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Updates on the Monkey Contraceptive/Sterilisation Programme: Findings from the Population Viability Analysis

PURPOSE

This paper briefs Members on the latest progress of the monkey contraceptive/sterilisation programme conducted by the Agriculture, Fisheries and Conservation Department (AFCD) since 1999, and the latest findings arising from the Population Viability Analysis (PVA) commenced in 2022.

BACKGROUND

2. The Rhesus Macaque (*Macaca mulatta*) is native to Hong Kong. However, it is believed that the indigenous populations have been extirpated due to urban development. The current wild monkey populations in the territory are descendants of Rhesus Macaques and Long-tailed Macaques (*M. fascicularis*) which were intentionally released in the Kowloon Hills area during the 1910s and 1950s respectively. As a result, hybridisation arising from these two species has occurred.

3. In the early 1990, local studies estimated that the monkey population in the Kowloon Hills area consisted of about 600 to 700 individuals while the annual population growth ranged from 6.8% to 13%, indicating that the population would double every 7 to 12 years. The primary cause of the significant population surge was largely intentional feeding by humans. Consequently, monkeys lost their natural fear of humans due to human feeding, and became habituated to venturing into residential and urban areas in search of human food. Some of these monkeys showed aggressive behaviours, causing nuisance to the public.

4. Currently, monkeys have a fairly restricted distribution in Hong Kong. About 90% of them are found in Kam Shan, Lion Rock, and Shing Mun Country Parks. Peripheral populations have also been found in other areas like Tai Po Kau Nature Reserve, Sai Kung, as well as Tai Mo Shan and Tai Lam Country Parks. The latest monkey population in Hong Kong is estimated at about 2,000 individuals, belonging to 31 identified troops¹.

MONITORING AND MEASURES TO ADDRESS GROWTH OF MONKEY POPULATIONS

5. Since 1999, the AFCD had been conducting trials of contraceptive/sterilisation treatments on monkeys in captivity and in country parks². In 2007, the AFCD conducted a large-scale monkey contraceptive/sterilisation programme in country parks. During each operation, approximately 20-130 monkeys were captured using large trapping cages, which were then sedated, with suitable individuals treated with contraceptive/sterilisation treatments.

6. In 2009, the AFCD commissioned the Ocean Park Conservation Foundation, Hong Kong (OPCFHK) to undertake the monkey contraceptive/sterilisation programme by commencing comprehensive monkey population surveys³, and adopting a two-step endoscopic surgical treatments for the permanent sterilisation of female monkeys. The permanent sterilisation operations were further extended to male monkeys in 2014⁴. To intensify the efforts, the OPCFHK further extended the permanent sterilisation operations to monkeys found in urban fringe areas next to the districts with more monkey nuisance cases, such as Shatin, Tai Po, Wong Tai Sin and Sham Shui Po. As at end-2022, an accumulative total of 1,560 females and 377 males had been sterilised in Hong Kong.

¹ Monkeys form troops of varying sizes dominated by an alpha male.

² Initially, females were injected with an immuno-contraceptive vaccine, while males underwent chemical vasectomy.

³ The population surveys are carried out by direct counting or census walks along the roads and trails of all known monkey sites throughout the year. Direct head count is used to estimate the population sizes of all troops encountered. Troops are identified based on their alpha males or any recognisable individuals. During the surveys, monkeys are counted and categorized into four age groups – adults (males & females), sub-adults (males & females), juveniles (unisex) and infants (unisex).

⁴ These procedures involve using a pediatric endoscopic instrument with a diameter of 3 mm to cauterise, cut, and ligate the middle part of the oviducts or vas deferens of monkeys.

THE PVA STUDY

7. As non-human primates, including Rhesus Macaque and its hybrid with Long-tailed Macaque which are monkey species found in Hong Kong, are protected wild animals under the Wild Animals Protection Ordinance (Cap. 170)⁵, the AFCD's policy is always a balance between controlling population of monkeys thereby containing its nuisance caused to the public, while conserving the species without leading to its extirpation.

8. In light of the decade-long operation of the contraceptive/sterilisation programme implemented since 2007, the AFCD commissioned the PVA study in 2022 with the OPCFHK and Lingnan University, with a view to evaluating the effectiveness of the programme, determining the annual target number of monkey for sterilisation, and establishing suitable indicators for the contraceptive/sterilisation programme. The methodology of the PVA study is set out at Annex.

MAJOR FINDINGS OF THE PVA STUDY

9. The results of the PVA study completed in June 2023 indicated that the monkey population in Hong Kong **would increase** if 20, 40, 60, and 80 individuals were sterilised annually, whereas the population **would decline** if 100, 120 and 140 individuals were sterilised annually (see Figure 1 at the end of this paper).

10. The study also reveals that monitoring the population size and the birth rate is crucial for assessing monkey population trends in Hong Kong⁶. It showed that the birth rate of monkeys **at or below 35%** would **maintain the sustainability** of the monkey population, while **birth rate at 21.4% or below** in 2028 would **affect the sustainability**.

11. According to population surveys, the monkey population in Hong Kong has experienced a decline in both birth rate and overall population size. The birth rate over the past five years has been consistently reduced to about 32%. Meanwhile, the number of monkey nuisance cases received by the AFCD has

⁵ All non-human primates including Rhesus Macaque and its hybrid with Long-tailed Macaque are scheduled as protected wild animals under the Wild Animals Protection Ordinance (Cap. 170), meaning that it is an offence to hunt, wilfully disturb, possess or control, buy, sell, export or offer for sale or export them without special permit.

⁶ The PVA emphasises the importance of regularly evaluating the birth rate using population data to ensure a sustainable population.

significantly decreased from the range of about 800 to 1,400 cases in the 2000s, to about 200 cases in recent years (see **Figure 2** at the end of this paper). These findings indicate that the monkey contraceptive/sterilisation programme implemented by the AFCD so far has proven generally effective, while preserving sustainability of the monkey population.

RECOMMENDATIONS

12. To further restrain the monkey population growth in the wild, it is recommended to implement the contraceptive/sterilisation programme, with a target of **100 to 120 monkeys being sterilised between 2024 and 2028 every year**, and the projected monkey population expected to decrease to about 1,600 to 1,700 individuals by 2028. This range aims to achieve **a controlled and gradual decline in the monkey population**, thereby curbing any further increase in the long run. As regards the birth rate, it is recommended to adopt the target **birth rate at or below 35%, but not below 21.4% in 2028**. If the birth rate reaches 35% above or drops below 21.4% in 2028, the AFCD should adjust the sterilisation efforts accordingly to avoid overpopulation and catastrophic drop of the population. Regular conduct of monkey population surveys is essential to promptly detect any changes in the monkey populations, and provide valuable information for adjusting the sterilisation efforts accordingly, bearing any unforeseen factors such as disease outbreak or discovery of previously undetected populations and ensuring sterilisation target not to extirpate the monkey population. AFCD will continue to conduct regular monkey population survey in 2023 onwards following similar survey effort as in 2022⁷ to ensure consistent data collection.

13. Meanwhile, to further curb illegal feeding of monkeys leading to its overpopulation and aggressive behaviour towards the public, the AFCD will explore the feasibility of installing CCTV cameras at blackspots of illegal feeding activities. Furthermore, the Government will introduce a bill to the Legislative Council later this year to amend the Wild Animals Protection Ordinance (Cap. 170) to increase the penalty on illegal feeding of wild animals and introduce a fixed penalty system to enhance deterrent effect. Based on regular patrol and complaints received, the AFCD will also step up efforts in capturing monkeys causing nuisance to the public for sterilisation treatments or other appropriate measures.

⁷ In 2022, AFCD's contractor (OPCFHK) conducted about 200 survey days under the monkey sterilisation programme in the monkey living areas. Such survey effort is required to ensure the accuracy and to monitor the change of monkey population since monkey groups may not be encountered during every survey.

ADVICE SOUGHT

14. Members are invited to take note of the updates of the monkey contraceptive/sterilisation programme and provide comments.

Agriculture, Fisheries and Conservation Department
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Applied Methodology of the PVA Study Commenced in 2022

The study applied methodology (i.e. age-structured based matrix demographic model⁸ was constructed using the popbio⁹ package in R software) commonly used in studying population variability, which offers flexibility in modelling procedures, allowing for the incorporation of the number of contraceptive treatments to be performed annually. In the matrix population model, female monkeys instead of males were considered because of their promiscuous nature which was the key factor of reproductive success. Though demographic data from the comprehensive population surveys were utilised, certain parameters (e.g. survival rates) unavailable in Hong Kong were obtained through literature review.

2. Population analyses were carried out to assess the population trajectories¹⁰ of monkeys in Hong Kong by using the demographic data obtained from 2010 to 2021, in addition to various survival rates obtained from the literature review. Based on the observed trajectory, the survival rates of two literatures^{11,12} which closely matched the observed trajectory of monkey populations in Hong Kong were selected for the PVA. The survival rates adopted in the PVA were modified according to the literatures to align with the observed trend in Hong Kong.

3. The PVA aimed to utilise the age-structured matrix model constructed to forecast the monkey population trajectory under different number of sterilisation treatments performed annually (i.e. 20, 40, 60, 80, 100, 120 and 140 individuals sterilised every year), ultimately providing recommendations on whether to increase, maintain, or decrease the intensity of the sterilisation treatments.

⁸ Anderson, C. J., M. Van De Kerk, W. E. Pine, M. E. Hostetler, D. J. Heard, and S. A. Johnson. 2018. Population estimate and management options for introduced rhesus macaques. *The Journal of Wildlife Management* 83:295-303.

⁹ Stubben, C., and B. Milligan. 2007. Estimating and analyzing demographic models using the popbio package in R. *Journal of Statistical Software* 22:1–23.

¹⁰ Population trajectory describes the course of population trend over time.

¹¹ Hernandez-Pacheco, R., R.G. Rawlins, M.J. Kessler, L.E. Williams, T.M. Ruiz-Maldonado, J. Gonzalez-Martinez, A. V. Ruiz-Lambides, and A.M. Sabat. 2013. Demographic variability and density-dependent dynamics of a free-ranging rhesus macaque population. *American Journal of Primatology* 75: 1152-1164.

¹² Jiang, H., J. Lian, Feng, M., J. Wang, and Y. Li. 1998. Studies on population growth of *Macaca mulatta* at Nanwan, Hainan. *Arcta Theriologica Sinica* 18(2):100-106.

Figure 1: Forecasting monkey population trajectory using an age-structured matrix model with 20 to 140 number of monkeys sterilised per year.

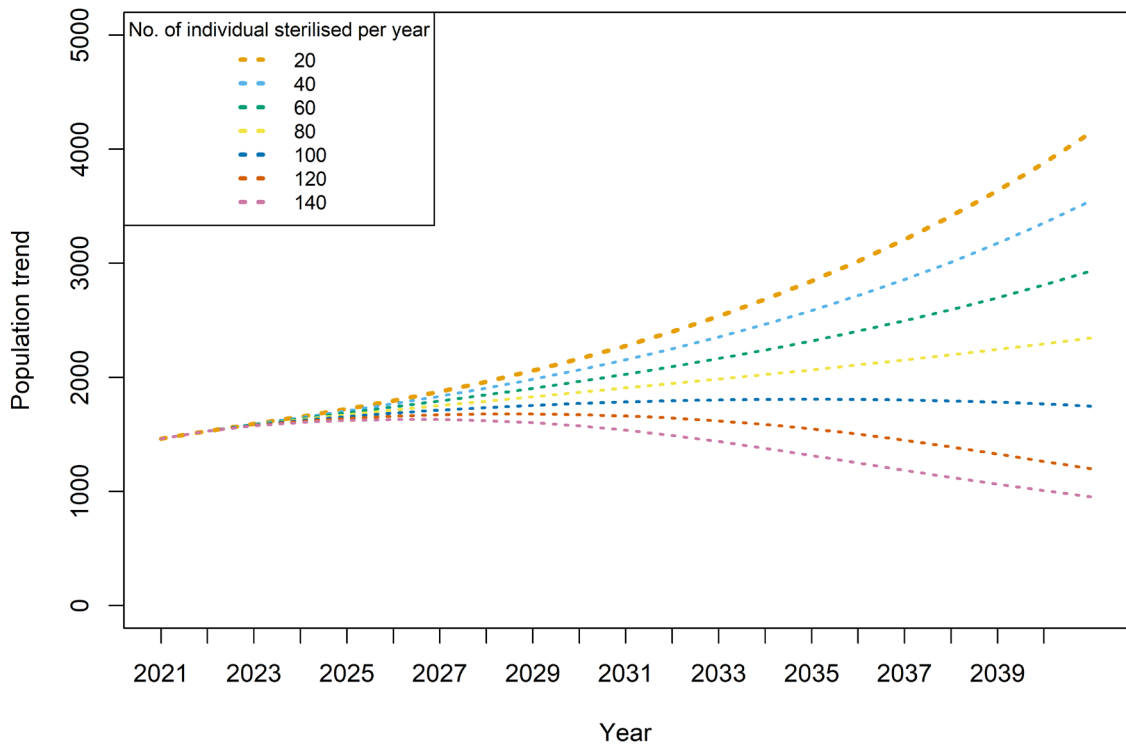


Figure 2: Number of monkey nuisance cases received by AFCD from 2001 to 2022.

