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Pallas's cat Status Review & Conservation Strategy

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Cover Photo: Camera trap picture of manul in the Kotbas Hills, Kazakhstan, 20. July 2016 (Photo A. Barashkova, I Smelansky, Sibecocenter)

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Pathogens and parasites as potential threats for the Pallas's cat

Pathogens may be important factors affecting population dynamics of different wild mammalian species (Roelke-Parker et al. 1996, Daniels et al. 1999, Goncharuk et al. 2012, Bevins et al. 2012). There are several examples of different pathogens leading to a decrease in number or even extinction of different populations of mammals in the wild (Roelke-Parker et al. 1996, Meli et al. 2009). These have been epizootics caused by mutated canine distemper virus CDV in the Serengeti in 1994, and feline leukemia virus in Doñana National Park (Spain). Sometimes also very unusual pathogens may result in the death of animals. For example, Eurasian lynxes in a Netherlands zoo succumbed to the Bluetongue virus (Jauniaux et al. 2008), and the lethality of CDV to bears has been previously described (Cottrell et al. 2013). Knowledge of potential threats and risks for animal species, including infectious/invasive pathogens, may has critical value for their conservation.

Very little is known about the natural sources of most infections in wild cats. At the same time, many species or populations of Felidae, including the Pallas's cat, are already seriously threatened by factors such as reduced and fragmented range, habitat destruction and poaching of the predators themselves or their prey. Thus, otherwise minor diseases can potentially be devastating if occurring in feline populations that are already small or in decline. In addition, the Felidae are susceptible to a wide array of highly lethal or debilitating microparasites (Appel 1994), many of which are either native to, or easily transmitted by domestic species (Roelke-Parker et al. 1996). Free-ranging domestic cats and dogs might be regarded as the most likely source of different pathogens for wild cats.

It is very difficult to obtain data on felids, especially small species, and their mortality in the wild when addressing the reasons of their death. Correctly diagnosing causes of mortality is very difficult since the animals need to be studied when they are ill or immediately after death. This is additionally hampered by habitats difficult to access such as the ones of the Pallas's cat. In this case, data obtained from captive individuals becomes very valuable. It is known, that *Toxoplasma gondii* may result in deaths of adult and young Pallas's cats in captivity. Some authors believe that toxoplasmosis prevents the accumulation of a sustainable captive population of this cat. Captive breeding of Pallas's cats has been successful; however, the kittens' survival has been low (40%; Swanson 1999, Kenny et al. 2002) primarily because of susceptibility to *Toxoplasma gondii* (Dubey et al. 1988, Basso et al. 2005). However, some other infectious agents may result in death of Pallas's cats too. Our analysis showed that in the Moscow Zoo, feline panleukopenia virus FPV caused the deaths of Pallas's cats in 43% of the cases (of 37 analysed animals). Among younger animals (up to 6 years of age) this percentage was even higher with 59% (T. S. Demina, pers. comm.). Another 8% of animals died of co-infections (toxoplasmosis and panleukopenia) and 14% of toxoplasmosis. Respiratory infections (rhinotracheitis and calicivirus) caused 5% of deaths of Pallas's cats (Fig. 1). To sum up, infectious pathogens resulted in the death of 76% of captive Pallas's cats, and among animals up to 6 years old this number increased to 96%. Most of these animals were vaccinated against rabies, feline calicivirus, panleukopenia and herpesvirus but based on the results this vaccination was not effective (later the vaccine producer has been changed).

Fig. 1. Rhinotracheitis in captive Pallas's cat in Moscow zoo (Photo T. Demina).

Little is known about the effect of these path-ogens on Pallas's cats in the wild. To date, cases of death of wild Pallas's cats from FPV and undetermined causes have been documented in the wild in Russia (Kirilyuk & Puzanskii 1999). In comparison with captive Pallas's cats, a low prevalence of some pathogens has been found in Mongolian and Daurian wild Pallas's cats (Dubey et al. 1988, Basso et al. 2005, Brown et al. 2005, 2010, Naidenko et al. 2014). Brown et al. (2005) showed that prevalence of antibodies to *T. gondii* was 13% (2/15) in wild cats in Mongolia, but 100% (9/9) in tested cats in captivity. Another potential pathogen in wild Pallas's cats is *Cytauxzoon* documented in Mongolian cats but not in captivity (Ketz-Riley et al. 2003). These studies were conducted in Mongolia where the density of feral domestic cats is extremely low. In Russia, free-ranging domestic cats inhabit the same area as the Pallas's cat. However, little is known about the prevalence of different pathogens in these domestic cats, although they could potentially be an important source for infections in Pallas's cats.

The presence of pathogens in the Pallas's cat populations was studied in the northern range (Daurian reserve, Russia) more thoroughly than at other sites. On the northern edge of the range the seroprevalence to different pathogens was analysed for Pallas's cats (Naidenko et al. 2014), domestic cats (Pavlova et al. 2015) and their potential prey (Pavlova et al. 2016; Table 1). The Pallas's cats (n = 22) were serum positive to 5 of the 15 potential pathogens that were assessed

Table 1. Serum prevalence of Pallas's cats, domestic cats and their potential prey species to different pathogens (Naidenko et al. 2014, Pavlova et al. 2015, 2016).

Pathogen	Test system	Pallas's cat	Domestic cat	Prey species*
Toxoplasma gondii	EIA, Hema, Vector-Best (both Russia)	2/22	9/61	10/273
Feline panleukopenia virus FPV	Dot-test Immunocomb (BioGal, Israel)	0/20	27/60	
Feline herpes virus FHV	Dot-test Immunocomb (BioGal, Israel)	0/20	0/61	
Feline calicivirus FCV	Dot-test Immunocomb (BioGal, Israel)	0/20	37/60	
Canine distemper virus CDV	EIA, Hema (Russia)	0/16		
***Chlamydia* sp.**	EIA, Hema (Russia)	0/16		
Mycoplasma sp.	EIA, Hema (Russia)	2/16		
Feline immunodeficiency virus FIV	Speed-test, BVT (France)	1/19	6/58	
Feline leukemia virus FeLV	Speed-test, BVT (France)	1/21	6/58	
Feline coronavirus FCOV	Dot-test Immunocomb (BioGal, Israel)	0/3		
Influenza A virus	EIA, Narvak (Russia)	2/22	0/60	89/136
Pseudorabies virus	EIA, Narvak (Russia)	0/8		
Candida sp.	EIA, Hema (Russia)	0/14		
***Trichinella* sp.**	EIA, IDVet (France)	0/19	1/61	13/251
Coxiella burnetti	EIA, IDVet (France)	0/19	2/55	0/148
Bluetongue virus	EIA, IDVet (France)			

**the seroprevalence to these pathogens was different for different species. Bold names: pathogens which Pallas's cats were found to be serum positive for, but data is not published yet.*

by kits of Hema and Narvak (both – Moscow, Russia), IDVet and BVT (both France) and Immunocomb (BioGal, Israel; for details see Naidenko et al. 2014, Pavlova et al. 2015, 2016). Later we continued this study, increased sample size to 40 Pallas's cats and tested the serum prevalence to sixteenth pathogen (bluetongue virus). For the first time we found few individuals serum positive for four more pathogens (feline calicivirus, feline coronavirus, *Chlamydia* sp., *Trichinella* sp.). It is very difficult to estimate the negative effect of pathogen exposure on Pallas's cats: some of them usually do not have a lethal effect (for example, *Trichinella*, *Mycoplasma*, *Chlamydia*), but may be dangerous when the immunity is low. Some other pathogens may not be dangerous for Pallas's cats: canine distemper virus is considered to be dangerous only for large and medium-sized cats (Daoust et al. 2009, Seimon et al. 2013, Gilbert et al. 2015, Sulikhan et al. 2018), and mortality caused by feline leukemia virus has so far only been described for *Lynx*, *Puma* and *Felis* genera (Hoover & Mullins 1991, Sleeman et al. 2001, Cunningham et al. 2008). The effect of these three pathogens seems to be the most relevant: *Toxoplasma gondii*, feline panleukopenia virus FPV and feline calicivirus FCV. Nevertheless, the effect of Toxoplasma on Pallas's cats in the wild is unknown. Brown et al. (2005) showed that prevalence of antibodies to *T. gondii* was 13% in wild cats in Mongolia. Seroprevalence of Pallas's cats to *Toxoplasma* in Daurskii reserve was similar (9%; Naidenko et al. 2014), although the number and density of domestic cats (the main vector of *Toxoplasma*) is much higher there than in Mongolia. However, the seroprevalence of domestic cats to *Toxoplasma* in Dauria was comparable to that of Pallas's cats and did not depend on their population density (14.8%; Pavlova et al. 2015). The main prey species of Pallas's cats are also in contact with *Toxoplasma*, although serum prevalence in those species was not high (Pavlova et al. 2016). To sum up, the lower serum prevalence to *Toxoplasma* of domestic cats in Mongolia and Dauria in comparison with the domestic and wild cats in the Russian Far East (near Vladivostok (up to 39%, Naidenko et al. 2019)) probably relates to the climatic conditions: extremely dry climate with extremely low winter and extremely high summer temperatures.

Pallas's cats positive to FPV and FCV have never been detected in the wild (although we found one of forty Pallas's cat serum positive to FCV). However, antibodies to both pathogens were detected in domestic cats in the same area, and the effect of animal density was found to be significant whereas the effect of gender was not (Pavlova et al. 2015). For FCV and FPV: domestic cats in the village were positive for these viruses more frequently (76% and 54%, respectively) than domestic cats at the herdsman stations (44% and 33%, respectively), where the density of the animals was much lower (Pavlova et al. 2015). It is difficult to imagine that Pallas's cats did not have contact with these pathogens when they visit herdsman stations and villages or encounter domestic cats in the steppe. It is more probable (based on captivity data) that these pathogens are lethal to Pallas's cats (in Moscow zoo FPV is the main source of mortality (see above)). Thus, these pathogens are possibly an important threat for Pallas's cats in the wild. Climatic conditions of Dauria create a natural barrier for Toxoplasma dissemination, but for FPV and FCV an increase of domestic cat density enhances threats to Pallas's cats. The vaccination of domestic cats with a polyvalent vaccine against FPV, FCV and feline rhinotracheitis (herpes) virus seems the most reliable way to reduce this threat to wild Pallas's cats. Similarly, vaccination of Pallas's cats in zoos is the most effective means to prevent their infection with these potentially lethal pathogens.

Another aspect is the distribution of helminths in Pallas's cats. The information about them is extremely scarce. We know 9 helminths' species of Pallas's cats (Konyaev et al. 2012, Esaulova et al. 2017) which mostly have the same helminths (7 species) as other cat species in Siberia and the Russian Far East (tiger *Panthera tigris*, leopard *Panthera pardus*, snow leopard *Panthera uncia*). There are flat tapeworms (two species) and roundworms (7 species). One Acanthocephala species was also described as parasite of Pallas's cats (Esaulova et al. 2017). The percentage of Pallas's cats with helminths' eggs in faeces was much lower than in tiger and leopards that was explained by weather conditions in Dauria (Esaulova et al. 2017). Mainly these pathogens may be dangerous for the carriers when the habitats are unfavourable, for example, when prey abundance is low. However, at present we have no efficient way of affecting or controlling the distribution of these pathogens in the wild.

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References

Appel M. J. G., Yates R. A., Foley G. L., Bernstein J. J. et al. 1994. Canine distemper epizootic in lions, tigers, and leopards in North America. Journal of Veterinary Diagnostic Investigation 6, 277–288.

Basso W., Edelhoffer R., Zenker W., Moestl K., Kue Biber-Heiss A. & Prosl H. 2005. Toxoplasmosis in Pallas' cats (*Otocolobus manul*) raised in captivity. Parasitology 130, 293–299.

Bevins S. N., Carver S., Boydston E. E., Lyren L. M. et al. 2012. Three pathogens in sympatric populations of pumas, bobcats, and domestic cats: implications for infectious disease trans-mis-sion. PLoS ONE, 7, 1–10.

Brown M., Lappin M. R., Brown J. L., Munkhtsog B. & Swanson W. 2005. Exploring the ecologic basis for extreme susceptibility of Pallas' cats (*Otocolobus manul*) to fatal toxoplasmosis: comparison of wild and captive populations. Journal of Wildlife Diseases 41, 691–700.

Brown M. A., Munkhtsog B., Troyer J. L., Ross S. et al. 2010. Feline immunodefi-ciency virus (FIV) in wild Pallas' cats. Veterinary Immunology and Immunopathology 134, 90–95.

Cottrell W. O., Keel M. K., Brooks J. W., Mead D. G. & Phillips J. E. 2013. First report of clinical disease associated with canine distemper virus infection in a wild black bear (*Ursus americana*). Journal of Wildlife Diseases 49, 1024–1027.

Cunningham M. W., Brown M. A., Shindle D. B., Terrell S. P. et al. 2008. Epizootiology and management of feline leukemia virus in the Florida puma. Journal of Wildlife Diseases 44, 537–552.

Daniels M. J., Golder M. C., Jarrett O. & MacDonald D. W. 1999. Feline viruses in wildcats from Scotland. Journal of Wildlife Diseases 35, 121–124.

Daoust P.-Y., McBurney S. R., Godson D. L., van de Bildt M. W. G. & Osterhaus A. D. M. E. 2009. Canine distemper virus-asociated encephalitis in free-living lynx (*Lynx canadensis*) and bobcats (*Lynx rufus*). Journal of Wildlife Diseases 45, 611–624.

Dubey J. P., Gendron-Fitzpaztrick A. P., Lenhard A. L. Bowman D. 1988. Fatal toxoplasmosis and enteroepithelial stages of *Toxoplasma gondii* in a Pallas' cat (*Felis manul*). Journal of Protozoology 35, 528–530.

Esaulova N., Naidenko S., Rozhnov V., Vasilevich F. et al. 2017. Helminths of rare feline species (Felidae) in Siberia and Russian Far East. International Journal of Research in Ayurveda Pharmacy 8, 70–74.

Gilbert M., Soutyrina S. V., Seryodkin S. V., Sulikhan N. et al. 2015. Canine distemper virus as a threat to wild tigers in Russia and across their range. Integerative Zoology 10, 329–343.

Goncharuk M., Kerley L., Naidenko S. & Rozhnov V. 2012. Prevalence of seropositivity to pathogens in small carnivores in adjacent areas of Lazovskii Reserve. Biology Bulletin 39, 708–713.

Jauniaux T. P., De Clercq K. E., Cassart D. E., Kennedy S. et al. 2008. Bluetongue in Eurasian Lynx. Emergiing Infectious Diseases 14, 1496–1498.

Hoover E. A., Olsen R. G., Hardy W. D. J., Schaller J. P., Mathes L. E. & Cockerell G. L. 1975. Biologic and immunologic response of cats to experimental infection with feline leukemia virus. Bibliotheca Haematologica 43, 180–183.

Kenny D. E., Lappin M. R., Knightly F., Baier J., Brewer M. & Getzy D. M. 2002. Toxoplasmosis in Pallas' cats (*Otocolobus felis manul*) at the Denver Zoological Gardens. Journal of Zoo and Wildlife Medicine 33, 131–138.

Ketz-Riley C. J., Ritchey J. W., Hoover J. P., Johnson C. M. & Barrie M. T. 2003. Immunodeficiency associated with multiple concurrent infections in captive Pallas' cats (*Otocolobus manul*). Journal of Zoo and Wildlife Medicine 34, 239–245.

Kirilyuk V. E. & Puzansky V. A. 2000. Distribution and number of manul in south-east Transbaikalia. Bulletin of Moscow Society of Naturalists Biological Series 105, 3–9.

Konyaev S. V. 2012. Helminth fauna of feline (Felidae) residing in Siberia and the Far East. *In* Disease and parasites of wild animals of Siberia and the Russian Far East. Novosibirsk. pp. 141–172.

Meli M. L., Cattori V., Martınez F., Lopez G. et al. 2009. Threats to the Iberian lynx (*Lynx pardinus*) by feline pathogens. *In* Iberian lynx ex situ conservation: An interdisciplinary approach, Vargas A. (Ed). Fundacion Biodiversidad, Madrid, Spain. pp. 220–233.

Naidenko S. V., Pavlova E. V. & Kirilyuk V. E. 2014. Detection of seasonal weight loss and a serologic survey of potential pathogens in wild Pallas' cats (*Felis [Otocolobus] manul)* of the Daurian steppe, Russia. Journal of Wildlife Diseases 50, 188–194.

Naidenko S. V., Hernandez-Blanco J. A., Erofeeva M. N., Litvinov M. N., Kotlyar A. K. & Rozhnov V. V. 2019 (accepted). Serum prevalence to non-viral pathogens in wild felids of Southern Primorie, Russia. Nat Cons Res.

Pavlova E. V., Kirilyuk V. E. & Naidenko S. V. 2015. Patterns of seroprevalence of feline viruses among domestic cats (*Felis catus*) and Pallas' cats (*Otocolobus manul*) in Daursky Reserve, Russia. Canadian Journal of Zoology 93, 849–855.

Pavlova E. V., Kirilyuk V. E. & Naidenko S. V. 2016. Occurrence pattern of influenza A virus, *Coxiella burnetii*, *Toxoplasma gondii*, and *Trichinella* sp. in the Pallas cat and domestic cat and their potential prey under arid climate conditions. Arid Ecosystms 6, 277–283.

Roelke-Parker M. E., Munson L., Packer C., Kock R. et al. 1996. A canine distemper virus epidemic in Serengeti lions (*Panthera leo*). Nature 379, 441–445.

Seimon T. A., Miquelle D. G., Chang T. Y., Newton A. L. et al. 2013. Canine Distemper Virus: an Emerging Disease in Wild Endangered Amur Tigers (*Panthera tigris altaica*). mBio4, e00410-13.

Sleeman J. M., Keane J. M., Johnson J. S., Brown R. J. & Woude S. V. 2001. Feline leukemia virus in a captive bobcat. J. Wildl. Dis. 37, 194–200.

Sulikhan N. S., Gilbert M., Blidchenko E. Y., Naidenko S. V. et al. 2018. Canine distemper virus in a wild far eastern leopard. Journal of Wildlife Diseases 54, 170–174.

Swanson W. F. 1999. Toxoplasmosis and neonatal mortality in Pallas' cats: A survey of North American zoological institutions. In Proceedings of the annual meeting of the American Association of Zoo Veterinarians. Columbus, Ohio, 9–14 October. pp. 347–350.

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