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The impacts of commercial civet farming in central Vietnam

TRINH Thi Mai, Russell GRAY, PHAM Van Thong, TRAN Thi Thuy Hang, LE Kim Long, CAO Nhat Long, NGUYEN Van Thai & Daniel WILLCOX

Abstract

Demand for wild meat (consumed as a luxury) and civet coffee (produced from coffee beans that have been partially digested and then excreted by civets) has driven the establishment of civet farms in South-east Asia, including in Vietnam. Common Palm Civet *Paradoxurus hermaphroditus* is the main species kept in civet farms. Little is known about the impacts of these farms on wild civet populations. In 2020, semi-structured interviews were used to explore the status and trade dynamics of 57 commercial civet farms in Lam Dong and Dak Lak provinces, Vietnam. Interviewees comprised civet farm owners as well as local government staff that were responsible for monitoring these facilities. Sixty-four percent of interviewed farm owners reported restocking with wild-caught civets. Sixty-three percent reported disease as a cause of captive mortalities. At one facility, approximately 200 civets reportedly died in one mortality event because of an unknown disease. Twenty percent of the farms kept more civets than were legally registered. High mortality and low breeding success rates were reported by 74% of owners. Civet farms in these two provinces are an ongoing threat to wild civet populations and potentially also to public health. These facilities are probably beyond regulatory control. The commercial farming of civets for their meat and civet coffee production should be phased out to support conservation and as a zoonotic prevention measure.

Keywords: civet coffee, Common Palm Civet, illegal wildlife trade, *kopi luwak*, Masked Palm Civet, wildlife farms

Introduction

Civets (Viverridae) are hunted and trapped for human consumption as food and traditional medicine in Africa and Asia (Shepherd & Shepherd 2010, Wondmagegne et al. 2011, Shepherd 2012, Nijman et al. 2014, Carder et al. 2016, Jelil et al. 2018). In some African countries, civet gland fluids are believed to cure a range of diseases and illnesses, including headaches, skin ailments, cancer (Taye 2009) and female infertility (El-Kamali 2000). In India, the civet gland is an ingredient of Ayurvedic holistic healing medicines (Balakrishnan & Sreedevi 2007). In South-east Asia, civets are traded for their meat and body parts, as pets and for the civet coffee industry (Bell et al. 2004, Roberton 2007, Shepherd & Shepherd 2010). Civets are one of the most frequently consumed wild mammals in Vietnam (Roberton 2007, Van Song 2008, Sandalj et al. 2016), China (Cheng 2007) and Lao PDR (Johnson et al. 2003). In Vietnam and other countries, civet meat, like most other wildlife meat and products, is consumed as a luxury item rather than for subsistence (Drury 2009, 2011, Sandalj et al. 2016, Shairp et al. 2016, Ingram et al. 2021, Olmedo et al. 2021).

Commercial civet breeding on 'civet farms' has supplied the demand for civet meat, civet coffee and other products, e.g. scent gland fluids (Wondmagegne et al. 2011). Over the last 20 years, the number of wildlife farms has grown in some South-east Asian countries, including in Vietnam (WCS 2008, Vu et al. 2017), where 1 kg of civet coffee sells for 40–80 times the price of ordinary coffee (Nam Giang 2011). In Indonesia, where civet coffee (*kopi luwak*) is popular, civets are caged and forced to eat coffee and are reported to be captured from forests to keep the farms stocked (Carder et al. 2016). Civets are also employed for the civet coffee tourism plantations in Indonesia, where they are showcased to entertain tourists and facilitate the sale of civet coffee to visitors (Lewis-Whelan et al. 2023). Common Palm Civet *Paradoxurus hermaphroditus* is the main species kept in civet farms (Shepherd 2012, Nijman et al. 2014, Carder et al. 2016); Masked Palm Civet is also commonly observed. Globally threatened civet species have been also recorded on these farms; three Owston's Civets *Chrotogale owstoni* were recorded in civet coffee facilities in Da Lat, Vietnam, in 2018 (Willcox et al. 2019).

In Vietnam, civet coffee farms are mainly in the central highlands and the south (Nam Giang 2011). They are regulated under Decree 06/2019/ND-CP and its update Decree 84/2021/ND-CP on wildlife management, Decree 160/2013/ND-CP and its update Decree 64/2019/ND-CP on criteria of prioritized protected species, and Decree 35/2019/ND-CP on administrative violations in forestry. Under Vietnamese law, any species can be commercially farmed provided the origin of the founder stock is legal, e.g. from other legal farms, from legally harvested wildlife or from illegal trade confiscations. Wildlife farms are under the management of the Forest Protection Department (FPD) and Vietnam's Convention on International Trade in Endangered Species of Wild

Fauna and Flora (CITES) Management Authority. The latter provides permits for all CITES Appendix I listed species, whilst the former can grant permits for CITES Appendix II species, as well as any not listed on CITES. The provincial FPD is mandated to monitor and manage any wildlife farms within its jurisdiction. Civet species listed in Group IB of Decree 06 can be exploited under a license, and the law includes some limited provisions for ensuring a legal origin. Civet species listed in group IIB of the same decree can be commercially exploited if permission from the relevant authority is acquired. Trade-confiscated civets listed in group IIB can be legally auctioned or sold to commercial enterprises, including legal wildlife farms.

There are eight civet species in Vietnam: Binturong *Arctictis binturong*, Common Palm Civet *Paradoxurus hermaphroditus*, Large Indian Civet *Viverra zibetha*, Large-spotted Civet *Viverra megaspila*, Owston's Civet *Chrotogale owstoni*, Small Indian Civet *Viverricula indica*, Small-toothed Palm Civet *Arctogalidia trivirgata* and Masked Palm Civet *Paguma larvata*. All civet species are probably far below natural population densities in Vietnam, including in protected areas, as hunting and trapping, particularly with snares, is common in the country (Gray et al. 2018). Many of these snares are set to supply the demand for the commercial wildlife trade (Gray et al. 2018, 2021, Belecky & Gray 2020).

To our knowledge, there is no published research on Vietnam's civet farming industry and its potential impacts. Several civet coffee producing areas in Vietnam are close to important populations of Owston's Civets, which has the potential to affect the conservation of this species. To better understand the impacts of civet farming on wild civet populations, this survey focused on the status of civet farming in central Vietnam and the trade dynamics of these civet farms.

Methods

Survey area

Lam Dong (11°57'N, 108°26'E) and Dak Lak (12°40'N, 108°3'E) provinces, in Vietnam's central highlands, produce the most coffee in Vietnam and are known as hotspots for civet coffee facilities. The area for coffee production in Lam Dong is estimated at 1441 km^2, which accounts for approximately 57% of the total crop area in the province (Lam Dong News 2020). Around 2000 km^2 are used for coffee plantations in Dak Lak (Dinh Doi 2019) and this represents 32% of the coffee production area for the entire country (Dinh Doi 2019). Coffee is one of the most important economic products of the two provinces. In 2020, the annual export of coffee in Lam Dong was up to 80 tonnes and valued at 173 million USD (Lam Dong News 2020), accounting for 86% of all agricultural exports. In Dak Lak, coffee contributed to 60% of the province's total income (Dinh Doi 2019).

Data collection

The surveys were carried out in Lam Dong and Dak Lak provinces in June and December 2020. The main target for the surveys were commercial facilities – commonly referred to as 'wildlife farms' and herein referred to as 'civet farms' – that kept or sold civets, including for meat and/or for the production of civet coffee. Wild meat restaurants were also visited, to assess potential links to the captive civet facilities that were visited.

CyberTracker and Spatial Monitoring and Reporting Tool (SMART) enforcement software (https://smartconservationtools.org/) was used to collect and store the survey data. Data forms were constructed using SMART and then loaded onto standard Android mobile phones. This method was used for two purposes: to enable systematic data collection, and so reduce recording errors; and to enable the surveyors to record information inconspicuously, without pen, paper or more obvious electronic recording devices. The interviewers would complete parts or all of the data collection form immediately after the interview had been completed and when the interviewee was no longer present. All interviews were conducted in Vietnamese.

Commercial civet farms

In Vietnam, the provincial FPD is the responsible government authority for managing and monitoring civet farms, including registration and licensing. Details on registered civet coffee farms were first gathered from the FPD of Lam Dong and Dak Lak provinces. The information provided by the FPD was used to identify potential facilities for interviews. Information given by members of the public and 'snowball sampling' (Bryman 2004), wherein interviewees at a farm were asked if they knew of other commercial civet farms, led to the identification of additional facilities.

Information on the scale and trade dynamics of civet farms, including reports of illegal civet trade, were gathered through semi-structured interviews with owners or employees at each facility. Direct observations of the operations (e.g. number of enclosures, civet species present, numbers of civets, snare wounds or missing limbs, other traded/commercially -bred wildlife), helped to verify statements made by the interviewees. The majority of the semi-structured interviews were conducted face-to-face; telephone interviews were carried out only when the facilities could not be physically accessed because they could not be located or the owners did not want the researchers visiting their facility.

Cover stories were used when approaching and interviewing the owners or staff at civet farms. The initial cover story was that the team were students, researching the economics of civet farms and how civet farm owners responded to the Covid-19 pandemic. However, after struggling to get responses, the survey team changed tactics and posed as potential buyers of civet coffee or civet meat or as tourist agencies, as several of the facilities were partially marketed towards tourists. The prices were collected in VND during the interviews and converted to USD. The USD/VND exchange rate used was 1 USD = 23,191 VND.

Market and restaurant surveys

Local markets in Lam Dong and Dak Lak provinces that sold agricultural products and had the potential to sell wildlife or wildlife products were surveyed. One or two observers would walk along a market to see whether any wild animals were being sold. If wild animals were detected, semi-structured interviews were conducted with the seller. Questions were asked about the price, quantity, source, trends and species sold. Restaurants in the survey areas, especially in any touristic areas, were visited to assess whether they sold civet meat and if there were links between the restaurants and the civet farms in the surveyed provinces. Restaurants with banners advertising 'forest' food, such as 'wild chicken' or 'wild boar', were also checked for wild civet meat. When surveying the markets and restaurants, the researchers posed as wild meat buyers or tourism agents.

Data analysis

Nonparametric Wilcoxon tests were used to assess pairwise differences between the observed number of civets in facilities in Dak Lak and Lam Dong provinces as the data were not normally distributed. When civets could not be observed, the number of civets reported by interviewees was used as the observed number. The same pairwise test was also employed to compare the size of registered and non-registered facilities; any facilities in the process of registration and inactive farms were excluded from the test data. A Kruskal-Wallis test was used to test for the difference in the number of civets reported by the FPD, interviewee claims and the survey team's observations. All analyses were carried out in R statistical software (R Core Team 2020).

Results

Demographics and data quality

Staff at 57 civet farms were interviewed during the surveys. The majority of interviewees self-identified as the owner or co-owner (98.2%, 56/57), with only one interviewee an employee. Of interviewed civet farms, 12.3% (7/57) were stated to be inactive by interviewees. Among the interviewees, 75% of respondents were male and 25% were female. Direct observations of the number of civets, enclosures and husbandry conditions were possible in 61.4% (35/57) of the facilities.

The establishment year for a civet farm ranged from 1999 to 2019. Fifty-five percent (27/49) of farms interviewed were established between 2016 and 2019. According to the FPD, most civet facilities were small (fewer than 50 civets) and run as family businesses. In contrast to the interviewee-reported figures, the FPD stated that most civet farms were established between 2005 and 2010, when there was a trend to farm civets for civet coffee as the price was high; the number of farms was then reduced as the civet coffee produced could not be sold. The number of civet farms registered with the FPD in Lam Dong dropped from 39 in March 2019 to 21 in June 2020. However, approximately 79% (19/24) of civet farm owners stated that they believed the demand for civets to sustain other farms or to supply wild meat restaurants was increasing and that they were therefore guaranteed buyers for their civets.

Number of civet farms

There were 21 FPD-registered civet farms in Lam Dong province and 17 in Dak Lak province, the two provinces that were the focus of the study. One was registered in Dong Nai province. The survey team identified an additional 18 facilities that were not on the lists of registered facilities maintained by the FPD. The locations of the surveyed civet farms, and their proximities to protected areas, are shown in Fig. 1.

Observed and reported species

Binturong, Common Palm Civet, Masked Palm Civet and Small Indian Civet were observed at the farms that were visited (Table 1). Owston's Civet was not seen in any facilities; however, 3/19 interviewees reported seeing this species at other farms in other provinces and one interviewee reported having kept the species in the past. Common Palm Civet was the most commonly observed civet species, accounting for approximately 94% of all civet observations. Seven respondents reported that, except for Common Palm Civet and Masked Palm Civet, other civet species did not eat coffee fruits or ate very few. Small Indian Civets were reported by two respondents to eat some coffee fruits, but the scent of the coffee beans produced was considered to be inferior to those produced by Common Palm Civets. A third of the surveyed facilities kept and bred taxa other than civets, including other wildlife species and domestic species.

The average number of observed civets at each

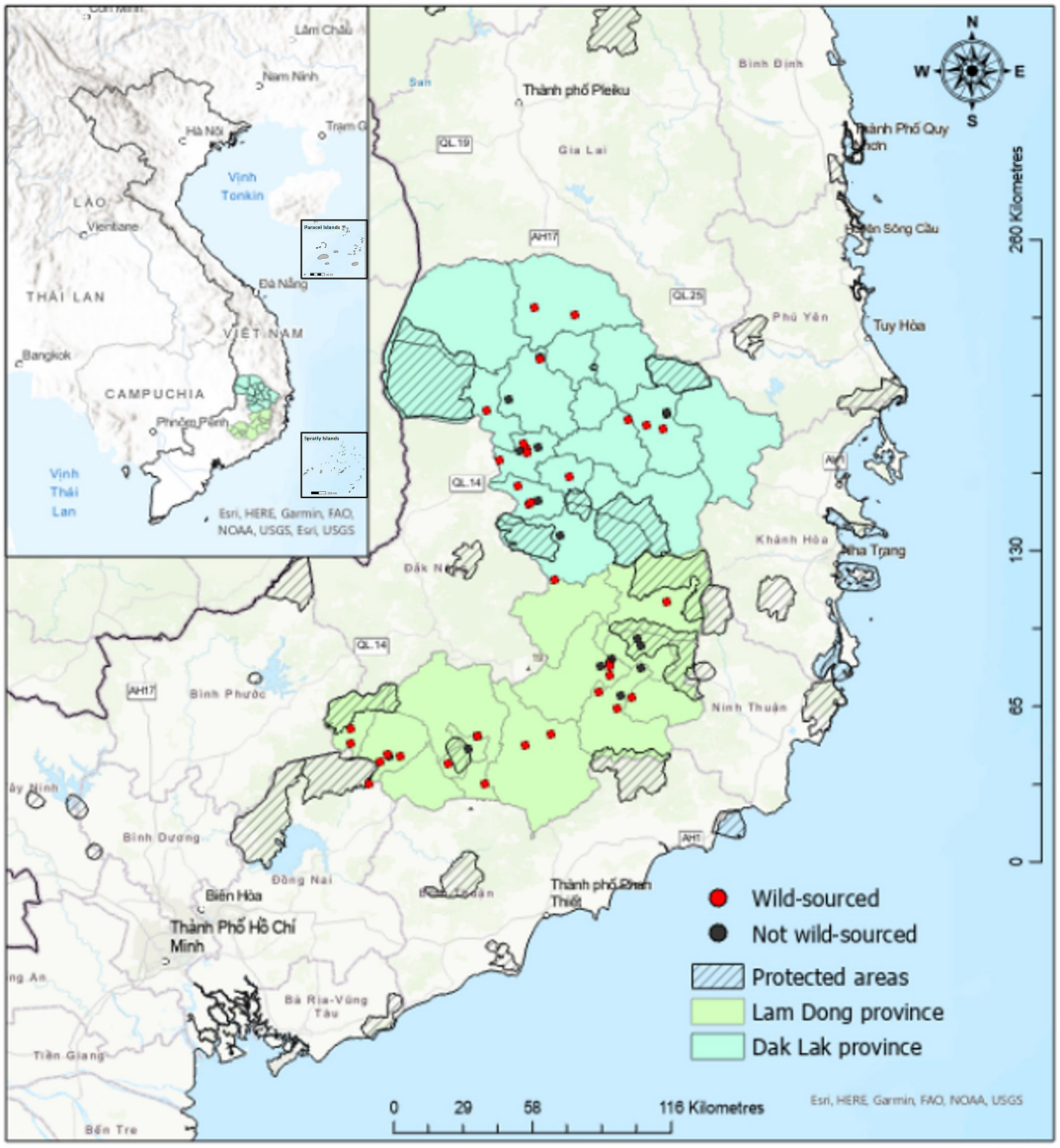

Fig. 1. Distribution of civet farms in Lam Dong and Dak Lak provinces, Vietnam, where interviews were carried out, indicating their proximity to protected areas (source: UNEP-WCMC 2022). Dots indicate whether the farms reportedly sourced their animals from the wild.

civet farm (registered and non-registered) was 30 civets in Dak Lak and 37 civets in Lam Dong, ranging from 3 to 330 civets. The total number of civets in all interviewed facilities was 1566 civets; this number includes 393 civets reported by farms that could not be physically accessed by the survey team. The average number of civets at each facility in Dak Lak was not significantly different from that in Lam Dong (W = 471, *p* value = 0.194). The number of civets at non-registered facilities was significantly lower than that at registered farms (W = 325.5, *p* value = 0.001).

For registered facilities, a higher number of civets were reported by interviewees compared to those reported by the FPD, although it was not statistically different (χ^2 = 0.17, *p* value = 0.92). The number of civets reported by interviews was slightly lower than that observed by the survey team. Direct observations were made of 1166 civets; however, only 1125 civets were reported by interviewees (41 unaccounted for), and 751 civets were reported by the FPD (415 unaccounted for).

Type of civet farm and main outputs

The commercial outputs of the facilities were civet coffee, civet meat and/or breeding civets (Table 2). The number of farms that sold civet meat and live civets accounted for the highest proportion, followed by farms that sold civet coffee, meat and live civets. Sixty-eight percent (39/57) of farms reported that they sold civets to other farms as founder or breeding stock. The main consumers of civet coffee were overseas Vietnamese, as well as tourists from Japan, Taiwan, France, Russia and Korea, as reported by 13

farm owners that produced civet coffee. The other seven farms that aimed to produce civet coffee had not succeeded in selling it. Seven farms interviewed were inactive at the time of the surveys; these owners cited low survival rates of the captive civets (3/7), escaped civets (1/7), no buyers of civet coffee (1/7), no time (1/7) and unpleasant smell from civet cages/areas (1/7).

Ownership

A quarter of the interviewees (15/57) were working full-time for the civet farms (Table 2). Amongst those working part-time on civet farms, the professional backgrounds of the owners were diverse and included retired governmental officials (five respondents), seasonal hunters (three respondents) and re-

Table 1. Civet species and other wild and domestic animal species recorded in civet farms, where a total of 1566 civets were observed. Whether each species is covered by Decree 64 (the update of Decree 160) and Decree 84 (the update of Decree 06) – Vietnam's two principle national laws for regulating species use or protection – is indicated by an ×. IUCN Red List status and the managing authority for each species are also shown.

Scientific name	Decree 64 (update of Decree 160)	Decree 84 (update of Decree 06)	IUCN Red List[a]	Management under[b]	Number of individuals observed	%
Civet species						
Arctictis binturong	×	IB	VU	CITES VN	19	1.21
Paradoxurus hermaphroditus	–	IIB	LC	Provincial FPD	1478	94.38
Viverricula indica	–	IIB	LC	Provincial FPD	5	0.32
Paguma larvata	–	IIB	LC	Provincial FPD	64	4.09
Viverra zibethac	–	IIB	LC	Provincial FPD	–	–
Viverra megaspila[c]	×	IIB	EN	Provincial FPD	–	–
Chrotogale owstoni[c]	×	IIB	EN	Provincial FPD	–	–
Other species observed						
Martes flavigula[c]	–	–	LC	–		
Melogale sp.	–	–	-	–		
Herpestes javanicus	–	–	LC	–		
Cervus nippon	–	–	LC	–		
Sus scrofa	–	–	LC	–		
Rhizomys sp.	–	–	–	–		
Hystrix brachyura	–	–	LC	–		
Atherurus macrourus	–	–	LC	–		
Elephas maximus	×	IB	EN	CITES VN		
Nomascus leucogenys	×	IB	CR	CITES VN		
Pavo muticus	×	IIB	EN	Provincial FPD		
Gallus gallus domesticus	–	–	–	–		
Columba livia domestica	–	–	–	–		
Heosemys grandis	–	IIB	VU	Provincial FPD		
Ptyas mucosus	–	IIB	–	Provincial FPD		
Ophiophagus hannah	×	IB	VU	CITES VN		
Python bivittatus	–	IIB	VU	Provincial FPD		
Varanus salvator	–	IIB	LC	Provincial FPD		
Hoplobatrachus rugulosus	–	–	LC	–		
Anabas testudineus	–	–	LC	–		
Pila conica	–	–	–	–		

[a] Critically Endangered (CR) Endangered (EN), Vulnerable (VU), Least Concern (LC). [b] CITES Management Authority for Vietnam (CITES VN), Forest Protection Department (FDP). [c] Reported to have been kept by farm owners in the past; none were observed in captivity during the survey.

staurant owners (three respondents). One farm was founded to operate as a 'ghost' farm. A 'ghost' farm is a farm that is legally registered but does not keep any animals; the registration allows it to legalise illegally caught wild animals that are then sold to other farms or restaurants. One civet facility was observed to not have any civets but instead sold bamboo rats and other wild animals.

Sourcing civets

The majority of interviewees bought civets directly from hunters or live animal traders to supply their farms (Table 2). Seven interviewees stated, without a leading question or prompting, that wild civets were cheaper than captive-bred animals. The difference in price between captive- and wild-sourced was to cover the paperwork or certification costs to prove the animal had a legal origin. Civets with a 'proof of origin' from registered farms could sell at a higher price than those without (five respondents). Three interviewees who were former seasonal hunters stated that they started civet farms as they saw that overexploitation had dramatically reduced the number of wild civets, with civets extirpated in their local areas. Additionally, five of the 35 farms that were accessed had civets with visible snare wounds, indicating a probable wild origin.

Captive mortalities

Ninety-seven percent of interviewees reported that they had witnessed premature deaths of their captive civets in the past (Table 2), with disease (10/16 interviewees), injury (6/16) and over-ingestion of coffee beans (5/16) cited as possible reasons. Four small inactive farms in Lam Dong reported that they lost all of their civets because of disease in 2019. One farm in Dak Lak reported a single loss of 200 civets to disease; the surviving civets were then reportedly sold at a discount to wild meat restaurants. Representatives of 54% of facilities reported that wild civets would die within two months after being bought from wildlife traders (Table 2); the animals reportedly refusing to eat, were diseased or succumbed to severe injuries caused by hunting traps. Less than half of the respondents reported having no issues with purchased wild civets.

Table 2. Summary of respondent answers.

Topic of question	Respondent answer/criteria	N/Nt[a]	%
Purpose of commercial exploitation	Only civet coffee	7/57	12.28
	Only civet breeding stock	2/57	3.51
	Only civet meat	4/57	7.02
	Civet coffee, tourism and meat	7/57	12.28
	Civet coffee, meat and breeding stock	13/57	22.81
	Civet meat and breeding stock	20/57	35.09
	Civet coffee, tourism, meat and breeding stock	4/57	7.02
Income	Working full-time for the civet farm	15/57	26.31
Civet sourcing	Source civets from hunters or live animal traders	35/54	64.81
	Source founder civets from hunters only	10/54	18.52
Mortality	Premature mortality in civets due to diseases, injuries and other reasons[b]	41/42	97.62
	Newborn civets die prematurely	22/23	95.65
	Wild-caught civets die within two months after arriving at farms	19/35	54.29
Husbandry/breeding	Failures in breeding civets	20/27	74.07
	Civets escaped from the facility	16/47	34.04
	Civets are vaccinated, medicines are bought to treat sick civets	11/52	21.15
	Cage/individual civet is marked to differentiate males/prevent inbreeding	4/15	26.67
Links to restaurants	Sell civet meat to restaurants	28/40	65.12
	Civets that do not breed or are too weak/injured are sold to nearby restaurants	15/28	53.57

[a] Number of interviewed farms that responded with the answer (N) and total number of interviewed farms that responded to the specific question (Nt). Not all respondents gave answers or gave clear answers, so Nt varies. [b] Because respondents often cited multiple reasons for premature mortalities in their captive civets, their responses have been aggregated.

Fig. 2. Examples of standard civet enclosures at three farms visited during the surveys. Enclosures are typically small and made of metal mesh or bars, with open bottoms that allow faeces and urine to be washed with water from the floorbelow (or collected for coffee). All three photographs taken in June 2020. (Photo: Trinh Thi Mai / Save Vietnam's Wildlife.)

Breeding success

Seventy-four percent (20/27) of the interviewees reported breeding failures, with civets not producing any young in a year. Six interviewees reported that civets could breed two to three times per year, producing one to three young each time. Three facilities that focused on breeding civets claimed that wild civets were relatively more difficult to raise in captivity, with issues that included disease susceptibility, difficulties in establishing breeding pairs and refusing food in captivity (Table 2).

Captive management

The captive management of civets was poor and enclosures were small. Little to no attention appeared to be paid to the enclosure conditions, husbandry or animal welfare (Table 3, Fig. 2). Multiple civets were kept in the same enclosure in five farms, with enclosure sizes that ranged from 2 to 10m^2. Injuries were seen on the civets' bodies in all five of these facilities. Twenty-six percent (4/15) of owners that bred civets knew the importance of marking individuals and of unlrelated breeding pairs. External markings, or other forms of individual identification to aid captive management, were observed at only one civet breeding facility. The remaining 11 owners that bred civets did not make any statements on the importance of individually marking civets or switching males. The newborn civets in these farms were reported to be weak and died very soon after being born. Civets were also reported to have escaped from 16 facilities.

Biosecurity and disease management

None of the 57 facilities had separate quarantine areas for new civets nor for civets that required treatment. No gloves or other personal protective gear were worn by owners or staff when feeding civets or cleaning enclosures. Twenty-one percent of

Table 3. The survey team's direct observations of husbandry standards at the civet farms.

Observation	N/Nt[a]	%
Wooden logs in the cages	5/35	14.29
More than one civet in the same cage	5/35	14.29
Cage is marked to differentiate males/prevent inbreeding	1/15[b]	6.67
Unhygienic conditions in cages	13/35	37.14

[a] Number of visited farms where the observation was made (N) and total number of farms visited where the enclosures could be observed (Nt). [b] Representatives of 19 farms stated that they bred civets; 15 of these allowed further questions on this topic and their facilities to be observed.

interviewees reported vaccinating civets (the types of vaccine were not mentioned) or buying chicken/pig medicines to treat sick civets (Table 2). Bowls used to keep food for animals were unclean and some were observed with fungi. Thirty-seven percent of civet facilities were observed with faeces left uncleaned (Table 2). The facilities were cleaned daily or weekly with water; one farm which sold civets for meat reported that they only cleaned once a month. Seventy-nine percent of interviewees reported that they would let civets die if they got sick; they would not buy medication or seek veterinary help since they did not understand what the disease was, and that in their opinion the diseases are incurable. Out of 40 interviewees who provided answers about where they sell their civets, 28 claimed to sell them to restaurants, and 53% of that subset (15/28) reported selling weak, injured or sick civets to wild meat restaurants (Table 2).

Wild meat restaurants

Forty restaurants in two provinces with banners or advertisements relating to 'forest' or 'wild' food, like wild chicken or wild boar, were checked. Civet meat was commonly sold or available on request at restaurants: 65% (28/40) of interviewees offered civet meat. All restaurants reported sourcing civet meat from hunters (100%, 28/28), with a minority also sourcing from civet farms (11%, 3/28). Two restaurants claimed that they have connections with other restaurants in terms of exchanging wild meat. Three civet farms which all sold civet coffee, civet meat and live civets were also operating restaurants so that they could directly supply their restaurants with live animals. None of restaurants that sold wild meat had public advertisements for civet meat and only one restaurant had civet meat on its menu. Without prompting, five interviewees stated that people with high incomes and/or high social status, including government officials, were the main consumers of civet meat. Six restaurants reported that other restaurants would sell wild meat from mongooses, rabbits and squirrels as fake civet meat because this would sell at a higher price. Markets were surveyed but no wild meat (including civet meat) or live civets was observed being sold.

Investment

The investment costs explored included costs of enclosures, breeding pairs, civet food, coffee fruits and any medicines (Table 3). The reported price for a breeding civets ranged from 108 USD to 520 USD (23 respondents) and was reported to be dependent on the current market price in each province, the sex of the civet and the reported quality of the breeding stock. Male civets were reported to be more expensive than female civets (five respondents). It would cost farm owners about 80 USD to feed a civet per annum. One farm fed the animals fresh coffee fruits for 3–6 months a year. The cost of medicines was re-

Table 4. Summary of average figuress for the number of civets observed per farm, civet enclosure size, and reported economic figures.

	Criteria	Average	N [a]
Farm size	Observed number of civets per farm in Dak Lak	30	17
	Observed number of civets per farm in Lam Dong	37	18
Husbandry	Working full-time for the civet farm	0.96×1 × 1.01 m	26
	Size of civet enclosure in Lam Dong	0.7 × 0.77 × 0.83 m	24
Investment	Food cost per civet per day	0.22 USD	32
	Cost of an enclosure that is less than 1 m each side	23 USD	12
	Cost of a breeding civet	230 USD	23
Benefits, income and market price (2020)	Price per kg of raw civet coffee (minimal processing apart from sun-drying)	41 USD	95
	Price per kg of processed civet coffee [b]	220 USD	14
	Price per kg of civet meat	63 USD	25
	Percentage of annual income obtained from civet farms, averaged for all surveyed farms	32.1%	50
	Percentage of annual income obtained from civet farms, averaged for all surveyed surveyed, excluding farms that had not produced any income yet	48.64 %	33
	Kg of civet coffee that one civet can produce per annum	9.82	12

[a] Number of farms. [b] Civet coffee ready to sell commercially.

ported to be very low (22 respondents). Electricity, water and labour costs were not mentioned by interviewees.

Annual income

The percentage of a household's annual income derived from civet farming was reported to be low (Table 3). Removing farms that reportedly did not bring in any income or were closed, the average income from a farm was under 50% of total annual income; only 5/50 owners derived 75% or more of their annual income from their civet farms. These were five large facilities (more than 50 civets) where the interviewees worked full-time.

Market prices

Civets were sold for coffee, meat and as breeding stock (Table 3). The price for 1 kg of raw civet coffee was reported to range from 17 USD to 108 USD, averaging 41 USD, and processed civet coffee prices ranged from 35 USD to 1299 USD per kilogram, averaging 220 USD (Table 4). However, these estimates could be biased as the interviewers were playing the role of buyers when inquiring. The large range of reported prices for civet coffee appeared to also be linked to the quality (i.e. fake/real), the coffee bean varieties and how the civet coffee companies defined their brands. Civet meat is sold between 22 and 74 USD per kilogram, depending on the species of civet (Table 4). Five facilities stated that civet meat was in high demand. The demand for breeding civets was also high; seven farm owners said they had been propositioned to sell civet breeding pairs but they did not have any spare animals to sell. Three farms reportedly sold up to 90 civet breeding pairs per annum, and six other farms claimed to sell 30–50 civet breeding pairs a year.

Management and monitoring of wildlife farms

Facility owners must keep a monitoring book for recording the number of civets in their facility and any changes due to births, deaths or traded animals, according to Decree 06/2019/ND-CP. Three monitoring books were briefly assessed during the survey; none appeared to be up to date. One facility reported to have sold 30 civets the previous year, but this information was not included in its monitoring book and therefore had not been reported to the FPD.

Twenty-two percent of the interviewed facilities were not registered and were therefore operating illegally; this number excludes five civet farms that were in the process of registering with the provincial FPD (Table 2). Two civet farms in Dak Lak had reported to the FPD that they had stopped operating and were closed; during phone interviews, however, these were both reported by the owners to be open. Eight large farms that kept more than 50 civets reported registering only one farm at a location; they would then split their civets between different locations, often in different communes, to avoid any inspection from the authorities. Four facility owners reported that they had bought licenses to sell civets from other registered farms. They would then use these fraudulent licenses to sell their civets at a higher price to buyers; the extra cost for each civet with a legal 'proof of origin' paper ranged from an additional 44 USD to 87 USD.

Discussion

This survey provides data and information on the status and legality of commercial civet farming in central Vietnam in 2020. The capture or trade of wild-caught civets to restock farms was a common activity. Several civet farms reported disease as a cause of premature deaths and five reported mass die-offs in captivity. Several farms also reported selling dead civets or weak animals that would not breed, to wildlife restaurants. Given the known role of civets in zoonotic and infectious diseases (Bell et al. 2004, Roberton et al. 2006, Shi & Hu 2008, Wicker et al. 2017, He et al. 2021), the trade of sick, potentially diseased, civets to restaurants, is a significant public health concern that should be investigated further.

Conservation impacts on wild civet populations

Both registered and non-registered civet farms were engaged in activities that will be impacting wild civet populations. This included restocking using wild-caught civets and laundering wild civets through their facilities. The laundering of wild animals through wildlife farms is a known threat to wildlife and has been documented with other taxa (e.g. Brooks et al. 2010, Lyons & Natusch 2011). Common Palm Civet, Masked Palm Civet, Small Indian Civet and Binturong were all observed at civet farms during the survey. Although Common Palm Civet is a very adaptable species and has been recorded in a variety of rural, peri-urban and urban landscapes (e.g. Jothish et al. 2011), in Vietnam most observations and records of this species are in blocks of natural or semi-natural habitat, away from high human population densities (D. Willcox, pers. comm.). Masked Palm Civets are mostly restricted to hill evergreen forests in Vietnam (Roberton 2007) and Binturong has not been reliably recorded in the country since 2009 (Shih-chih Yen 2009). The latter species is probably now restricted to either functional protected areas or isolated (i.e. inaccessible) blocks of forest. Of the 34 civet farms whose representatives indicated that they used hunters/animal traders to source wild-caught civets,

four were located within 2 km of a protected area (minimum ca. 500 m), including Cat Tien National Park and Nui Dai Binh Nature Reserve (Fig. 1). The national conservation status of the three recorded civet species, the observations of snare wounds and the statements made by the majority of interviewees that they sourced wild-caught civets to restock their farms are all strong indicators that these civet farms are sourcing from wild civet populations, and probably from protected forests.

Snaring is a commonly used hunting method in Vietnam's protected areas (Gray et al. 2018). Snaring has caused significant declines in a wide range of species in the country (e.g. Timmins et al. 2016, 2020, Gray et al. 2018, 2021). While hunters and hunting methods were not the focus of the interviewees, given the common use of unselective snaring in forested habitats in Vietnam, and its effectiveness for capturing nearly all species of civet (except the more arboreal Small-toothed Palm Civet), it is highly probable that a large proportion of the wild-caught civets in the farms where interviews were carried out were caught using snares; observations of snare wounds at five farms provide some support for this. The proximity of these farms to protected areas that are known to support populations of threatened ground-dwelling hunting-sensitive wildlife, including Owston's Civets, suggests that the demand for wild civets to re-stock these farms will have impacts beyond the four civet species observed during the surveys.

Animal health implications

Civets are known to be hosts of several zoonotic and infectious diseases (Wicker et al. 2017, Chaiyasak et al. 2020, Sabeta et al. 2020, Clark et al. 2022). Carnivore protoparvovirus-1 led to a mass die-off of captive Small Indian Civets in a civet perfume farm in Thailand (Chaiyasak et al. 2020). There were reported mass die-offs of civets (up to 200 civets) at civet farms in the survey area. Civets kept in commercial facilities are a potential reservoir of pathogens; when these animals escape or are released into the wild, they could harm wild populations (WCS 2008).

Public health implications

The link between wildlife trade and zoonoses is well-documented (Bell et al. 2004, Karesh et al. 2005, Aguirre et al. 2020, Borsky et al. 2020, Huong et al. 2020, Ye et al. 2020, Bezerra-Santos et al. 2021, Hilderink & de Winter 2021). A range of pathogens have been detected in the Viverridae family (Wicker et al. 2017), and some of these are zoonotic, such as SARS-CoV (Cui et al. 2019, Salata et al. 2019). There is strong evidence that suggests the COVID-19 pandemic might have had had an animal origin (Boni et al. 2020, Lu et al. 2020). Civets and other viverrids are among the animals considered to pose the highest risk in terms of zoonotic disease, especially in markets such as wild meat restaurants and when kept in farms (Wikramanayake et al. 2021). The facilities visited as part of this survey did not have standardised biosecurity protocols, e.g. quarantining new or sick animals, and animals were kept in high-density and unhygienic conditions, often in proximity to other species of animal (domestic and wild). Better, more stringent, regulation is unlikely to limit or remove these risks entirely; civets are known to carry a wide range of diseases, and even the most biosecure captive facility will not be able to reduce these risks to zero. There is a strong potential for a zoonotic disease to emerge from civet farming.

Role of civet farms in supplying consumer demand

It is often argued that captive-bred wildlife is a cheaper and more sustainable alternative to wild-caught animals and that these farming systems can help to reduce pressures on wild populations (Nogueira & Nogueira-Filho 2011). Contrary to these statements, the surveyed civet farms did not provide a cheaper alternative; snared or trapped wild-caught civets were sold to restaurants and breeding farms at a cheaper price than the farmed civets. Farmed civets (whether of a genuine farmed origin or not) would have a higher price per kilogram, partly because of the cost of acquiring licenses or certificates to prove a legal origin.

A large proportion of the surveyed farms had failed to breed civets and some had to close operations as a consequence, a finding similar to previous studies of wildlife farms in Vietnam (WCS 2008, Brooks et al. 2010). Conditions in the surveyed farms were too poor to support captive breeding at a rate that could keep these farms stocked to a level that would supply demand, assuming that consumer preferences could shift to farmed civet meat (see Roberton 2007).

Another reason for the reported low breeding rates and high mortalities could be the failure to control inbreeding; only one farm marked the individuals and only a third of farms switched males to limit inbreeding. This poor captive management could lead to a decrease in genetic diversity and therefore a lower breeding success in the captive populations (e.g. Brooks et al. 2010). Inbreeding depression is a known factor contributing to infant mortalities in a range of taxa (e.g. Brekke et al. 2010, Mishra et al. 2017). As well as limiting the captive breeding success, poor management of genetic diversity (including inbreeding) will severely limit the role of captive civets as potential source animals for releases or reintroductions to the wild.

Poor management and governance of civet farms

While commercial wildlife facilities, like civet farms, are often touted as sustainable options for wild meat production, the lack of regulations, inspections and accurate record keeping, in an environment of weak governance, often enable wildlife farms in Vietnam to unsustainably harvest animals from the wild. The monitoring and management of wildlife farms by the FPD in Vietnam is ineffective and under-resourced (Brooks et al. 2010, Huong et al. 2020). Reliable, objective, corruption-proof and cost-effective monitoring schemes for farmed wildlife have yet to be fully or even partially implemented in Vietnam, primarily because of issues related to governance and poor legislation. The main monitoring method that the FPD has is based on the registration of a facility, and then subsequent checks on a facility's record book for its animals. Given the discrepancies between the lists maintained by the FPD, and the observations made by the survey team on the number of farms, as well as the number of civets in registered farms, clearly the current system is not fit for purpose and is vulnerable to mismanagement or abuse. Better individual marking methods for captive animals, such as micro-chipping may solve some of these issues, but such systems do not address the root causes of weak governance (including the absence of any third-party oversight) and political apathy.

Civet farms and livelihoods

Wildlife farms are sometimes viewed as a strategy for strengthening food security and alleviating poverty (Nogueira & Nogueira-Filho 2011). However, in Vietnam, the vast majority of wild meat consumption is as luxury food and has no direct relevance to food security (e.g. Brooks et al. 2010, Sandalj et al. 2016, Olmedo et al. 2021). This survey showed that most civet farm owners interviewed did not consider farming as their main source of income. Additionally, the reported profits were relatively significant for large farms, which had a fast rotation of animals and stable outputs, but not for the majority of farms which were relatively small in size and therefore vulnerable to changes in market prices and losses of captive civets.

Conclusion

Civet farms in central Vietnam do not support the conservation of wild civet species in the country but instead represent a threat to wild populations. There appeared to be very little regulation of the facilities by the government authorities: a substantial number of farms were non-registered and, therefore, illegal. Interviewees reported poor standards of captive and veterinary care, a dependency on wild civets to restock, and very rarely any management of breeding individuals. Additionally, civets were often in close proximity to each other, with different animal species kept within the same facility; this will increase the potential for emerging infectious diseases and zoonoses.

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Trinh Thi Mai
Save Vietnam's Wildlife, Cuc Phuong National Park,
Cuc Phuong, Nho Quan, 430000 Ninh Binh, Vietnam
Email: maitrinh.eco@gmail.com