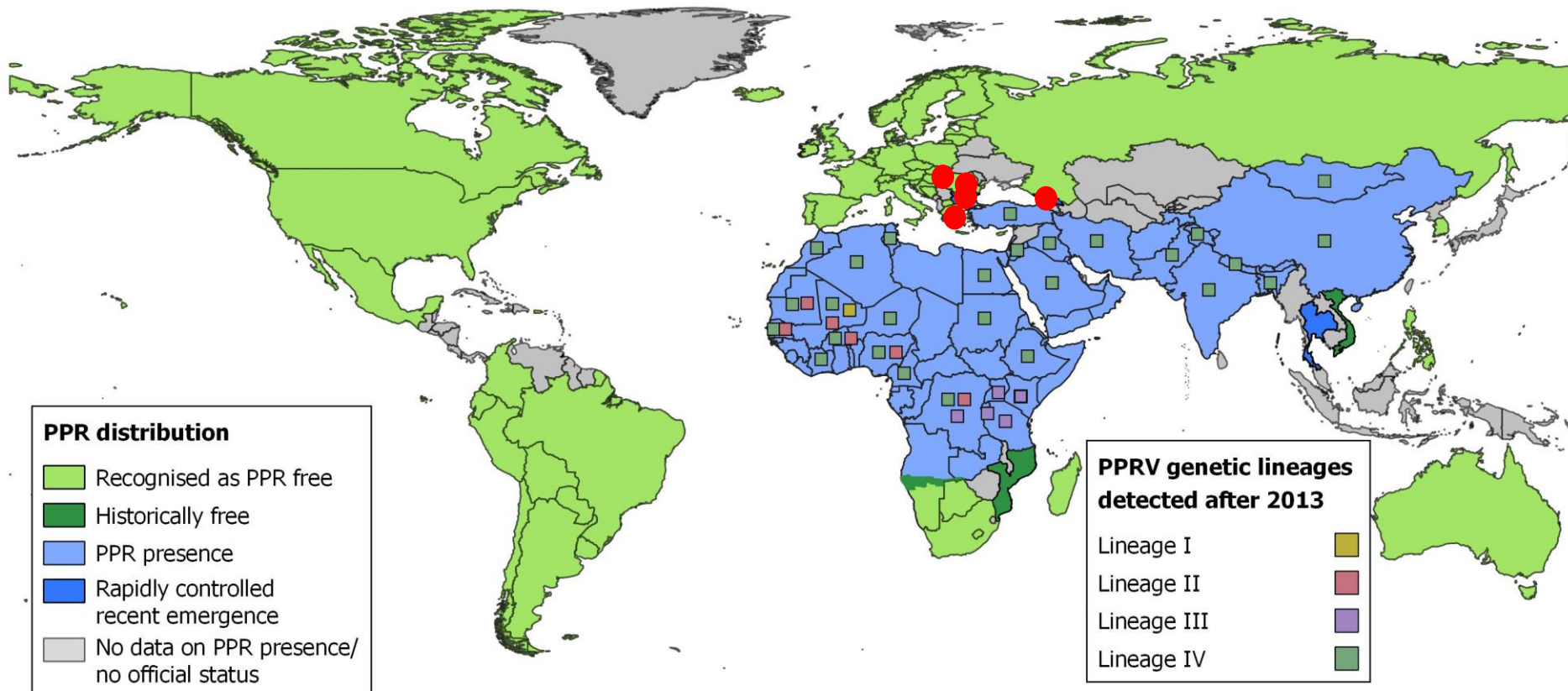
Virus Evolution, 2024, 10(1), veae012
DOI: <https://doi.org/10.1093/ve/veae012>
Advance Access Publication 6 March 2024
Research Article

Comparative evolutionary analyses of peste des petits ruminants virus genetic lineages



New PPR emergences

- Recent outbreaks (●) in Georgia (Feb 24), Greece and Romania (July 24), Bulgaria (Nov 24), Hungary (Jan 25)



New PPR emergences

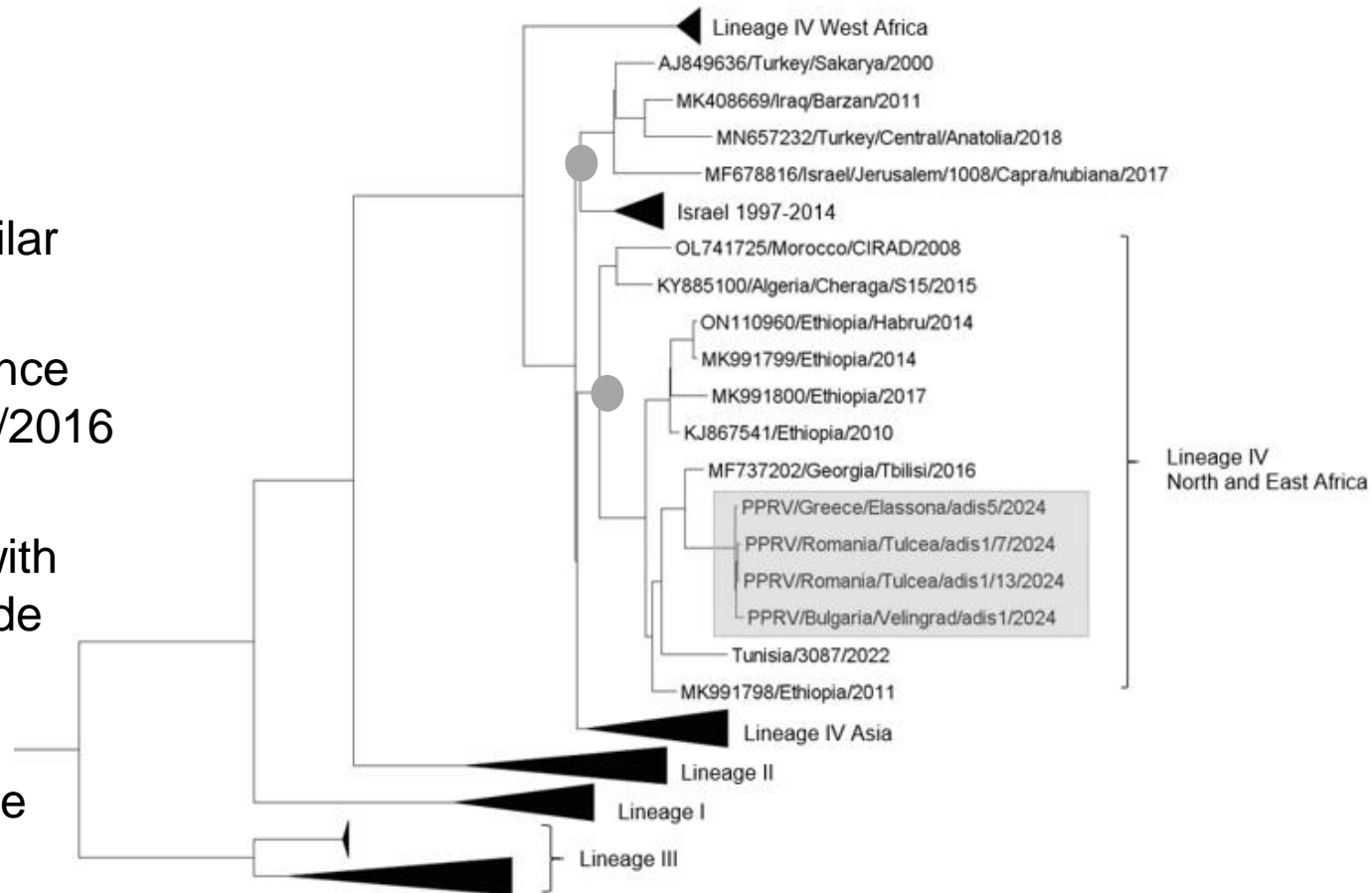
EURL activities during PPR emergences in Europe

- Participation to field mission
- Confirmatory diagnosis on sera and molecular biology samples received from NRLs
- Supports to NRLs with technical advises and reference material when requested
- Partial genome sequencing (portion of N gene) on all samples tested positive
- Full genome sequencing on at least one positive sample with highest viral load (based on RT-qPCR results)
- Alignment with curated PPRV sequence dataset available at <https://www.ppr-labs-oie-network.org/>
- Phylogenetic analyses and genome comparisons

Results of genome sequencing

Complete genome sequence for 1 sample from Greece (ADIS 5), 2 samples from Romania (ADIS 1), and 1 sample from Bulgaria (ADIS 1)

- Genomes from Romania, Greece, Bulgaria highly similar (99.5% identity)
- Most similar sequence published: Georgia/2016 (98.3% identity)
- Confirm grouping with Lineage IV sub-clade North-East Africa
- Different from sequences available from Turkey



Results of genome sequencing

Genome comparisons Georgia/2016 vs European strains

Differences, including some that may change protein functions, observed across the genome

	Nucleotide differences	Amino acid differences	AA differences unique (not found in other published sequences)
Georgia/2016 vs Greece/2024	176	30	12
Georgia/2016 vs Romania-7/2024	177	35	14
Georgia/2016 vs Romania-13/2024	173	34	14
Greece/2024 vs Romania-7/2024	22	4	2
Greece/2024 vs Romania-13/2024	20	5	2
Romania-7/2024 vs Romania-13/2024	8	1	0

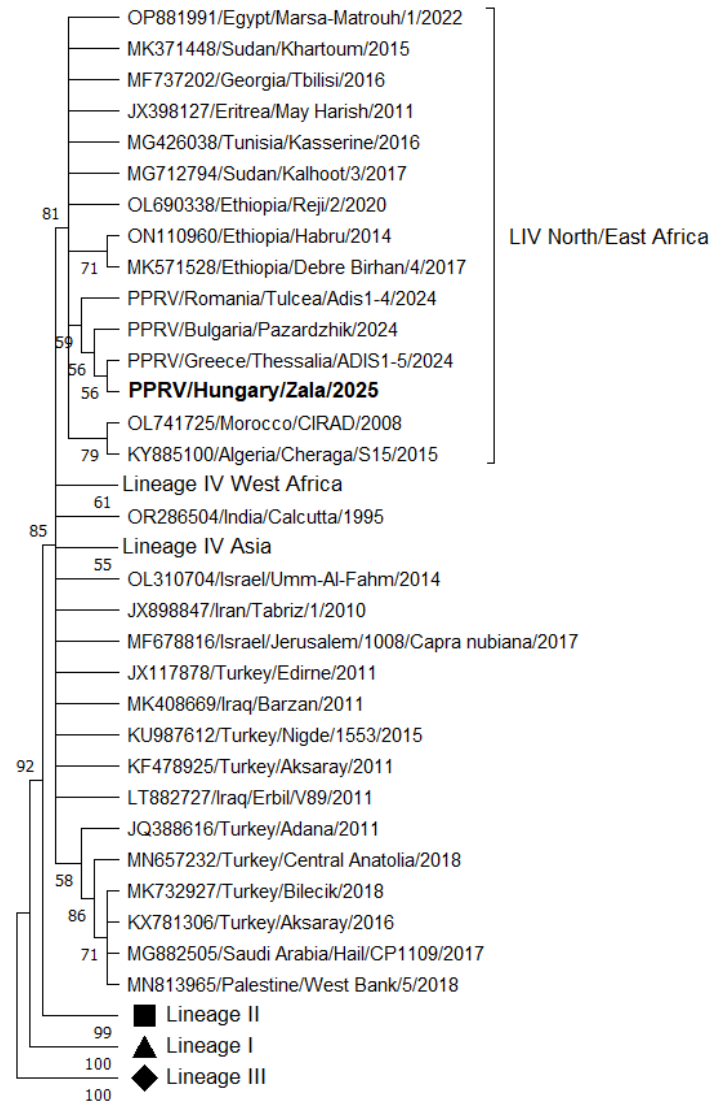
Results of partial genome sequencing

New partial N gene sequence (255bp) from Hungary

Identical to sequences from other European countries

All emergences in Europe have a common origin, associated with PPRV strains circulating in North/East Africa

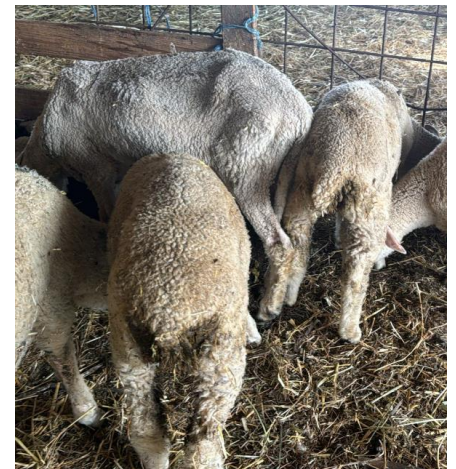
Outbreak in Georgia in 2016 also related to North/East Africa cluster, but not the outbreak of 2024



Early detection of PPR

Symptoms can include

- Loss of appetite, loss of weight, apathy, nasal/ocular excretions, coughing, sudden death, diarrhea, lesions in the mouth
- Varies across species and breeds
- For the strain in Europe, stronger symptoms and higher mortality observed on sheep
- Samples should be sent to NRL if any one of these symptoms are observed (only way to confirm PPR cases)



Early detection of PPR

Risks of delays in reporting PPR suspicion by farmers/ veterinary officers

- Limited number of symptoms, low mortality with recovery of many infected animals
- Suspicion of other, better-known disease (e.g. BT) leading to analysis by regional lab without capacity to test for PPR
- Symptoms observed thought to be due to heat (notably loss of appetite, apathy)
- Only symptoms associated with secondary bacterial infections (e.g. pasteurellosis) are identified, then confirmed by lab, leading to antibiotic treatment
- Poor communication between veterinary services and communities



Need to increase awareness in PPR-free countries

Importance of biosecurity

Indirect transmission

- Investigation in the field suggest that some farms may have been infected without direct contact with infected animals
- Possible routes of indirect transmission:
 - Trucks visiting multiple farms (milk collection, transport of feed)
 - Persons visiting multiple farms

Clear guidelines for biosecurity measures for disinfection of equipment and personal to be provided in areas at risk



Conclusions

- Threat of PPR to Europe has materialised, with 4 countries infected with a strain of common origin
- Strong measures in place but risks of introductions still present as origin of emergence not yet identified
- Risks associated to animal movements across multiple regions including North/East Africa to take into account by PPR-free countries
- Additional genome sequencing on-going to investigate further, but lack data from countries out of Europe
- Information on symptoms and sampling procedure should be disseminated largely
- Reference laboratories can support for field and lab preparedness and genetic sequencing effort

THANK YOU

To receive information on the disease, on appropriate sampling, on laboratory methods, and available supports

- EU and WOA/FAO reference laboratory for PPR

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email: contact-eurl-ppr@cirad.fr

website: <https://eurl-ppr.cirad.fr/>

<https://www.ppr-labs-oie-network.org/>

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