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CAT NEWS

# Pallas's cat Status Review & Conservation Strategy

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Original contributions and short notes about wild cats are welcome
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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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# Ex-situ conservation of manul

**Throughout history the primary objective of ex-situ facilities i.e. zoological collections (zoos and aquariums) has evolved, moving away from simple exotic attractions and more toward specialised centres of education, research and conservation. In 1946 the World Association of Zoos and Aquaria WAZA was formed, albeit under its former name the International Union of Directors of Zoological Gardens IUDZG. WAZA has since acted as the "umbrella" organisation for the world zoo and aquarium community and has been instrumental in the global development and contribution of zoos towards conservation. This is highlighted by the WAZA vision "*A world where all zoos and aquariums maximise their conservation impact*" (Barongi et al. 2015). With over 300 WAZA member institutions and 700 million annual visitors it is clear to see the vast reach zoological collections have and the enormous potential for zoological institutions to become conservation leaders. Through a dedicated focus and global collaboration zoos continue to play a vital role in the primary elements of ex-situ conservation, these being; education, research, capacity building, in-situ support and ex-situ population management. This is highlighted by the annual financial contribution of zoos toward conservation of over $350 million.**

## Ex-situ conservation

There is an increasing need to ensure the integration of in-situ and ex-situ conservation planning to ensure that, whenever appropriate, ex-situ conservation is used to support in-situ conservation to the best effect possible (IUCN/SSC 2014). To date, ex-situ management has been used successfully to deliver conservation benefit for a range of threatened species (IUCN/SSC 2014). As the role of conservation management evolves it has been suggested that the boundary between ex-situ and in-situ management is becoming blurred (McGowan et al. 2016). The IUCN recognises the considerable set of resources committed worldwide to ex-situ conservation by the world's zoological and botanical gardens, gene banks, and other ex-situ facilities. The effective utilisation of these resources represents an essential component of conservation strategies at all levels (IUCN 2002). With regards specifically to in-situ population support, be it from reintroductions or reinforcement, there is no doubt that ex-situ management has played a significant role. Well known examples such as the California condor *Gymnogyps californianus*, Arabian oryx *Oryx leucoryx*, whooping crane *Grus americana* and the black footed ferret *Mustela nigripes*, to name a few, highlight this contribution (Maunders & Byers 2005). However, wild populations that may not require immediate conservation action from reinforcement or reintroductions, like the Pallas's cat, can still benefit from targeted ex-situ activities. Actions including species specific research, capacity building, education campaigns, awareness and fundraising are all available from ex-situ facilities. It is important however that additional activities undertaken in the ex-situ environment are transformed into tangible contributions to species conservation and where possible target their support toward range countries.

Ex-situ contribution to Pallas's cat conservation and research has been active for some time with individual zoological collections such as Cincinnati Zoo, Denver Zoo, Moscow Zoo and the Royal Zoological Society of Scotland RZSS having, historically, supported several projects. Although some of this support work continues, for example Moscow zoo still contribute to the Pallas's cat Study and Conservation Program led by the Siberian Environmental Centre, few were conducted with a long term or large-scale vision. In 2016 a tripartite partnership between RZSS, Nordens Ark and the Snow Leopard Trust gave rise to the Pallas's cat International Conservation Alliance PICA. PICA has since established a collective approach from zoological collections toward in-situ conservation support with 14 global zoological collections, representing all zoological regions holding the species, providing financial support. This funding along with core project funding from Fondation Segre and support from the Pallas's Cat Working Group PCWG allows PICA to develop range country education, conservation capacity building, support to in-situ field projects, research and long-term conservation planning. Zoos are also increasingly adopting an approach to species conservation, called the One Plan Approach. The One Plan Approach is a conservation planning framework that integrates all populations of a species, both in-situ and ex-situ, under all conditions of management, bringing together all responsible stakeholders and all available resources. The development of one integrated plan creates a greater collaboration between zoological facilities and other conservation organisations and is the most effective use of all populations and all existing expertise to promote the conservation of a species (Byers et al. 2013). PICA applies the One Plan Approach philosophy ensuring that there is a tangible connection between ex-situ and in-situ conservation efforts. PICA's key objectives focus on in-situ support, capacity building, education and research (PICA report). Since 2016 PICA has made great efforts to widen the Pallas's cat network by forming new connections between conservationists, researchers and specialists in ex-situ population management. This work supports the existing Pallas's cat community which has, in large, been driven by the PCWG, formed by experienced species-specific field researchers and conservationists. Through this community PICA has been able to connect directly with researchers working across Pallas's cat range countries and support their work financially or through the provision of field equipment. This would not have been possible without the direct support from ex-situ zoological institu-

**Fig. 1.** Pallas's cat on display at Nordens Ark Zoo, Sweden (Nordens Ark 2016).

**Fig. 2.** Pallas's cat kittens born at Chemnitz Zoo, Germany 2018 (Photo Chemnitz Zoo).

tions. To date PICA has supported six field projects/researchers working across Nepal, Russia, Kazakhstan, Mongolia, Bhutan, Uzbekistan and Kyrgyzstan. This work continues to bolster the existing efforts from individual zoological collections and the working group in support of Pallas's cat conservation and research.



Regardless of origin (ex-situ or in-situ) conservation action should always have a primary focus toward range country populations, threat mitigation and habitat protection whilst establishing a strong connection with local communities and authorities. With a collaborative approach through global partnerships and targeted pro-active support it is clear that ex-situ institutions can continue to play an important role in the long-term conservation of Pallas's cat.

**Population management**

According to the Zoological Information Management System ZIMS Pallas's cats were first recorded in zoological collections in the late 1950's (Barclay 2018a), however written records from Moscow zoo indicate specimens were held as early as 1949 (I. Alekseicheva, pers. comm.). Like many small cat species during this time exact knowledge on their biology, physiology, veterinary care and reproduction was scarce and as a result the population proved challenging to manage. Although challenges still exist with captive management of the species there are currently four managed populations in the European, Russian, North American and Japanese Zoological associations. As of August 2018, there were 177 Pallas's cats held across 60 global zoological collections coordinated jointly by regional breeding programmes in Europe, North America and Japan all of which are included in the Pallas's cat International studbook ISB managed by WAZA (Barclay 2018a). Since the 1950s 136 individual collections have managed a historical global population of 1,526 specimens (Barclay 2018a; Fig. 1, 2). Europe (including Russia) has consistently managed the largest population followed by North America and Japan.

Pallas's cats have also had a long history with several range country (Russian) zoological collections including Moscow zoo, Novosibirsk zoo, Leningrad zoo, and Chita zoos, as well as at the zoos of Rostov-on-Don, Seversk, Izhevsk, and Perm. This close connection to range country zoos has been an important tool in ex-situ population management as it offers a route for wild caught animals to enter zoos should this ever be necessary.

Within zoos captive populations are predominantly managed as breeding programmes, which include studbooks, the population management database for the species. Regional zoological associations often offer a range of management levels (high level to low level) to breeding programmes dependent on varying factors such as conservation status, population size, management challenges or education needs. Breeding programmes aim at conserving healthy populations of animals in captivity. The populations should be demographically robust, the animals behaviourally competent and genetically representative of wild counterparts, and the breeding programme should be able to sustain these characteristics for the future. In Europe the first studbook for Pallas's cat was developed by Moscow zoo in 1997 and managed until 2004. Since this time the studbook and breeding programme have been managed at the highest level as a European Endangered Species Programme EEP by the RZSS.

In addition to the European EEP the American Association of Zoos and Aquaria AZA manage a Pallas's cat Species Survival Plan SSP, the Eurasian Regional Association of Zoos and Aquariums EARAZA manage a Pallas's cat Research, Conservation and Breeding Programme and the Japanese Association of Zoos and Aquaria JAZA manage a Pallas's cat breeding programme. Animals from all these individual programmes are included in the wider WAZA Pallas's cat International Studbook, also managed by RZSS.

The first captive breeding event for Pallas's cat was documented in the International studbook in 1960 at the National Zoological Park, Washington (USA) although the offspring did not survive more than three days. The first surviving birth was recorded at Augsburg zoo (Germany) in 1971. This individual lived until it was three years old before it died whilst at Hannover zoo (Germany) in 1974 (Barclay 2018a). Range country zoos have also successfully bred the species with the first being Moscow zoo (1979) followed by Novosibirsk (1995). Subsequent births took place in Leningrad zoo, Seversk zoo and Perm Zoo (Barclay 2018a). By 2018, a total of 294 kittens were born at Russian zoos, with over 76% born between Moscow zoo (149) and Novosibirsk zoo (76). Since the 1960's there have been over 1,300 captive births recorded in the International studbook ISB.

Although data from captive management programmes of Pallas's cats may be considered somewhat biased given that populations are actively managed they still provide opportunities to improve our understanding of the species biology. From historical data we can accurately assess, at least for captive populations, a range of biological factors such as; seasonality, litter size, generation length, life expectancy, causes of death, sexual maturity, activity patterns and specific behaviours. Such data can in turn be used to assist field research projects.

In captivity the main breeding season runs from January to May. January, February and March are the key months for mating with March, April and May the key months for parturition. The highest percentage of births occur in April (43%), followed by May (26%)

and March (18%). The mean litter size is 3.9 however litter sizes of 9 have been recorded (Barclay 2018b). One of the largest litters (6) where all offspring survived was recorded by RZSS Highland Wildlife Park in 2014 (Barclay 2018a). Pallas's cats can be sexually active in their first year with the youngest female to have bred being eleven months and eight days with the youngest male to have sired offspring being eight months and twenty-nine days. The average age for females at first birth is two years eleven months and five days, whereas the average age for males to sire their first litter is three years four months and ten days. The longest living male specimen, with known birthdate, was fifteen years and eleven months at death with the longest living female was sixteen years at death (Barclay 2018b). The current global population has a gene diversity of 95.4% and derives from 36 "founders" i.e. individuals that are related only to their direct descendants in the living population and assumed to be completely heterogenous (Barclay 2018c). Most of the founders arrived at Russian and former USSR zoos from the Trans-Baikal region, particularly from the Tyva Autonomous Republic, except for a small number of cats that came from Mongolia between 1985 and 1989 (I. Alekseicheva, pers. comm.). Most of the wild caught animals arrived in Russian zoos in the period from 1990 through 1999. From 1999 onwards, the transfer of wild animals into zoos reduced dramatically with only two separate transfers into regional (Russian) zoos: 7 animals were obtained by the Moscow Zoo and 4 by Novosibirsk Zoo (Barclay 2018a). With established populations across four zoological regions the objective for the global captive population is to develop and maintain a self-sustaining pop-ulation whilst retaining a high genetic diversity and low level of mean kinship.

**Ex-situ research**

Captive management and research provides zoos with a unique opportunity to increase the understanding of species and their behaviour. This can be particularly beneficial to species that are notoriously challenging to study in-situ. Cryptic behaviour, high altitude range, remote and hostile habitats and predominantly nocturnal or crepuscular daily activity patterns places the Pallas's cat firmly within this category. In addition to data extracted from captive breeding programmes i.e. birth seasonality, litter size, sexual maturity etc. zoos can, and have, undertaken various research projects that has helped shed new light on both animal behaviour and other species-specific issues.

A study in Moscow Zoo between 2006–2007 examined the activity budgets of Pallas's cats in relation to season, time of day and animal physiological status. Until this study very little quantifiable data relating to activity budgets from wild living animals had been collected with most information comprising of anecdotal evidence. Apart from activity budgets no data on seasonable behaviour in the species was found in any published materials (Alekseicheva 2009). It has however been suggested that wild living Pallas's cats move over greater distances during winter months to find better feeding territories (Kirilyyuk 1999). The study in Moscow zoo collected data from six individuals (three male and three females) four of which were proven breeders and two having mated but producing no offspring. Evidence from this study showed that, in captivity, Pallas's cat activity decreases in late winter and early spring and then increases in April and May. The study also showed a slight increase in activity from all but one animal during October to November. It was suggested that this change could be caused by an "inherited tendency" to increase body mass prior to the breeding season (Alekseicheva 2009). Other studies at Moscow Zoo's Breeding Station indicated that an increase in daily food consumption occurs as early as June (Demina 2006) but that it is in October when the behaviour of "food craving" begins (Alekseicheva 2009). All animals produced a pronounced peak of activity in February which was believed to be directly related to the breeding season. The highest activity was recorded in males that demonstrated sexual behaviour (Alekseicheva 2009).

In the wild Pallas's cats are considered to be predominantly crepuscular with most encounters occurring in early morning or after sunset (Alek 2000). Research from wild studies also found animals would start hunting one or two hours before sunset (Bannikov 1954). Evidence from the Moscow zoo study found that most daily activity for the males and females would peak at three separate periods throughout the day. The first activity peak occurred between 01:00 h and 08:00 h, the second between 10:00 h and 16:00 h with the final peak between 16:00 h and 23:00 h (Alekseicheva 2009). This evidence suggests that captive Pallas's cat exhibit both crepuscular and diurnal activity patterns.

A study at RZSS Highland Wildlife Park set out to record and analyse vocalisations from Pallas's cat as a means of monitoring and managing behaviour during the breeding season. This study used an automatic recording device to non-invasively collect vocalisations (above minus 16 decibels) from the breeding pair between December 2013 and February 2014. Recordings were collected and stored systematically each day with vocalisations separated into six categories; "base call", "hissing", "growling", "yowling", "fighting" and "mating". During a two-month period over 1,500 individual vocalisations were recorded. The "base call", which was considered the main mating call, was the most prominent call recorded during the study period. The peak vocal activity was noted as being most intensive between the hours of 02:00 h and 09:00 h. During a four-day period in mid-January 2014 the frequency of call "type" changed significantly from predominantly base calls, hissing and growling to mating and growling. This four-day period also correlated with a reduction in appetite from both cats.

**Fig. 3.** Pallas's cat featured alongside snow leopard during a Chinese giant lantern festival, RZSS Edinburgh zoo, Scotland (Photo RZSS, 2017)

Over the four-day period the results indicated this was the most intensive period of mating calls and as a result the male was removed from the female in preparation of an assumed pregnancy and birth. These results allowed for the animal management plan to be refined to limit any unnecessary disturbance around the enclosure. This data also allowed for the administering of oral medication (Clindamycin) to the female prior to birth to reduce the risk of parasitic infection from *Toxoplasma gondii*. Following a gestation period of 68–72 days the female produced a surviving litter of six kittens. Toxoplasmosis is a common cause of neonatal mortality within the captive population. Evidence suggests that Pallas's cats are rarely exposed to Toxoplasma in the wild and may be highly susceptible to this parasite from an evolutionary basis (Brown et al. 2005, Swanson et al. 2010).

This work has not only shed new light on species specific behaviours during the breeding season but also on the range and frequency of vocalisations. Since this study specific vocalisations have been made available to field researchers for use in field monitoring surveys. In 2018 a camera trapping study was undertaken in the Tian-Shan mountains of Kyrgyzstan using these vocalisations in conjunction with camera trapping surveys. Camera traps were setup up in Pallas's cat habitats where presence was already confirmed to test the effectiveness of vocal lures against that of olfactory lures. The study is due for completion in December 2018.

Ex-situ research that has involved the transfer of samples from the wild to captivity with the long term aim of artificial propagation in support of captive population sustainability has also been undertaken. Semen samples were collected from wild living Pallas's cats in the early 1990's by staff at Cincinnati Zoo's Centre for Conservation and Research of Endangered Wildlife CREW, working in collaboration with the Mongolian Academy of Sciences, Bristol University and the Wildlife Conservation Society (Oyuntuya et al. 2012). These samples, which have been cryogenically preserved since, have made it feasible for artificial insemination A. I. procedures to take place in the zoological facilities. In partnership with the North American SSP breeding programme CREW have been able to trial insemination procedures with captive born females using these samples with the objective of adding new (wild) founder genes to the captive population. Initial studies showed that frozen sperm from wild males had excellent motility post-thaw and could readily fertilize both Pallas's cat and domestic cat oocytes in vitro to produce developing embryos. Although A. I. with these frozen wild samples failed to result in any pregnancies, several full-term pregnancies have been produced by A. I. in U.S. zoos using both freshly-collected semen and frozen semen stored for 23 years before use (Swanson, in press). Further refinement of these semen freezing and A. I. procedures should allow viable offspring to be produced from wild specimens and facilitate increased collaboration with field teams to improve captive sustainability.

**Education to conservation support**

Zoos provides a unique experience for people as they see, hear and smell wild animals from their local environment and from all over the world. These experiences can often be the first point of contact between zoo visitors and the animals themselves making it a significant bridging moment in terms of zoo education. For small, unique and elusive species like the Pallas's cat that have, historically, been given a low level of media exposure (certainly when compared to the larger more iconic species) it can at times create challenges for people out-with range countries to establish a strong connection or understanding with the species. Even within range countries basic knowledge of the species can be somewhat lacking. Zoo education programmes can however help fill this gap by taking advantage of the daily encounters with zoo visitors and by supporting education campaigns across range countries. Developing these connections between people and animals helps to encourage empathy with the natural world and a sense of responsibility and stewardship, all of which can lead to more active support of conservation projects. Zoo education programmes offer a wide range of opportunities for visitor engagement and, dependant on certain factors e.g. connection to specific conservation projects, can be adapted accordingly to target individual species. With regards to Pallas's cats there are several activities undertaken by global zoological collections that not only aim to improve the visitor's knowledge of the species but aim to turn the experiences and connections into conservation support. These activities include daily zoo keeper talks, animal enrichment displays, public presentations, children's art competitions, media exposure, distribution of educational materials and fundraising events (Fig. 3, 4). Some collections, like that of Moscow zoo (who had the Pallas's cat as their zoo emblem) and Novosibirsk Zoo have taken Pallas's cat awareness one step further by establishing an annual zoo event "Day of the Pallas's cat". This event has the added ability of combining the positive role of ex-situ education with the education of zoo visitors from a range country.

It is important however that whilst zoos deliver a diverse range of education-based activities that they also try to evaluate the impact of these activities with regards to zoo visitor perceptions toward the natural world, species and conservation.

A study conducted across several North American zoological collections (members of AZA) helped to shed light on the impact of targeted education programmes within the zoo environ-

**Fig. 4.** Pallas's cat public enrichment display, Parken Zoo, Sweden, 2010 (Photo Parken Zoo).

ment. Over three-year period more than 5,500 zoo visitors were surveyed across twelve AZA accredited institutions with the aim of identifying the changes in visitors thinking towards awareness and understanding of zoos and the role they play in conservation. Results showed that 61% of visitors found that their experience supported or reinforced their values and attitudes towards conservation (Falk et al. 2007). Zoo visits also prompted 54% to reconsider their role in environment problems and conservation action, and to see themselves as part of the solution (Falk et al. 2007). Most visitors (54%) also said that their visit experience strengthened their connection to nature (Falk et al. 2007). This study highlights the positive impact zoos education programmes can have in not only changing the mind-set of zoo visitors but in translating this into greater support toward conservation projects.

Zoo education programmes are not always restricted to the ex-situ environment and at times can also offer additional skills and expertise in support of in-situ action. A recent project from PICA utilised existing ex-situ skills, focused on educational design, to develop Pallas's cat specific posters, leaflets and pockets guides to be used across range countries. These materials were translated into multiple range country languages and have since been made available, with additional financial support, to field researchers and distributed across range countries including Mongolia, Nepal and Kyrgyzstan (Fig. 5). This work highlights the positive connection that can be made between ex-situ and in-situ education programmes and how this can directly support the efforts across range countries. For most zoo visitors that will never have the privilege of visiting Pallas's cat range countries zoo-based education programmes play an important role in not only increasing the awareness of a species but also by inspiring and developing some of the next generation conservationists. With greater interest and support towards Pallas's cat's conservation, research and education it is clear to see that ex-situ facilities fulfil a valuable role in global conservation efforts.


**Fig. 5.** Children receiving PICA educational posters, Kyrgyzstan 2018 (Photo PICA).

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