Food and Agriculture Organization of the United Nations

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GUIDELINES FOR THE CONTROL AND PREVENTION OF PESTE DES PETITS RUMINANTS (PPR) IN WILDLIFE POPULATIONS

Peste des petits ruminants Global Eradication Programme

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Published by
the World Organisation for Animal Health
and
the Food and Agriculture Organization of the United Nations

Rome, 2021

Required citation:
OIE and FAO. 2021. *FAO/OIE Guidelines for the Control and Prevention of Peste des Petits Ruminants (PPR) in Wildlife Populations*. Rome. https://doi.org/10.20506/PPR.2943

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ISBN 978-92-95115-89-7 [OIE]
ISBN 978-92-5-134565-8 [FAO]
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Acknowledgements

The authors would like to thank the members of the OIE's Working Group on Wildlife and experts from the PPR Global Research and Expertise Network (PPR GREN) for helpful comments and input on these guidelines.

Introduction

Peste des petits ruminants (PPR) is a widespread, virulent and devastating animal disease of domestic small ruminants and wild artiodactyls, caused by the morbillivirus peste des petits ruminants virus (PPRV). Mortality rates may exceed 90%, particularly in immunologically naïve, malnourished and stressed populations. In endemic settings, the disease is more cryptic, but causes chronic loss of newborn animals as the virus circulates and persists in populations. Economic losses are estimated at US$ 1.5 to 2.1 billion per year in locations where 80% of the world's 2.1 billion sheep and goats are raised to provide livelihoods for more than 330 million of the world's poorest people. In geographical terms, this is also where some of the world's most endangered susceptible wildlife ungulate species share the landscape. Both the Food and Agriculture Organization of the United Nations (FAO) and World Organisation for Animal Health (OIE) adopted the Global Control and Eradication Strategy for PPR (PPR GCES) in 2015, with the aim of eradicating the disease globally by 2030. The GCES is underpinned by the international standards of the OIE *Terrestrial Animal Health Code* (*OIE Terrestrial Code*) and OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (*OIE Terrestrial Manual*). The OIE *Terrestrial Code* currently defines a case of PPR with reference to infection in sheep and goats. The *Terrestrial Code* notes that, even if some wild small ruminants can be infected, only domestic sheep and goats play a significant epidemiological role. Among other purposes, these guidelines are expected to assist with the systematic accumulation of evidence to evaluate the validity of this important assumption, since it has been challenged by a growing body of field-based experience.

Experiences in Asia suggest that wildlife can be adversely affected by the continuing presence or incursion of PPR in livestock with severe, periodic mortality events. These adverse impacts of PPR on wildlife populations and wildlife conservation efforts are greater than previously recognised. For example, outbreaks in Mongolia during 2016–2017 resulted in an estimated 80% decline in the endangered Mongolian saiga antelope (*Saiga tatarica mongolica*) population. Furthermore, eradication efforts in livestock may be hampered by the occurrence of PPR in susceptible wildlife populations, since it remains possible, but not yet proven, that infected wildlife could reinfect livestock and thereby act as a reservoir or vector of PPRV. In Africa, PPRV infection appears to remain cryptic in wild ungulate species, with current evidence indicating widespread infection without apparent disease, which could also hamper eradication efforts in certain ecosystems on that continent. However, African ungulate species have expressed PPR disease in zoological collections in the Middle East, indicating a potential role for environmental or nutritional factors in disease expression. In summary, knowledge of the role that wildlife may play in PPR epidemiology (as maintenance, bridge or dead-end hosts) has increased and is currently improving, but there are still several knowledge gaps. However, there is now widespread agreement that wildlife must be considered and integrated within the next phase of the PPR Global Eradication Program (GEP) towards global freedom.

The Strategic Approach of the PPR GCES is based on four different stages. These stages correspond to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control. The stages range from stage 1, at which the epidemiological situation is being assessed, to stage 4, at which a country can provide evidence that there is no virus circulation, either at the zonal or national level, and is ready to apply for the official recognition by the OIE of its PPR-free status. At all four stages, surveillance is needed to assess the PPR epidemiological situation in domestic animals and wildlife throughout the national territory, as

well as to identify the main risk factors for its introduction, maintenance and spread. Surveillance also assists in understanding PPR epidemiology in a country, as well as monitoring progress in control and eradication efforts.

Consequently, the PPR Secretariat, the OIE Working Group on Wildlife, and the PPR Global Research and Expertise Network (GREN) formed a joint Working Group to develop guidelines for PPR prevention, outbreak response, and control in wildlife, which can be used by countries to develop their PPR national strategic plans. These guidelines are intended to help countries in the development and implementation of PPR eradication programmes, including objectives, policies and strategies that can be adapted to the full range of national needs, and that facilitate the integration of the wildlife sector into the national strategic plan. Integration will enhance the conservation of wildlife populations, and facilitate management of diseases at the wildlife–livestock interface. The purpose of this document is to provide a conceptual framework that can be tailored to a particular national and epidemiological context. In addition, these guidelines, while specific to PPR eradication, can be adapted for any disease at the wildlife–human–livestock interface.

Components of guidelines for PPR control in wildlife

Programme planning and governance

Risk assessment to identify wildlife populations that are potentially susceptible to PPRV is a vital initial step to determine the extent to which the wildlife sector needs to be integrated into the PPR national strategic plan. It is also important to identify the key wildlife populations living in proximity to livestock within a country. Once this is determined, the relevant wildlife-sector stakeholders, who should be included as early as possible in national PPR eradication planning efforts, should then be identified. An institutional analysis that examines the organisations involved in disease control and prevention and the processes that govern their interactions may be helpful in identifying such partners. In some countries, the authorities that manage wildlife may be divided among different Ministries and agencies, and may differ from those authorities that manage livestock diseases. In addition, expertise on the ecology of populations of PPR-susceptible species should be sought from other relevant institutions, such as universities and non-governmental organisations.

Establishing a multisectoral coordination mechanism is essential to ensure good governance and effective collaboration in achieving PPR eradication goals. Multisectoral coordination mechanisms have both leadership and technical coordination functions:

- inter-Ministerial leadership, which supports coordination, collaboration, and communication among sectors at the leadership level, and advocates a multisectoral approach to policy-making, strategic planning, decision-making, and resource allocation;
- technical coordination of activities (including surveillance, outbreak investigation and laboratory diagnostic activities) to ensure that a multisectoral approach is taken and that this approach is aligned across existing governmental and non-governmental structures, as well as across the technical activities addressing PPR and, potentially, other wildlife diseases.

Assessing, improving and adapting existing national structures, mechanisms and plans is more cost-effective than establishing new ones, and more likely to be successful.

In summary, programme planning and establishing a governance structure will provide decision-makers with well-thought-out advice on PPR risk assessment, surveillance, management, vaccination strategies and communication, etc., that draws on a range of institutional knowledge and expertise. This is a vital foundation for a successful eradication programme. Practical steps to strengthen PPR surveillance and response and to ensure the inclusion of the wildlife sector include:

a. coordination with the Ministry or agency responsible for wildlife management

b. the participation of the wildlife sector in regional epidemiosurveillance network activities (where these exist)

c. the organisation of meetings involving wildlife specialists and other stakeholders (such as hunters and game ranchers) on PPR surveillance and response

d. the establishment of a procedure to improve external coordination with the Ministry of Environment and other organisations involved in wildlife management (notably to improve the reporting of PPR cases in wildlife)

e. the organisation of PPR awareness campaigns targeting hunters and other wildlife stakeholders.

Peste des petits ruminants surveillance in wildlife

An effective surveillance system for PPRV-susceptible wildlife species underpins the success of PPR control and prevention in these populations, once risk assessment has identified key wildlife populations. Serological, passive and clinical surveillance approaches are fundamental to effective eradication: without these, demonstrating disease-free status will not be possible and the disease will persist or re-emerge. As in domestic species, disease surveillance in wildlife consists of general surveillance (i.e. the investigation of morbidity and mortality events) and targeted, pathogen-specific surveillance – also known as passive and active surveillance, respectively. Ideally, PPR surveillance should be a coordinated system among all sectors that facilitates information sharing to support the early detection of PPR in wildlife populations and a coordinated response. The coordinated surveillance system should have high sensitivity for detecting new occurrences of PPR in wildlife, should be able to determine seroprevalence trends by adequate sampling of the population, and should be linked to joint response plans. The surveillance plan should include options for general and targeted surveillance and should evolve, based on the results obtained. All relevant sectors should collaborate in developing the surveillance plan as well as in any revisions and updates of the plan.

There are specific challenges related to conducting surveillance in wildlife, including, but not limited to, knowledge of the abundance and geographical distribution of PPR-susceptible wildlife species; knowledge of wildlife species ecology and life-history traits; access to diagnostic samples; a lack of validated serological tests for use in a range of wildlife species; timely reporting of events; and an adequate cold chain for the storage and shipment of samples. Establishing a network of partners to conduct surveillance in free-ranging wildlife, which includes local citizens, farmers, veterinarians, hunters, game-wardens, etc., who are trained to recognise the clinical signs of PPR and in reporting protocols, is essential to help overcome these challenges. Emphasis should be given to surveillance in the areas (e.g. watering and grazing locations) and seasons in which livestock and wildlife potentially come into contact. Surveillance is further complicated by the nature of diseases in wildlife, which can be cryptic with subclinical infection. Regular reporting, either of suspicious or negative findings, is important to ensure the network is functioning well. Reported cases suggestive of PPR should prompt appropriate field and/or laboratory follow-up investigations to confirm or rule out the disease. Note that general disease surveillance alone is insufficient to determine the presence or absence of PPR in wild populations.

Targeted surveillance for PPR in wildlife and the absence of PPR expression in some species will require a serosurveillance approach. Surveillance in captive wildlife also needs to be considered although the disease appears to be expressed readily in this context. Serological surveillance for PPRV in wildlife during the eradication phase may also play an important role as a sentinel system and indicator of virus circulation when small ruminants have been vaccinated.

Standardisation and data management

Ideally, aspects of the coordinated surveillance system should be standardised: for example, by using established OIE case definitions for surveillance, diagnostic protocols, and confirmatory diagnostic tests, whenever possible. The fact that some wildlife species do not have validated confirmatory serological tests is a current gap and the OIE, FAO, International Atomic Energy Agency (IAEA), and OIE Reference Laboratories for PPR are currently working towards addressing this concern.

Managing wildlife surveillance data is equally important as this facilitates data sharing among sectors to help ensure that each sector is aware of what is happening in the other sectors.

Best practices include the development of a common data dictionary, i.e. the collection of names, definitions and attributes of data elements that are being used or captured in a database during the establishment of the surveillance system. This will allow data from various surveillance streams to be combined for further analysis or investigation. Common variables include identification number systems, geospatial referencing, etc. If possible, the same data collection forms should be used by domestic animal health and wildlife health surveillance teams. Data-sharing agreements and protocols should be established to ensure the timely sharing of data among all relevant sectors. The FAO event mobile application (EMA-i) database can be used to collect and share information from the grassroots level to national Veterinary Services and agencies, and at the international level. Use of the OIE's World Animal Health Information System (OIE-WAHIS) or other established databases may also be useful for sharing data and information.

Outbreak investigation in wildlife populations

Outbreak investigation in susceptible wildlife populations is important for early detection of PPR activity. An outbreak investigation is a systematic process to identify the aetiology and source of cases of infection with a view to controlling and preventing possible future occurrences. Developing protocols for implementing a coordinated investigation and response to wildlife mortality events and having the field capabilities to respond to outbreaks and to collect, store and transport biological specimens are essential for success. As mentioned earlier, a partner network that can identify and report wildlife morbidity and mortality will greatly improve the speed of response to these events. Using animal-side diagnostic tests, such as lateral flow devices, for rapid diagnosis may assist in the initial assessment of the cause of mortality while confirmatory laboratory tests are being conducted. Protocols should include disease control and prevention measures to manage the initial outbreak, in addition to appropriate biosecurity and carcass disposal procedures. Where cryptic subclinical infection is suspected, targeted or active surveillance will be necessary.

Laboratory diagnostics

The National Strategic Plan for PPR should be supported by diagnostic facilities with adequate capability and capacity, which are willing to accept diagnostic samples from wildlife species and use histopathological, molecular and serological techniques. Protocols should be established for the collection, submission and storage of diagnostic specimens from wildlife. The quality and integrity of the cold chain, traceability of biological samples, and proper biosafety and biosecurity measures for samples and diagnostic tests must be ensured for wildlife specimens. This is particularly critical for the validity of molecular tests for PPRV, such as conventional or real-time reverse transcription polymerase chain reaction (RT-PCR), for which samples must be collected into nucleic acid stabilisation reagents and care taken to ensure correct storage temperatures and prevent contamination during processing. Diagnostic testing should follow OIE standards, where possible, and the diagnostic laboratories should be overseen by a quality assurance scheme coordinated by the designated national reference laboratory. Both government laboratories and research institutions should work together to address the diagnostic challenges involved with different wildlife species. The OIE has defined standards for validating diagnostic tests, in general and in wildlife (OIE *Terrestrial Manual*, Chapters 2.2.7. and 3.7.9.). In the case of PPR, OIE standards are currently valid for the target host species, sheep and goats. The current 'gold standard' PPR virus neutralisation test (VNT) is not commonly used, except in exceptional circumstances, as it is costly and impractical for most national diagnostic laboratories. Consequently, there is a need to review alternative gold standards

for this disease. Furthermore, given the costs and challenges involved in wildlife capture, the development of non-invasive diagnostic tools should be considered to obtain cost-effective epidemiological information.

Aligning local diagnostic protocols with internationally recognised standards to ensure diagnostic quality and integrity is an important goal. Reliable test protocols are not yet in place and this must urgently be addressed, particularly in the case of national reference laboratories. Additionally, having the appropriate permits in place, including permits from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), will expedite the international shipment of wildlife samples to reference laboratories. Material transfer agreements to ensure that obligations arising from the Nagoya Protocol are respected should also be used (OIE *Terrestrial Manual*, Chapter 1.1.3.).

Policies and procedures for data sharing and the communication of results by all diagnostic laboratories within the surveillance system to the appropriate parties should also be established, to ensure an effective and coordinated response to positive detections of PPR in wildlife.

Risk assessments

Joint risk assessments should be undertaken to identify risks to wildlife from PPR and the potential for spillover of the pathogen from wildlife to livestock. Documenting the level of risk, degree of uncertainty, and gaps in our present knowledge is important to guide surveillance and response plans and determine research priorities. The surveillance data generated will also help to refine future risk assessments. Risk mapping and other visualisation tools are useful in conveying this information to decision-makers.

Prevention and management options in wildlife populations

Managing PPR in free-ranging wildlife populations is challenging, and few tools currently exist to control the disease in wildlife. Consultation with international experts to discuss potential options is important if PPR is detected in wildlife populations in a particular jurisdiction, especially for species of conservation concern. Culling or restricting the movement of free-ranging wildlife is generally considered ineffective in controlling infectious diseases in these populations. Vaccination of free-ranging wildlife to achieve herd immunity is currently not feasible. However, planning and implementation of national vaccination campaigns should be informed by an understanding of PPRV epidemiology and risks for disease transmission at the livestock–wildlife interface. Vaccinating captive populations of non-domestic ungulates and suids should also be considered as they appear to have higher susceptibility to PPR under these conditions. Temporo-spatial separation of wildlife and livestock populations could be considered in some circumstances. For countries with low wildlife population numbers, the risk of these populations being a major factor in PPRV persistence is also low, as was the case with rinderpest. However, in these circumstances, greater emphasis is needed on PPR control in livestock, especially in mixed-species ecosystems, to ensure elimination from the domestic compartment. Control measures in domestic species must be effective enough to prevent spillover to wildlife, and consequent spill back where wildlife numbers might be sufficient to suffer periodic epidemics and circulate the virus.

Risk communication

Risk reduction and risk communication material for internal and external audiences and stakeholders should be developed jointly to ensure consistent messaging on PPR risks at the livestock–wildlife interface. Jointly determining who needs to know what information, and what actions stakeholders should be asked to undertake, would assist in a coordinated approach, and increase the success of potential risk reduction strategies that should be applied by different stakeholders, including communities and livestock farmers affected by PPR.

Knowledge gaps and research

Support for research on the epidemiology and control of PPR at the livestock–wildlife interface will help to reduce the gaps in our knowledge; in particular, the role of wildlife in PPR epidemiology in different ecosystems. Information gaps include knowledge of the full range of susceptible species, patterns and pathways of transmission within a wildlife population and between wildlife and livestock, viral evolution in wildlife, and the role of co-factors, for example, stress, nutrition, etc., on disease expression in wildlife. These gaps in knowledge could be addressed by additional targeted wildlife sampling in key socio-ecosystems. Molecular epidemiology can be a powerful tool for inferring virus transmission pathways, and every opportunity to collect appropriate samples for molecular analysis and sequencing should be taken (together with the relevant epidemiological data). Furthermore, none of the commercially available diagnostic tests for PPR serology is validated for wildlife species and there are unanswered questions regarding their sensitivity and specificity with wildlife serum samples. New serological test methodologies have been published, such as the luciferase immunoprecipitation systems (LIPS) assay and pseudotype virus neutralisation assay (PVNA), that could be useful in this context, including as a potential gold standard to replace the current PPR VNT. Clear guidelines and standards will need to be established for the application of PPR diagnostics tests in wildlife species, using true positive and negative sera across species. Communication with national and international research bodies should be established to address these knowledge gaps, and research planning should be coordinated across the wildlife and domestic animal sectors. The design of surveillance and investigation activities should consider research questions to take advantage of the information that arises from these efforts.

Capacity building

Wildlife disease surveillance and management infrastructure is at various stages of development in different countries and regions. Thus, institutional capacity building is an important component in the development of a wildlife health surveillance and management programme designed to implement these guidelines. The establishment of a sustainable national wildlife health programme should be considered, if so desired. Including wildlife practitioners and agencies with responsibility for protecting wildlife in training and capacity building for PPR eradication will be vital.

References and resources

Fine A.E., Pruvot M., Benfield C.A., Caron A., Cattoli G., Chardonnet P. […] & Meeting Participants (2020). – Eradication of peste des petits ruminants virus and the wildlife–livestock interface. *Front. Vet. Sci.*, **7**, 50. doi:10.3389/fvets.2020.00050.

Food and Agriculture Organization of the United Nations (FAO) (2019). – Taking a multisectoral One Health approach: a Tripartite guide to addressing zoonotic diseases in countries. FAO, Rome, Italy; World Organisation for Animal Health (OIE), Paris, France; & World Health Organization (WHO), Geneva, Switzerland, 166 pp. Available at: www.fao.org/3/ca2942en/CA2942EN.pdf (accessed on 9 March 2021).

Jakob-Hoff R.M., MacDiarmid S.C., Lees C., Miller P.S., Travis D. & Kock R. (2014). – Manual of procedures for wildlife disease risk analysis. World Organisation for Animal Health (OIE), Paris, 160 pp. Published in association with the International Union for Conservation of Nature and the Species Survival Commission. Available at: https://portals.iucn.org/library/sites/library/files/documents/2014-007.pdf (accessed on 9 March 2021).

Pruvot M., Fine A.E., Hollinger C. […] & Shiilegdamba E. (2020). – Outbreak of peste des petits ruminants among critically endangered Mongolian saiga and other wild ungulates, Mongolia, 2016–2017. *Emerg. Infect. Dis.*, **26** (1), 51–62. doi: 10.3201/eid2601.181998.

World Organisation for Animal Health (OIE) (2014). – OIE Guidelines for animal disease control. OIE, Paris, 9 pp. Available at: www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/A_Guidelines_for_Animal_Disease_Control_final.pdf (accessed on 9 March 2021).

World Organisation for Animal Health (OIE) (2019). – Chapter 1.1.3. Transport of biological materials. *In* Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. OIE, Paris, 23–47. [This version was adopted in May 2018.] Available at: www.oie.int/fileadmin/Home/eng/Health_standards/tahm/1.01.03_TRANSPORT.pdf (accessed on 9 March 2021).

World Organisation for Animal Health (OIE) (2019). – Chapter 2.2.7. Principles and methods for the validation of diagnostic tests for infectious diseases applicable to wildlife. *In* Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. OIE, Paris, 231–237. [This version was adopted in May 2018.] Available at: www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.02.07_WILDLIFE.pdf (accessed on 9 March 2021).

World Organisation for Animal Health (OIE) (2019). – Chapter 3.7.9. Peste des petits ruminants (infection with peste des petits ruminants virus). *In* Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. OIE, Paris, 231–237. [This version was adopted in May 2019.] Available at: www.oie.int/fileadmin/Home/eng/Health_standards/tahm/3.07.09_PPR.pdf (accessed on 9 March 2021).

World Organisation for Animal Health (OIE) (2019). – OIE Reference Experts and Laboratories for Peste des Petits Ruminants. Available at: www.oie.int/scientific-expertise/reference-laboratories/list-of-laboratories/ (accessed on 9 March 2021).

World Organisation for Animal Health (OIE) & International Union for Conservation of Nature (IUCN) (2014). – Guidelines for wildlife disease risk analysis. OIE, Paris, 24 pp. Published in association with the IUCN and the Species Survival Commission. Available at: https://portals.iucn.org/library/sites/library/files/documents/2014-006.pdf (accessed on 9 March 2021).