

COMMUNITY CASE STUDY

Successful Control of Feral Cat Populations Through Trap-Neuterreturn and Long-term Monitoring on a Remote Island in Hong Kong: A Community Case Study

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Abstract

Cat colonies are common in SE Asia and are a result of irresponsible pet ownership, high abandonment rates, and a lack of legislation limiting pet shop breeding. The Society for the Prevention of Cruelty to Animals (SPCA) in Hong Kong Special Administrative Region controls feral cat populations by providing trap-neuter-return (TNR) services, under the Cat Colony Care Program (CCCP). During CCCP programs cats are caught, assessed on behavioural/health grounds, and (1) neutered and returned to the colony location, (2) placed in rehoming programs for public adoption, or (3) euthanized. In this longitudinal study we present representative desexing and observational survey results for a feral cat population on a remote island in Hong Kong Special Administrative Region that was subject to action under the CCCP. Results from desexing data and surveys show initial high cat numbers, close to public restaurants and walkways ($n > 100$). However, as the program progresses, a decrease in cat abundance is documented until only a single individual was sighted between 2019 and 2023. This case study is an example of a successful population control program for island cats in Asia, and highlights the fact that TNR programs coupled with consistent, long-term monitoring, public awareness programs, and cat removal for re-homing can reduce feral animal numbers.

Keywords: *colony cats; Asia; trap-neuter-return; Colony Care Program; population control; rehoming*

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Feral free-roaming cats (FFCs) arise from reproduction in existing feral populations, pet abandonment, or from owned cats that are permitted to roam freely. This creates issues for cat welfare, humans, and wildlife. With high fecundity rates, populations of unneutered FFCs are sustained or can drastically increase. The cats themselves may suffer poor welfare, as they are prone to disease and injury, may spread zoonotic disease,^{1–4} and can cause human disturbance in urban areas.^{5–8}

FFCs are abundant and widespread throughout China⁹ with high densities in certain cities.^{10,11} FFCs can contract and spread rabies¹² and cause damage to native animal populations through competition and predation.^{9,13} Due to the high biodiversity of China^{14,15} and the estimated effects of cats on fauna globally, regional programs controlling feral cat populations are vital for both cat welfare and for the survival of native species.

Here we report annual survey results of cat sightings during a cat colony care program on an island in Hong Kong Special Administrative Region (SAR) over a >20-year period. We also include desexing data from a trap-neuter-return (TNR) initiative. The objective of this study was to monitor the trend in cat sightings as a metric to assess population size and program effectiveness. We discuss the program's suitability and provide further directions on welfare to inform similar cat population management programs.

Background

Lamma Island (22.2000° N, 114.1350° E) is the third largest island located in the southwestern part of Hong Kong with an area of 13.55 km² (5.23 sq mi).¹⁶ Most of the island is uninhabited and forested, with strict laws prohibiting the building of houses over three stories. The largest and most accessible village (by ferry from Hong Kong Island)

is Yung Shue Wan where the majority of the islands' 5,900 individuals reside.¹⁷ Community complaints showed that this area and the surrounding villages was the location of a large feral cat population comprising approximately 600 individuals.¹⁸ Reports described uncontrolled breeding and cats with poor welfare (e.g. injuries and matted fur).

In Mainland China, no license is required to breed or keep cats. Licenses are also not required to keep cats in Hong Kong SAR; however, since April 2024, cats bred and offered for sale through pet shops (but not through private sales) must be microchipped for identification.¹⁹ There is no law in Hong Kong or China requiring owned cats to be neutered and, unlike owned dogs in Hong Kong, owned cats have not been targeted for microchipping as evidence of rabies vaccination. However, the Society for the Prevention of Cruelty to Animals (SPCA) and some other re-homing organizations microchip the cats they re-home and the SPCA microchips and vaccinates the feral cats it returns against rabies.

In 2000 the SPCA introduced trap -neuter-return (TNR) programs for dogs to Hong Kong.²⁰ The Cat Colony Care Program (CCCP) was established for feral and abandoned cats (including stray cats) at the same time to improve cat welfare, employ better population management, and as an alternative to culling as was governmental procedure previously, with 40,000 cats euthanized in the early 1960s and 6,000 in the mid-1990s.²¹ At its conception, the objectives of this program were to improve the overall welfare of FFCs by: (1) catching and desexing FFCs – returning cats to their original capture locations through a TNR initiative, (2) removing and rehoming any abandoned, socialized cats, and (3) registering local 'cat carers' to monitor returned FFCs, which are then referred to as 'colony cats'.²¹ Furthermore, (4) cats suffering from incurable disease or illness would be euthanized. Colony cats have an ear tipped to enable their identification by the animal carers and SPCA staff (to prevent unintended recapture). Through this program the SPCA has desexed >80,000 cats and euthanasia rates have fallen by 90%.^{18,21}

The CCCP program was initiated in 2000 and was officially recognized by the Agricultural Fisheries and Conservation Department (AFCD) of the Hong Kong SAR government in 2002. Through the CCCP, volunteer carers were identified and registered to assist with monitoring CCCP populations. The main village area of Lamma Island was registered as one CCCP site after residents reported the presence of a large FFC population, which had split into colonies and was freely breeding in the northeast (F. Woodhouse, oral communication, June 2024). TNR action under the CCCP on Lamma Island commenced in 2000.

Methods

The TNR aspect of the CCCP project commenced formally in July 2000 with carers catching cats for desexing by

the SPCA. From 2006 annual desexing data was collected in alignment with the SPCA operational year (April–March the following year). Prior to this the data for the first few years was aggregated. During CCCP TNR, cats were humanely trapped in wire cages baited with cat food and removed for sterilization by SPCA veterinarians. During this time SPCA veterinary and care staff assessed individual health and their suitability for rehoming (socialization). If rehoming was deemed possible then cats were placed in SPCA registered rehoming centers for public adoption. If not, cats were returned to trapping sites after desexing and cared for daily by SPCA registered carers (who fed and monitored cat health and welfare). Returned cats, which had undergone TNR, had ear tips docked to make them identifiable during surveys and to staff trapping cats for desexing in subsequent visits.

Annual transect surveys were also conducted; between July and September (summer) between 2002 and 2023. Surveys started at 5 pm, before sunset when the temperature was lower and cats were usually more active. During surveys four staff members completed a 3 km transect walk on the northwestern side of the island, traversing through scrubland, villages and past gravesites, around areas where cats had previously been reported (Fig. 1). One member of the team tracked the route, two members counted cats (surveying opposites sides of the route) and the final team member was responsible for documenting the number of observed cats. From 2019 only three SPCA members participated as the route was well-known by the team and the tracker was not required. The team distinguished between owned cats, stray, and colony cats during surveys. A cat was classified as 'owned' if, at the time of being observed, it was inside a property or wearing a collar. Colony cats were easily identifiable from 'ear-tipping' from the time of desexing and stray cats were cats seen free roaming with no signs of ownership and no evident ear tip.

Over the 22-year period, 21 annual survey data were available for the CCCP population on Lamma Island. Owned cats were distinguished from FFCs due to the presence of collars or being seen inside housing units. Data were absent for 2003, when, due to operational reasons, a survey was not carried out. Additionally, although some roaming cats were adopted by Lamma Island residents, most cat rehoming was not undertaken formally by the SPCA throughout the period. Therefore, we do not present rehoming data in this study. Furthermore, due to data availability we do not discuss or analyze other data from the CCCP program, but only the implied impact on the population as reflected in the desexing and annual survey data.

Results

A total of 553 FFCs were desexed through the TNR aspect of the CCCP program on Lamma Island during



Fig. 1. Map of the transect for annual cat surveys on Lamma Island. The blue line indicates the route taken by SPCA staff for annual surveys. The route starts adjacent to Yung Shue Wan (YSW) ferry pier (A) and finishes on YSW main street by the local island pier (F). The route encompasses several villages including O Tsai (B), Tai Peng Kau Tsuen (C), Wang Long (D), and Tai Shan (E). Scale bar and elevation during the 3 km transect are indicated.

the 19 years spanning July 2000 to March 2024. The largest number of cats were desexed in 2007 (April 2007–March 2008) when 109 cats were sterilized. Peaks in the numbers of FFCs desexed are evident in 2007 and 2010 ($n = 72$); however, after 2010 a substantial decline in number of desexing is shown with only two cats undergoing TNR from 2018 (2018: $n = 1$, 2020: $n = 1$).

Data for 21 annual surveys was collected from 2002 to 2023. The greatest number of total FFCs was recorded in the first survey year ($n = 107$). A sharp decrease in the total number of cats is evident from 2002 to 2010, after which a more gradual decrease is shown (2010–2018). In 2019, 2021 and 2022 one non-colony FFC was recorded with no FFCs (colony or otherwise) being recorded in 2020 or in the final year (2023).

The number of colony cats follows a trend similar to the total number of cats encountered, with greater numbers of cats observed in earlier survey years and fewer in later years. Greater numbers of colony cats were seen in 2004 and 2006 than any other survey year. However, no colony cats were seen from 2019 to 2023.

Discussion

In this study, we investigated the effect of a CCCP program on a cat population on a remote island in south-western Hong Kong. We collected data on the number of cats desexed during the program and observational survey data of cat sightings over a ~20-year period to assess the FFC population size. Trends in the data show that the initial numbers of cats undergoing desexing and sightings on surveys were high reflecting the large estimated population initially reported by Lamma Island residents. However, overall a significant decrease in cat abundance is evident, which is most likely indicative of a declining population and is corroborated by the carers (F. Woodhouse, oral communication, June 2024). This is likely due to a combination of factors: natural attrition over time, birth rate reduction due to TNR, ad-hoc removal (adoptions) by the community, and proactive interventions when end-of-life welfare issues were identified by SPCA carers. The decrease in the number of FFCs undergoing TNR or sighted on surveys in later years may be reflective of changing public attitudes towards desexing regionally. The Hong Kong Census and

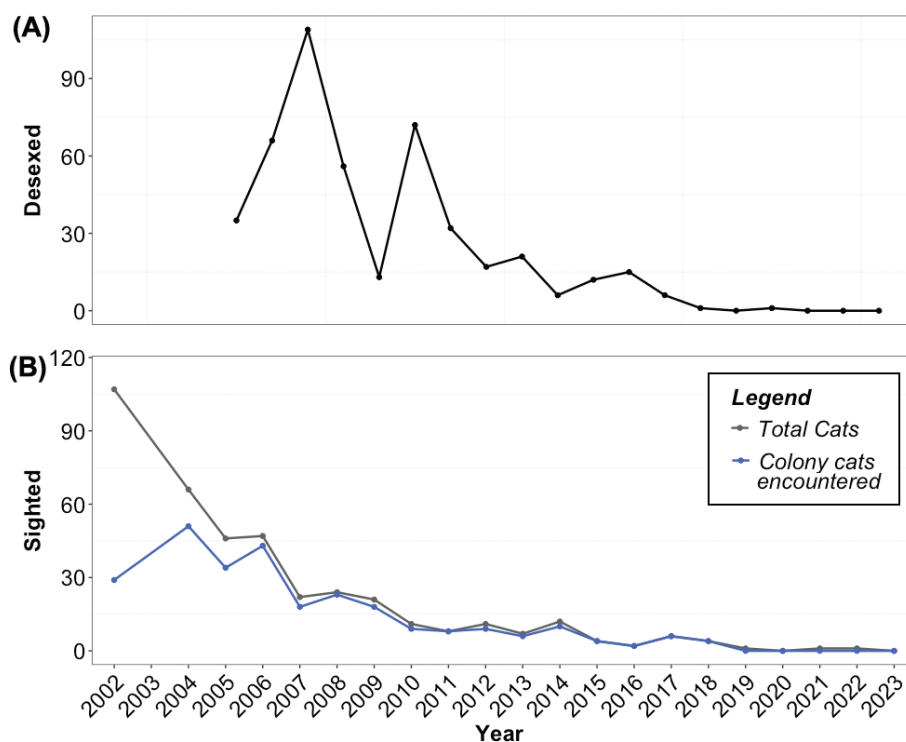


Fig. 2. Cumulative number of cats desexed and sighted on each survey for the Lamma Island population. FFC abundances during the CCCP program on Lamma Island. (A) Depicts the annual number of FFCs desexed by SPCA or associated carers during the period. Annual data was available from April 2000; 91 cats had been desexed prior but data was aggregated and the specific time period of desexing unknown. Data for 2005 spans a period of 9 months. (B) Shows the number of cats sighted on the annual surveys under the CCCP program. The grey line indicates the total number of FFCs sighted (stray or colony cats) and the blue line indicates the number of colony cats sighted by SPCA staff. Data for 2003 is absent.

Statistics Department reports dramatic increases in the numbers of owned household cats undergoing desexing over the past ~20 years. In 2005, 51.6% of owned household cats were desexed ($n = 99,200$) whereas 77.2% of pet cats were desexed in 2018 ($n = 184,100$).^{22,23}

The observable decrease in the FFC population could also be due to environmental factors or extreme weather events. Temperatures in Hong Kong exceed 31°C in the wet season, with mean annual rainfall of 300 cm in the New Territories.²⁴ Furthermore, within the wet season (May–September) tropical cyclones are common, where wind speeds of 185 km/hour have been recorded since 2009.²⁵ The single or combined effect of these climatic factors could significantly impact FFC mortality rates, especially for young individuals or cats with poor health.

Reports from the public and registered SPCA carers support the data trends observed in this study, with fewer cats sighted in public areas. Neither surveys nor desexing data revealed cat abundances similar to those initially reported by carers (approx. 600 individuals).¹⁸ This disparity is due to the survey design in that fundamentally a linear transect count is not a census and only reflects population trends. It should be noted that the survey started only 2 years after the TNR project had

commenced. A decreasing population trend of FFCs can be attributed to a range of factors including the initial TNR efforts and improved management of pet cats (including increased desexing rates, better control and management, and decreased instances of abandonment).

At the conception of the project, registered carers were enrolled through the CCCP program to care for desexed colony cats, monitor the FFC population, and provide food if required.⁷ As they are intimately familiar with each individual in their colony, carers can recognize new cats which are then trapped and desexed,²⁶ helping to maintain the declining population trend obvious in our study. Furthermore, through the dedication of carers, welfare of colony cats improves in TNR programs,^{27–29} with cat death or mistreatment information often swiftly reported by carers.^{29,30} Furthermore, as carers provide for cats' basic needs it is expected that cats will have a reduced effect on the environment, such as a decrease in predatory behaviours which affects wildlife.³¹

The presence of carers also offers an early warning system for animal mistreatment, such as poisoning. In Hong Kong, rates of poisoning are increasingly documented³² with special prevalence on outlying islands around areas where feral animals have been observed (F. Woodhouse,

oral communication, June 2024). In 2013 and 2017, stray dogs were reported to have been poisoned on Cheung Chau Island, resulting in seven and five fatalities respectively.^{33,34} This island lies 11.2 km from Lamma Island and has a medium sized feral dog population which is the source of another SPCA-led TNR study.³⁵ Suspected poisonings have also been documented on Lamma Island and have been investigated by island police, although whether this was purposeful or accidental has not been established.³⁴ The maximum penalty upon conviction for cruelty to animals in Hong Kong, which includes poisoning, is a fine of 200,000 HKD (~25,700 USD) and 3 years imprisonment. Although exact reasons for animal poisoning are unknown, instances occur where a high number of complaints regarding nuisance animal behaviour have been reported.^{36,37} The CCCP program offers some community engagement²¹; however, further education on the positives of TNR and the SPCAs efforts on reducing feral animal populations may be necessary on outlying islands to reduce animal mistreatment.

One key limitation of this study is the lack of data on the number of cats removed from the site throughout the surveyed period. From 2000 to 2020 the CCCP program throughout Hong Kong boasted multiple TNR projects with <1,750 active cat colonies, 1,100 registered volunteer SPCA carers, and >75,000 cats desexed.¹⁸ Although effective and with wide ranging implications, resources (monetary and personnel) for the program were restricted and funding was not available to hire staff to monitor specific sites. Community and local adoptions of FFCs were known to SPCA personnel; however, this was not officially recorded. Furthermore, the clinical aspects of the CCCP program including sex ratio data were not freely available to authors at the time of publication. Collecting and analyzing this data would allow for more accurate population statistics and possibly litter sizes, which in turn would enable further efforts by the program to be specifically targeted to FFC colonies in Hong Kong.

Despite the lack of rehoming data available in our study, results are directly comparable to prior cat control and management studies globally, although currently relatively novel in Asia. As with our study, decreasing numbers of free-roaming cats are congruent with a number of studies which have tracked community cats through time.^{38–40} Spehar and Wolf³⁹ found an 85% decrease in cat abundance and 11–16 active cat colonies eliminated under their 28-year cat management program. Kreisler and colleagues³⁸ found similar results with a 55% decrease in the free-roaming cat population within their 14-year study. These studies, along with our research support the growing number of global TNR studies deemed successful, by reducing feral and/or free-roaming cat populations over time.^{27,41–43} However, continued rates of cat abandonment and demographic connectivity (breeding

between intact individuals) decrease the effectiveness of programs.⁴⁴ Therefore, the continuation of monitoring and TNR efforts are vital to maintain low population levels through time.

Conclusion

Success for feral animal control programs is defined as the reduction in the number of individuals through time through desexing the majority of the population.⁴⁵ As evidenced by the annual survey results reflecting a decreasing FFC population, the TNR program operated by the SPCA on Lamma Island for cats can be considered a success and TNR viewed as an important component of cat population management. Continual monitoring provides an optimal way to assess cat abundance; however, further metrics such as adoption data and sex ratio data are also vital to monitor program success through time. Furthermore, engaging carers who report numbers of immigrating individuals and cat health issues to SPCA staff will ensure long-term animal welfare and continued program success.²⁹ Neutering programs for cat owners will also help to reduce unwanted litters (a source of recruitment for the feral cat population); however, this will be insufficient unless education is provided to engage the public on the importance of pet desexing.

Author contributions

Conceptualization, F.W.; Methodology, F.W., M.C.W., and K.Y.W.; Software, H.B.T.; Validation, H.B.T.; Formal Analysis, H.B.T.; Investigation, F.W. and H.B.T.; Resources, F.W.; Data Curation, H.B.T., M.C.W., and K.Y.W.; Writing – Original Draft Preparation, H.B.T.; Writing – Review and Editing, H.B.T., F.W., K.Y.W., and A.W.; Visualization, H.B.T.; Supervision, F.W. and A.W.; Project Administration, A.W.; Funding Acquisition, NA. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest and funding

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