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Natural History

Illegal Wildlife Trade gives insights into suspected Feline Panleukopenia Virus (FPV) Occurrence in *Puma concolor*

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Resumen

El tráfico y comercio ilegal de fauna silvestre es una grave amenaza para la biodiversidad, alterando los ecosistemas y provocando la disminución de poblaciones animales a nivel mundial. Este estudio examina la potencial presencia del Virus de la Panleucopenia Felina (FPV) en un juvenil de *Puma concolor* rescatado de cautiverio. Los resultados de la histopatología y las detecciones macroscópicas revelaron diversas anomalías consistentes con la infección por FPV, describiendo el impacto de las enfermedades virales en los felinos salvajes. Este caso resalta el potencial papel de los felinos silvestres como reservorios para la transmisión del FPV y destaca el mayor riesgo de enfermedades asociado al comercio ilegal de vida silvestre. La detección temprana de patógenos es crucial para intervenciones oportunas que prevengan brotes de enfermedades. El diagnóstico integral y las estrategias de manejo adaptadas a especies de vida silvestre son esenciales para salvaguardar la biodiversidad y mitigar la transmisión de enfermedades zoonóticas. Al implementar estas medidas, el estudio enfatiza la importancia de abordar el vínculo entre el comercio ilegal de vida silvestre, las enfermedades virales y la conservación de la biodiversidad.

Palabras clave: Biología de la conservación, Enfermedades silvestres, León de montaña, Transmisión zoonótica.

Abstract

Illegal wildlife trade poses a grave threat to biodiversity worldwide, with viral diseases such as Feline Panleukopenia Virus (FPV) affecting the ecosystems health and biodiversity. This study examines a juvenile *Puma concolor* rescued from illegal trade in Colombia, revealing

a possible FPV infection through histopathological and macroscopic detections. The findings highlight FPV's impact on wild felids, suggesting wild cats' potential role as reservoirs for transmission. This underscores the heightened disease risk associated with illegal wildlife trade. Early pathogen detection is crucial for timely interventions to prevent disease outbreaks. Comprehensive diagnostics and tailored management strategies for wildlife species are essential for safeguarding biodiversity and mitigating zoonotic disease transmission. By implementing these measures, the study emphasizes the importance of addressing the nexus between illegal wildlife trade, viral diseases, and biodiversity conservation.

Keywords: Conservation biology, *Cougar*, Wildlife disease, Zoonotic transmission.

Illegal wildlife trade poses a significant threat to biodiversity by driving the decline of numerous species (Broad *et al*.,2014; Rush *et al*.,2021; Hughes *et al*.,2023). The unsustainable exploitation of wildlife for commercial gain disrupts ecosystems, leading to population declines and loss of genetic diversity (Laikre *et al*., 2010; Hughes *et al*.,2023). It directly impacts endangered species, pushing them closer to extinction, while also disrupting food chains and ecosystem functions (Duffy *et al*., 2016; Van 2016; Kumari & Deepali 2021; Hinsley *et al*.,2023). Furthermore, the illegal wildlife trade exacerbates the risk of disease transmission between domestic and wildlife (Travis *et al*.,2011; Shivaprakash *et al*.,2021), by trafficking animals across borders, pathogens can spread rapidly, potentially leading to outbreaks among vulnerable wildlife populations (Bezerra-Santos *et al*.,2021; Rush *et al*.,2021; Hinsley *et al*.,2023). This not only poses a direct threat to biodiversity but also increases the likelihood of zoonotic diseases spilling over into human populations, posing significant public health risks (Bezerra-Santos *et al*., 2021; Hughes *et al*., 2023).

The Feline Panleukopenia Virus (FPV), commonly known as Feline Parvovirus, represents a formidable threat within the Family Felidae, impacting domestic and wild cat populations (Durry & Capece 2012; Kim *et al*.,2013; Truyen & Parrish 2013; Gilbert *et al*., 2023). While extensively studied in domestic species, the influence of FPV on wild felids remains a subject of growing concern and scientific inquiry (Duarte et al. 2009; Barrs 2019; Gonzálvez *et al*., 2021). Reports of FPV infection in wild animals underscore the breadth of its impact, with documented cases including two adult snow leopards (*Panthera uncia*) at Blank Park Zoo in late 1988, despite being vaccinated (Fix *et al*., 1989), also in lynx (*Lynx lynx*) and in a European wildcat (*Felis silvestris silvestris;* Wasieri *et al*., 2009). Furthermore, fatal instances of FPV infection have been observed in a white tiger (*Panthera tigris*) and an African lion (*Panthera leo*) at Lisbon Zoo, as well as a leopard cub (*Panthera pardus*) at Nagpur Wildlife Rescue Center, highlighting the severity and varied manifestations of the disease (Duarte *et al*., 2009; Kolangath *et a*l., 2023). Here we present a study case on a rescued juvenile *Puma concolor* from illegal trade diagnosed with suspected Feline Panleukopenia in eastern Colombia.

Case Report: On October 9, 2017, in the municipality of Bucaramanga, Department of Santander, Colombia, the environmental authority: Corporación Autonoma Regional de Santander (CAS), delivered a juvenile Cougar (*Puma concolor*) to the non-profit wildlife organization Cabildo Verde; veterinarian facilities in Cristo Rey (7.133908°N, -73.128278°W, elevation 959 m), the juvenile was rescued from captivity due to illegal trade within the rural zone of central Santander, Andean region of Colombia. The cougar underwent medical

intervention, including specialized tests such as thoracoabdominal ultrasound, as part of the preventive medicine plan upon entering quarantine. This procedure aims to visualize and assess possible anomalies in structures within the thoracic and abdominal cavities. Additionally, intravenous fluid treatment was administered to compensate for a detected 5% dehydration.

On October 21, 2017, twelve days after reception, and with no initial anomalies detected, the juvenile cougar was transferred to Cabildo Verde Natural Reserve in Sabana de Torres, Santander, Colombia (7.35061°N, -73.49676°W, elevation 161 m), to initiate rehabilitation procedures. However, on October 23, 2017, the cougar exhibited signs of alertness, weakness, and dehydration during a physiological evaluation. Despite immediate hydration measures, the animal died suddenly.

In accordance with post-death protocols, the animal's body was placed in red bags and stored in a biological waste freezer for subsequent transfer to the veterinary facilities of Universidad Cooperativa de Colombia (coordinates: 7.128594°N, -73.113008°W, elevation 1027 m). On October 27, 2017, a necropsy was performed on the individual, and samples were extracted from vital organs including the heart, spleen, lungs, kidneys, liver, stomach, and intestines for histopathological analyses. Despite four days passing since the animal's death, no macroscopic changes in organs, which may affect subsequent histopathological analyses (Figure 1).

The macroscopic inspection revealed various abnormalities, including: deteriorated body condition, spleen congestion, hepatomegaly with altered structural edges, liver congestion, distended gallbladder, presence of mucoid and hemorrhagic content in the stomach, omental adhesions to abdominal organs, hyperemic and segmented hemorrhage in the small intestine walls, bile discoloration in the large intestine, hemorrhagic enteritis in the lumen, reduced size of submandibular and inguinal lymph nodes, and paleness in the cortical area and renal parenchyma. (Figure 1).

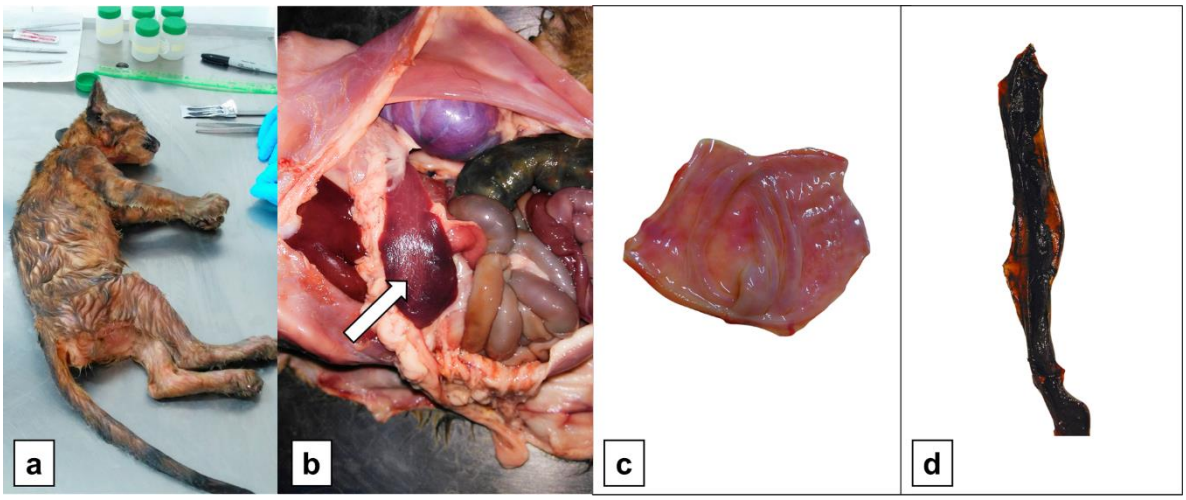

FIGURE 1. Detailed view of necropsy of the cougar; (a) external and internal view of the animal, (b) congested spleen (white arrow), (c) stomach with hemorrhagic spots, (d) large intestine with discoloration of bile and section of small intestine with segmental hemorrhage indicating hemorrhagic enteritis.

Histopathology results revealed splenic lymphoid dysplasia and lymphadenitis, interstitial pneumonia, suppurative nephritis, chronic cystitis, and mild necrotic gastroenteritis. The organs exhibiting lesions consistent with possibly feline parvovirus pathogenesis included the intestine. These lesions manifested as a flattened and thinned epithelium, accompanied by shortened and atrophied villi. This condition led to a loss of osmotic regulation, thereby causing diarrhea frequently accompanied by blood and mucus (Stuetzer & Hartmann 2014; Azizah 2023). The spleen with necrosis and lymphocytosis since virus replication is reported in this organ (Truyen & Parrish 1992; Kim *et al*., 2013). Finally, in kidneys with lesions related to a bacterial septicemic process with displacement of epithelial cells towards the lumen and karyolytic necrosis, the epithelial cells of the renal tubules show karyolysis and pyknosis, the latter coinciding with the pathological results of *P. concolor* (Sim Lam *et al*., 2020).

Various secondary conditions, including hepatomegaly, lymph node atrophy, and splenic congestion, observed in the individual, may arise from factors such as medication ingestion, nutritional deficiencies, immunosuppression, or opportunistic infections (Willard & Twedt 2012). Considering the clinical presentation, differential diagnoses involving pathogens such as Escherichia coli and Rotavirus were considered relevant based on symptomatic and histopathological evidence (Wronski *et al*., 2020, Gabriel *et al*., 2023). Despite the inability to conduct specialized serological tests due to the circumstances of the case, the diagnosis relies on clinical manifestations and histopathological findings.

The lack of comprehensive diagnostics for wildlife animals presents a challenge in providing timely medical assistance (Duarte *et al*., 2009; Ryser-Degiorgis 2013; Bird & Mazet 2018). In wild felids, early detection of rare viruses like FPV is crucial for initiating appropriate clinical interventions and management strategies (Parrish *et al*., 2008; Carreño *et al*., 2021; Hartmann *et al*., 2021). Implementing specialized diagnostic techniques tailored to wildlife species, such as non-invasive sampling methods and rapid field tests, can enhance early detection capabilities (Furtado & Filoni 2008; Ryser-Degiorgis 2013; Candela *et al*., 2019).

The early detection of pathologies is vital to prevent the release of diseased animals into natural habitats. Without proper diagnosis, released animals may serve as vectors for diseases, potentially endangering wildlife populations (Kock *et al*.,2010; Sainsbury & Vaughan-higgins 2012; Carreira *et al*., 2019). Prompt identification of illnesses ensures that only healthy individuals are reintroduced, safeguarding the health and integrity of ecosystems (Dubois *et al*., 2017; Hughes *et al*., 2023). Furthermore, it is imperative to emphasize that those involved in the rehabilitation and reintroduction of wildlife must always verify the health status of animals (Laikre *et al*., 2010; Foley *et al*., 2013; Tuzio 2021). Conducting thorough examinations and providing solid evidence that animals slated for reintroduction are free from such diseases is crucial (Bird *et al*., 2018). This practice not only ensures the welfare of individual animals but also mitigates the risk of introducing pathogens into wild populations, thereby safeguarding ecosystem health and integrity (Sainsbury & Vaughan-higgins 2012; Shivaprakash *et al*., 2021).

The cougar, rescued from a rural area in Colombia, is believed to have contracted the suspected feline parvovirus (FPV) through contact with domestic cats (Kim *et al*., 2013), which serve as the primary transmission vector during captivity. Whether or not the animal would have been reintegrated into its natural habitat, its time spent in Cabildo Verde could have posed health risks to other animals, underscoring the importance for environmental agencies to implement appropriate measures for relocating trafficked and previously

captive wildlife. This case of suspected FPV in the *Puma concolor* highlights the potential role of wild cats as reservoirs or vectors for the transmission of the virus between domestic and wild cat populations (Nájera *et al*., 2021; Tuzio 2021); while Illegal wildlife trade exacerbates this risk by promoting the transport and trade of potentially infected animals across regions (Carreira *et al*.,2019), increasing the likelihood of zoonotic transmission and the emergence of new diseases in wildlife populations (Travis *et al.,* 2011; Shivaprakash *et al*., 2021).

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ETHICAL CONSIDERATIONS

All clinical protocols and the management of the individual *Puma concolor*, which succumbed to suspected Feline Panleukopenia virus, adhered strictly to the guidelines established by the bioethical research committee of Universidad Cooperativa de Colombia, as outlined in agreement No. 02 dated April 28, 2006.

REFERENCES

Azizah A. 2023. Feline Parvovirus: Unveiling Insights Through a Clinical Study and Rapid Detection Via Polymerase Chain Reaction Method in Suspected Cats. The American Journal of Veterinary Sciences and Wildlife Discovery 5(06):05–09.

Barrs VR. 2019. Feline panleukopenia: a re-emergent disease. Veterinary Clinics of North America Small Animal Practice 49(4):651–670. https://doi.org/10.1016/j.cvsm.2019.02.006

Bezerra-Santos MA, Mendoza-Roldan JA, Thompson RA, Dantas-Torres F, Otranto D. 2021. Legal versus illegal wildlife trade: zoonotic disease risks. Trends in Parasitology 37(5):360–361. https://doi.org/10.1016/j.pt.2021.02.003

Bird BH, Mazet JA. 2018. Detection of emerging zoonotic pathogens: an integrated one health approach. Annual Review of Animal Biosciences 6:121–139. https://doi.org/10.1146/annurev-animal-030117-014628

Broad S, Mulliken T, Roe D. 2014. The nature and extent of legal and illegal trade in wildlife. In The trade in wildlife (pp. 25–44). Routledge.

Candela MG, Pardavila X, Ortega N, Lamosa A, Mangas JG, Martínez-Carrasco C. 2019. Canine distemper virus may affect European wild cat populations in Central Spain. Mammalian Biology 97:9–12. https://doi.org/10.1016/j.mambio.2019.04.006

Carreira JCA, Bueno C, da Silva AVM. 2019. Wild mammal translocations: a public health concern. Open Journal of Animal Sciences 10(1): 64–133. https://doi.org/10.4236/ojas.2020.101006

Carreño CH, Navarro CO, Jara MA. 2021. Design of primers in the molecular detection of Feline Panleukopenia Virus. World Journal of Biology Pharmacy and Health Sciences 8(3): 019–029. http://dx.doi.org/10.30574/wjbphs.2021.8.3.0129

Duarte MD, Barros SC, Henriques M, Fernandes TL, Bernardino R, Monteiro M, Fevereiro M. 2009. Fatal infection with feline panleukopenia virus in two captive wild carnivores (*Panthera tigris* and *Panthera leo*). Jornual of Zoo and Wildlife Medicine 40(2):354–359. https://doi.org/10.1638/2008-0015.1

Dubois S, Fenwick N, Ryan EA, Baker L, Baker SE, Beausoleil NJ, Fraser D. 2017. International consensus principles for ethical wildlife control. Conservation Biology 31(4):753–760. https://doi.org/10.1111/cobi.12896

Duffy DC, Capece P. 2012. Biology and impacts of Pacific Island invasive species. The domestic cat (*Felis catus*). Pacific Science 66(2): 173–212. http://dx.doi.org/10.2984/66.2.7

Duffy R, Elliott L, Schaedla WH. 2016. The illegal wildlife trade in global perspective. Handbook of Transnational Environmental Crime 109–128. http://dx.doi.org/10.4337/9781783476237.00015

Fix AS, Riordan DP, Hill HT, Gill MA, Evans MB. 1989. Feline panleukopenia virus and subsequent canine distemper virus infection in two snow leopards (*Panthera uncia*). Journal of Zoo and Wildlife Medicine, 273-281.

Foley JE, Swift P, Fleer KA, Torres S, Girard YA, Johnson CK. 2013. Risk factors for exposure to feline pathogens in California mountain lions (*Puma concolor*). Journal of Wildlife Diseases 49(2):279–293. https://doi.org/10.7589/2012-08-206

Furtado MM, Filoni C. 2008. Diseases and their role for jaguar conservation. Cat News 4: 35–40.

Gabriel ÁM, Pereira WLA, da Silva KSM, Kaiano JHL, Nobre AFS, Mascarenhas JDAP, Linhares AC. 2023. Group A rotavirus gastroenteritis in orphaned *Leopardus tigrinus* and *Leopardus pardalis* (Carnivora: Felidae) in the Eastern Amazon. Revista Pan-Amazônica de Saúde, 14(Único). http://dx.doi.org/10.5123/s2176-6223202301030

Gilbert M, Dvornicky-Raymond Z, Bodgener J. 2023. Disease threats to tigers and their prey. Frontiers in Ecology and Evolution 11:1135935. https://doi.org/10.3389/fevo.2023.1135935

Gonzálvez M, Martínez-Carrasco C, Moleón M. 2021. Understanding potential implications for non-trophic parasite transmission based on vertebrate behavior at mesocarnivore carcass sites. Veterinary Research Communications 45(4): 261–275. https://doi.org/10.1007/s11259-021-09806-2

Hartmann K, Hofmann-Lehmann R, Sykes JE. 2021. Feline leukemia virus infection. In Greene's Infectious Diseases of the Dog and Cat (pp. 382–413). WB Saunders. https://doi.org/10.1016%2FB978-1-4377-0795-3.00022-3

Hinsley A, Willis J, Dent AR, Oyanedel R, Kubo T, Challender DW. 2023. Trading species to extinction: evidence of extinction linked to the wildlife trade. Cambridge Prisms: Extinction, 1, e10. https://doi.org/10.1017/ext.2023.7

Hughes LJ, Morton O, Scheffers BR, Edwards DP. 2023. The ecological drivers and consequences of wildlife trade. Biological Reviews of the Cambridge Philosophical Society 98(3):775–791. https://doi.org/10.1111/brv.12929

Kim SG, Lee KI, Kim HJ, Park HM. 2013. Prevalence of feline panleukopenia virus in stray and household cats in Seoul, Korea. Journal of Veterinary Clinics 30(5): 333–338.

Kock RA, Woodford MH, Rossiter PB. 2010. Disease risks associated with the translocation of wildlife. Rev Sci Tech Off Int Epizoot 29(2): 329–50.

Kolangath SM, Upadhye SV, Dhoot VM, Pawshe MD, Bhadane BK, Gawande AP, Kolangath RM. 2023. Molecular investigation of Feline Panleukopenia in an endangered leopard (*Panthera pardus*) a case report. BMC Veterinary Research, 19(1), 56. https://doi.org/10.1186/s12917-023-03612-5

Kumari R, Deepali B. 2021. Biodiversity Loss: Threats and Conservation Strategies. International Journal of Pharmaceutical Sciences Review and Research 68:242–254. http://dx.doi.org/10.47583/ijpsrr.2021.v68i01.037

Laikre L, Schwartz MK, Waples RS, Ryman N. 2010. Compromising genetic diversity in the wild: unmonitored large-scale release of plants and animals. Trends in Ecology & Evolution, 25(9), 520-529. https://doi.org/10.1016/j.tree.2010.06.013

Nájera F, Grande-Gómez R, Peña J, Vázquez A, Palacios MJ, Rueda C, Jiménez J. 2021. Disease surveillance during the reintroduction of the Iberian Lynx (*Lynx pardinus*) in southwestern Spain. Animals, 11(2), 547. https://doi.org/10.3390/ani11020547

Parrish CR, Holmes EC, Morens DM, Park EC, Burke DS, Calisher CH, Daszak P. 2008. Cross-species virus transmission and the emergence of new epidemic diseases. Microbiology and Molecular Biology Reviews 72(3): 57–470. https://doi.org/10.1128/mmbr.00004-08

Ryser-Degiorgis MP. 2013. Wildlife health investigations: needs, challenges and recommendations BMC Veterinary Research 9:1–17. https://doi.org/10.1186%2F1746-6148-9-223

Rush ER, Dale E, Aguirre AA. 2021. Illegal wildlife trade and emerging infectious diseases: pervasive impacts to species, ecosystems and human health. Animals 11(6):1821. https://doi.org/10.3390/ani11061821

Sainsbury AW, Vaughan-Higgins RJ. 2012. Analyzing disease risks associated with translocations. Conservation Biology 26(3):442–452. https://doi.org/10.1111/j.1523-1739.2012.01839.x

Shivaprakash KN, Sen S, Paul S, Kiesecker JM, Bawa KS. 2021. Mammals, wildlife trade, and the next global pandemic. Current Biology, 31(16): 3671-3677. https://doi.org/10.1016/j.cub.2021.06.006

Sim Lam PPL, Reduan MFH, Jasni S, Shaari R, Shaharulnizim N, Nordin ML, Roslan NS. 2020. Polycystic kidney disease concurrent with feline parvovirus and bacterial infections in domestic shorthair cat: a case report. Comparative Clinical Pathology 29: 1283–1287. https://doi.org/10.1007/s00580-020-03170-4

Stuetzer B, Hartmann K. 2014. Feline parvovirus infection and associated diseases. The Veterinary Journal 201(2):150–155. https://doi.org/10.1016/j.tvjl.2014.05.027

Travis DA, Watson RP, Tauer A. 2011. The spread of pathogens through trade in wildlife. Revue Scientifique et Technique-OIE, 30(1): 219-239.

Truyen U, Parrish CR. 1992. Canine and feline host ranges of canine parvovirus and feline panleukopenia virus: distinct host cell tropisms of each virus in vitro and in vivo. Journal of Virology 66(9): 5399–5408. https://doi.org/10.1128%2Fjvi.66.9.5399-5408.1992

Truyen U, Parrish CR. 2013. Feline panleukopenia virus: Its interesting evolution and current problems in immunoprophylaxis against a serious pathogen. Veterinary Microbiology 165(1–2):29–32. https://doi.org/10.1016/j.vetmic.2013.02.005

Tuzio H. 2021. Feline panleukopenia. Infectious disease management in animal shelters, 337–366. http://dx.doi.org/10.1002/9781119294382.ch15

Van Uhm D. 2016. Illegal wildlife trade to the EU and harms to the world. In Environmental Crime in Transnational Context (pp. 43–66). Routledge. https://doi.org/10.4324/9781315580029

Wasieri J, Schmiedeknecht G, Förster C, König M, Reinacher M. 2009. Parvovirus infection in a Eurasian lynx (*Lynx lynx*) and in a European wildcat (*Felis silvestris silvestris*). Journal of Comparative Pathology 140(2–3):203–207. https://doi.org/10.1016/j.jcpa.2008.11.003

Willard MD, Twedt DC. 2012. Gastrointestinal, pancreatic, and hepatic disorders. Small Animal Clinical Diagnosis by Laboratory Methods. 2012:191–225. https://doi.org/10.1016/B978-1-4377-0657-4.00009-0

Wronski JG, Argenta FF, Raiter J, Ehlers LP, Sala RD, Siqueira FM, Pavarini SP. 2020. Bilateral pyelonephritis due to Escherichia coli infection in a captive jaguar (*Panthera onca*). Pesquisa Veterinária Brasileira, 40, 554-558. https://doi.org/10.1590/1678-5150-PVB-6530

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