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Management Guidelines for Owston's palm civet, *Chrotogale owstoni* (Thomas 1912)

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The Owston's Palm Civet Conservation Program
Cuc Phuong National Park
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Management Guidelines for the Welfare of Zoo Animals – Owston's palm civet
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Section 1: Biology & Field Data

1.1 Biology

1.1.1 Conservation Status

Due to its largely terrestrial habits, Owston's palm civet is vulnerable to snaring, a hunting method ubiquitous throughout all countries where the species is distributed (Barney Long, unpubl. data). It is rarely shot as it is difficult to observe (Le Khac Quyet pers comm., Simmons et al, 2001). All civet species in Indochina are eaten and the bones used in traditional medicine. Owston's palm civet appears to be in slightly higher demand than other civets due to its beautiful pelt and the large scent glands; the latter used in traditional medicine (Le Trong Dat & Barney Long, unpubl. data.).

The species has a relatively restricted range comprising of Vietnam, parts of Laos and extreme southern China bordering Vietnam and Laos (Schrieber et al, 1989; Rozhnov et al, 1992); at least one reason for its fragmented distribution is the destruction of lowland forests in Indochina over the past few decades (Wedge *et al.* 1999). The species is probably not in immediate danger of extinction in the wild, however data on its ranging patterns and social organisation is required in order to calculate the minimum dynamic area for a viable population. Until such information is available, the ongoing threat of forest fragmentation across the species range cannot be assessed. Although Owston's palm civet has been recorded at several protected areas, it is not known how many of these are large enough, ecologically intact or adequately protected to support viable populations.

Range state	Status	Reference
Vietnam	Vulnerable	MOSTE, 2000
Lao PDR	Little Known in Lao	Duckworth *et al.* 1999
China	Endangered	Sung Wang, 1998
Cambodia	Not confirmed – two specimens possibly originating from Cambodia are in Phnom Thmao museum.	Colin Poole pers. comm.
Global status	Globally Threatened; Vulnerable A1cd CITES Appendix II (Controlled Trade)	Hilton-Taylor, 2000

1.1.2 Taxonomy

[Carnivora – Viverridae – Hemigalinae – Chrotogale - owstoni]

The species belongs to the family Viverridae, subfamily Hemigalinae, which includes the four genera *Hemigalus*, *Chrotogale*, *Diplogale* and *Cynogale*. The sole living member of its genus, *Chrotogale* demonstrates an elongated skull and very unusual dentition for a civet. Thomas originally described the species in 1912, where it remained until Corbet & Hill (1992) moved it to the genus *Hemigalus*. This was, however, not followed by Wilson & Reeder (1993), and recent phylogenetic analysis (Veron & Heard, 2000) using cytochrome b sequencing has confirmed that *Chrotogale* is sufficiently distinct from *Hemigalus derbyanus* to justify it remaining a separate genus.

Although the distinctiveness of the genus in now well documented, there is still a question about the possibility of two sub-species of *Chrotogale owstoni.* The questionable status of subspecies has been raised by both Vietnamese and foreign scientists (Groves; Dang; Anh; pers. com), largely on the basis of morphological

evidence collected from a small number of specimens held at the Institute of Biological and Ecological Resources (IEBR), Hanoi. Other researches have also raised this possibility based on observations of live animals in the wildlife trade and exhibits in Vietnam, and it is suspected that the variation may reflect a north-south geographic divide, or of a geographic Red River Delta divide.

Clarification of the subspecies status and information on the species intraspecific diversity would be of considerable value to the ongoing efforts to improve and expand the species captive breeding, and refine in situ conservation priorities. Should there be two subspecies of *Chrotogale owstoni*, such information would be of great significance in order to retain the genetic diversity of subspecies and avoid hybridisation.

1.1.3 Pelage Patterns

Owston's palm civets are easily identified by the four brown-black dorsal bands which cross their backs. The tail is two-thirds black and has two smaller bands at its base. The dorsal neck has two black bands starting from the top of the head and splitting across the shoulders. On both sides of the neck, front legs and back legs are black blotches of varying definition. The background colour varies from ivory /grey to silver/grey with yellow tinges seen on the front of the body and face, and the underside varies from ivory to a striking orange. This orange coloration occurs around the genitalia in females and spreads weakly along the ventral pelage towards the belly. In males, the orange coloration ranges from barely visible, to a striking orange streak that spreads up the length of the animal's ventral pelage towards its chest.

1.1.4 Morphometrics

The following measurements are taken as an average from the captive adult animals held at the OCP.

Measurement	Adult Range	Method
Head/body length	545mm –590mm	From the tip of the nose on an outstretched head to base of tail
Tail	425mm –550mm	From the base to the tip of the outstretched tail
Right hind foot length	43mm –48mm	From the back of the footpad to the tip of the paw
Right front foot length	28mm –44mm	From the back of the footpad to the tip of the paw
Girth behind shoulders	227mm –280mm	Taken around chest immediately behind the front legs
Weight	2kg-3.5kg	Weighing scale (0g – 10kg)

1.1.5 Captive Behaviour

The following information is derived from the experiences of the Owston's palm civet Conservation Program in Cuc Phuong National Park.

Owston's palm civets are nocturnal. In captivity they are primarily active in bouts from around 5:30pm through till 5:00am, approximately sundown to sunrise (see also Dang et al, 1992), although active infants have been observed throughout the afternoon. Though excellent climbers they are mostly ground dwelling. While they forage primarily through leaf litter looking for insects, they will also spend time on branches foraging, travelling, resting and grooming.

The males have an external scent gland between the testicles and penis, and the females' horseshoe-shaped external scent gland is located around the vulva. Animals scent mark objects in their cage with these glands and also urinate and flank rub objects

to mark them. Scent marking is at its highest during the breeding season, and when an animal has been introduced to a new enclosure (Roberton, Rosenthal pers obs).

1.1.6 Physiology

The following are averages derived from Streicher (2001) taken from captive animals under anaesthesia. Records have not been gathered from animals not under anaesthesia.

Heart rate:	81 beats per minute
Respiratory rate:	60 breaths per minute
Body temperature:	37.2 °C

1.1.7 Longevity

An animal that was confiscated from the wildlife trade as an adult in 1996 is thought to be the oldest in captivity at this time. The animal is estimated to have been at least three years old when confiscated, which would make it at least eleven years old now. There is no data on longevity in the wild.

1.2 Field Data

1.2.1 Biogeography

Until the last decade, Owston's palm civet was only known from a few sites in northern Vietnam, and southern China bordering Vietnam (see Schreiber *et al.* 1989 and references therein; Rozhnov et al 1992). With the opening up of Indochina to field scientists since the late 1980's more field records have come to light. Rozhnov *et al*. (1992) recorded the species in the northern part of the Tainguen Plateau in Gai Lai Province (central Vietnam). More recent investigations have confirmed the presence of the species along the Annamite Mountain chain (SFNC, 2000). Apart from a single interview report from Bu Gia Map Nature Reserve (Nguyen Van Sang, 1997), no confirmed records have come from the southern Annamites below the dry forest complex of eastern Cambodia and south-west Vietnam.

To the east the species could not radiate due to the Gulf of Tonkin and it appears that it did not reach the Island of Hainan, which in many other respects has a fauna more closely related to the Annamites than adjacent main land China. To the west, Owston's palm civet appears restricted by the extent of the Annamite Mountains, which is halted by the Central Indochina Dry Forests in the western part of Lao PDR.

Its is probable that Owston's palm civet is one of a clade of species that evolved in the Annamite Mountains during a period of refugia in past ice ages, and which have radiated out from this evolutionary centre to differing degrees. Owston's palm civet appears to have spread northwards in a similar fashion to the crested gibbons (*Nomascus spp*); unlike this group it may not have spread south into the Southern Annamites, although the paucity of field surveys to date means that its presence in this area cannot yet be ruled out.

1.2.2 Reproduction

Nothing is known of the animal's breeding behaviour in the wild. The reproductive cycle in the wild has not been studied, however information on birth season in the wild has been deduced in part from young animals and pregnant females that appear in the trade. Thus, most of the information on this species reproduction originates from the captive populations at Cuc Phuong National Park and Hanoi Zoological Gardens.

1.2.3 Diet & Feeding Behaviour

Owston's palm civets forage through the leaf litter and respond to movement sounds more than insect calls (Roberton pers. obs.). Once a prey item has been located sight appears to be the primary sense used for capture.

The dentition of Owston's palm civets is far more delicate than that of other viverrids and this suggests certain restrictions in the diet of the species. For example, the strong jaws and teeth of a Large Indian civet can kill and masticate a chicken, but an Owston's palm civet offered chicken on the bone broke a tooth whilst eating (Linda King pers comm.). This is further reflected in their diet preferences in captivity, which is for primarily soft-bodied fruits and animals, with insects and earthworms being their predilection.

Hunters have reported that the stomach of Owston's palm civets always contains earthworms. Scats collected from two semi-wild living animals revealed a mostly invertebrate diet with evidence of earthworms, some fruits and plant matter (Hill 1998; Rosenthal, in prep).

1.2.4 Ecology

Very little is known about the wild ecology of Owston's palm civet. From the limited information gleaned from photo-trapping studies, interviews with hunters and a monitored release of two captive-bred animals, (Le Trong Dat, Long, Roberton & Rosenthal pers. obs.) it is likely that Owston's palm civet are restricted to evergreen moist tropical, sub-tropical and limestone forests. Furthermore, while some interview information indicates that they can exist in degraded forest (Schreiber et al, 1989; Linda King, pers comm.) interview data suggests the species prefers primary forest to heavily degraded forest (Barney Long unpubl. Data.). It has been recorded between 300 and 1600 m a.s.l. (SFNC, 2001; Steven Swan pers. comm.). It is a mainly terrestrial species, but will use arboreal routes to travel, and rest, and may sleep high in the canopy either in a hollow or on a sheltered branch.

Section 2: Management in Captivity

All information below is from experiences of the Owston's palm civet Conservation Program, Cuc Phuong National Park, Vietnam.

2.1 Housing and Exhibit

As so little was known about the species in the wild, enclosures were originally furnished based on (1) the basic behaviour and ecology of other civet species, and (2) common sense deductions made from observations on the first captive animals, prior to their cages being structured. The species was known to inhabit primary forest at Cuc Phuong, where leaf litter is often a ground substrate; their dentition and feeding habits are suited to animals and insects which often lay beneath such a surface; given their adept climbing skills they clearly use arboreal dimensions; and it was expected that they would use some sort of secure, private sleeping site. As a result, enclosures were created with a variety of plants and climbing substrates at various levels represented, in addition to meeting the basic needs of shelter. In captivity they are very competent scaling log runways, vertical branches, and even the wire mesh sides of their enclosures.

2.1.1 Cage Specifications

At Cuc Phuong, the following cage specifications have been developed based on the above, whilst working within the constraints of a limited budget and only locally available materials.

- Adult cages: Walls and roof made of a 55mm galvanised wire mesh.
- Breeding cages (to contain infants): Walls and roof of 30mm galvanised wire mesh to prevent infant escapes.
- The following dimensions to be considered a minimum: Length: 6m; Width: 5m; Height: 3.5m. (30 sq. m) This will comfortably house a pair of animals or a family group (mother, father, and offspring up to one year).
- The wire mesh is sunk into concrete footings 40cm deep to prevent escape by animals digging out, and to prevent rodents from digging under the cage.

Wire must be of good quality and rust resistant. It is critical that there are no loose or sharp ends from (i) adjoining wire ends and (ii) tie wire used to close lengths of mesh in order to prevent animal injury when animals climb the mesh. Cage doors open onto an enclosed porch that has a sloped concrete floor to allow easier cleaning. Breeding cages are separated with a concrete wall that has a (30cm x 45cm) wire mesh sliding door to allow introduction/separation of animals, controlled by the keeper from outside the enclosure. The sliding door can be solid or mesh depending on the level of contact required.

2.1.2 Substrate

The enclosure floor is not concrete, but rather it is left natural. Forest plants and grasses are planted around the floor giving areas of different vegetation density. Rocks, log piles, cut bamboo/grass and leaf-litter cover the floor and provide many different foraging substrates. If leaf litter is unavailable, other substitutes should be tried in order to promote maximum foraging behaviour.

Logs, branches and stones should be provided on the ground to enrich the environment. These items should be rotated, changed or supplemented within each cage monthly. The animals will scent mark these items. By making the above changes to these items, it is thought that the animals are provided with small changes in their environment which make it more interesting, without introducing major changes (such as a complete cage move) which may be a stressful experience. The provision of new items is one attempt to help keep the animal interested and active in its enclosure, promote a normal repertoire of behaviours and hopefully reduce the chance of any abnormal behaviour developing.

2.1.3 Furniture

Furniture should be constructed so that all cage levels are utilised, and animals have the maximum amount of usable space. Branch runways should be constructed at lower, middle and upper levels of the cage. Resting platforms should also be available at different heights. Branch work should be sufficiently complex to allow animals to avoid each other when climbing in the exhibit.

Regular checks of furniture should be made, and rotting pieces of wood moved to the floor to (i) prevent injury to animals and (ii) create log piles in the cages to attract insects or provide a hiding place for provided food, and thus increase foraging. Meticulous attention must be given to removing loose and fallen wire.

2.1.4 Shelter

A portion of the cage is roofed providing shelter for the nestbox. The same shelter needs could be met using an indoor house, particularly in areas where the temperature would drop below freezing, however a sheltered outdoor nestbox is still advisable. In addition to this, some animals have been found to make use of small caves, log tunnels, and log hollows as resting areas.

2.1.5 Nestbox

A nestbox is provided in a site elevated approximately 1.2 meters off the ground. It should be easily accessible to the animals from at least three approaches made of securely fixed branches. There must be adequate room to allow keeper access to the box.

At Cuc Phuong, boxes are made of wood with a hinged roof to facilitate keeper access. There is one entrance in the front, sufficiently large to allow the animal to enter easily but not so large that the animal remains exposed to the elements once inside. A baffle board can be added to increase protection from the weather and disturbances. The entrance has a removable door that can slide in and out, so that the whole box can be closed with an animal inside (to facilitate moving animals to other cages, veterinary treatment, etc). The box should be large enough to accommodate 2 individuals (~ 45cm x 40cm x 40cm). If more animals are caged together (i.e. mother and young) the box must be sufficiently large to allow all animals to enter and rest easily inside. Boxes should be provided at the rate of at least one per adult animal.

Any type of box that meets the needs of animal and keeper as indicated above can be tried. “Naturalistic” boxes, or boxes which allow better viewing access (i.e. part tinted glass) and thus provide a better exhibit are acceptable, provided they do not compromise the comfort, shelter and security of the animal.

In the winter (<13ºC) straw bedding approximately 2 inches deep should be placed in the boxes to provide some insulation against cold. This should be replaced as necessary

should it become soiled, and removed at the end of winter when the weather warms. A thin layer of straw also prevents the animals getting bedsores from laying on a hard surface, something which newly confiscated animals have been prone to (and thus perhaps sick animals).

In hot periods (>30ºC) there is a danger that animals may become overheated. During the summer months it is advisable to prop the roof open slightly (approximately 1.5 inches) to facilitate air movement in the bed box. Care must be taken to ensure that the box lid will not snap shut easily thereby causing injury.

2.2 Sanitation

The captive Owston's palm civets at Cuc Phuong have learned to habitually defecate in water. Animals confiscated from the illegal wildlife trade as well as captive-bred animals have been found to defecate in their water bowls. Therefore each cage should have a water bowl sunk into the ground in addition to a drinking water bowl. The animals will distinguish between the two and only use on as a toilet. However, it is important to check for other toilet sites that are being used independent of the toilet bowl and clean as necessary.

Nestboxes should be checked daily for defecation and old foods, as often during rain animals carry their food to the box to eat.

2.3 Enrichment

Pacing behaviour has been observed in some individuals reinforcing the need for an ongoing enrichment-monitoring program. Feeding enrichment is very important in reducing this abnormal behaviour and the devices used are shown in more detail in Appendix 1 (Roberton in prep).

2.4 Capture, Handling and Transport

2.4.1 Capture

The animals are best trapped within their nestbox to reduce stress from being chased around the enclosure. Capture can also be achieved using a crash cage, or a catch bag made of denim fixed around the nestbox doorway into which the animal can be encouraged.

2.4.2 Handling

Animals are best handled by grasping the base of the tail and the scruff of the neck. It is important that the handler wears thick gloves and keeps a first aid kit close at hand.

2.4.3 Transport

The animals are best transported in enclosed boxes with sufficient ventilation holes or fine mesh grills to allow adequate airflow. No aperture should be large enough to allow noses or paws to protrude out. Boxes should be sufficiently large to allow the animal to turn around easily, but small enough for the animal to feel secure. If the animals are being transported by air then boxes must conform to the recognised IATA standard. See IATA (1994) Live animal regulations or contact them at:

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International Air Transport Association
IATA Centre
33, route de l'aeroport

PO BOX 672
CH-1215 Geneva 15 airport
Switzerland

Tel: +41 (22) 799 2523
Fax: +41 (22) 799 2681

2.5 Social Structure and Behaviour

2.5.1 Basic Social Structure

There is no information on the animal's social structure in the wild, but observations in captivity suggest that the animal could be solitary and pair up in the breeding season (Rosenthal and Roberton pers obs).

There are no strict rules on how animals are best housed together. The five founding animals of the OCP were infants, and all kept in a single cage with little aggression for more than a year. However, it is thought that this was due to the young age of these animals. Recent attempts to house three animals of different origin have resulted in aggression, and one animal became subordinate to the other two. It is likely that siblings of the same sex will live together indefinitely without incidence if not separated for any length of time.

The success of single-sex pairings depends on the temperament of the individuals, some pairings working well and others not at all. In general it is easier to house a mixed sex pair than three or more unrelated animals. When choosing a male/female pair it is mandatory to consult the studbook keeper on most suitable pairings.

If a pair of animals shows constant aggressive interactions that limit their foraging, then these animals are not compatible. If aggression lasts longer than a few days, the animals should be separated.

Breeding pairs, or other animals newly introduced to each other, should be provided with a minimum of one nest box per animal. It is important to insure that neither box is obviously preferable to another. This can be achieved by locating both boxes in well-sheltered, accessible areas at the same height.

When new animals have been introduced to each other it is important to check the boxes regularly for faeces as stressed animals will defecate in their box. This is a sign that an animal is stressed and should be moved to another cage.

2.5.2 Mixed Species Exhibits

In the past the Owston's palm civets were house with a small number of tortoises. There was no observed antagonistic behaviour between the animals; the only problem experienced was that the civets would eat the tortoises' food (Hendrie pers comm.). This can easily be overcome by feeding the turtles in a separate area inaccessible to the civets.

2.6 Reproduction

2.6.1 Reproductive Cycle

Oestrus has been documented as occurring from late January - November (Hao, 1973), January - March (Dang et al 1992; Dang & Anh 1997), January - February (Heard Rosenthal, 1999) and January - April (Roberton unpubl.). Clarification of the reproductive cycle of Owston's palm civet is the focus of a study using faecal hormone analysis, and is being carried out at the time of writing this document.

Nonetheless, there are clear signs to oestrus in the females. The vulva becomes swollen and secretes, and the female exhibits increased scent marking and interest in males housed in the same cage or opposite.

Litter ranges from one to three offspring, yet in both cases of triplets one has died.

2.6.2 Mating System

Although not reinforced with field records, captive observations have indicated that Owston's palm civets may have a polygynous mating system (Roberton pers obs). Females have never been housed with different males after copulation has occurred, as the animals are part of a conservation breeding program. Therefore, it is possible that a polygamous system is in action.

2.6.3 Courtship and Mating Behaviour

During the breeding season scent marking and flank rubbing increases in both sexes, and animals are observed following each other more often. The male also will smell the ano-genitial region of the female with more interest. A bout of copulation usually lasts 2-3 minutes in which the female will lay prone to the ground often purring, whilst the male will straddle her sometimes resting his head on her back. The female will raise her tail, exposing her vulva allowing penetration, an action not present in failed attempts by the male. Males have been observed mounting females in an attempt to copulate throughout the year (Dang & Anh 1997; Heard Rosenthal & Roberton pers obsv.). In many cases this is simply ignored by the female who will walk away, yet in some cases she will snap at the male and break his mount.

Aggression between breeding pairs has been observed at varying intensities, often peaking throughout the breeding season. Throughout the breeding season, two nest boxes should be provided in all cages containing pairs to allow the animals to sleep separately if desired. Daily checks should be made as to whether either animal has sustained injuries throughout the night that went unobserved, and treatment administered as required (see Treatment 3.3)

When introducing animals to each other it is important to provide two nest boxes ensuring one is not obviously preferable to the other (see Basic Social Structure 2.6.1). A staff member must remain present for the animals' first interactions, and be prepared to split them up if aggressive encounters escalate and it appears that injury might occur. If animals are housed in neighbouring cages prior to being introduced, it is possible to deduce from their "neighbourly conduct" whether or not they will pair well. Maintaining a record of individual animal behaviour profiles can be very helpful in planning cage pairings. Records must be kept of which animals have been tried together and this can also assist pairing and housing decisions.

2.6.4 Pregnancy and Birth

Disturbance is minimised throughout pregnancy and the first weeks after birth, as it thought that the problems in infant mortality at Hanoi Zoo might have been partly stress related.

The gestation period of Owston's palm civet has ranged from around 75 to 90 days (Rosenthal 1999, Roberton unpubl.). Hanoi Zoo recorded gestation periods ranging from 60-70 days (Dang et al, 1992), yet only one of these offspring survived, and those that died weighed much less than other offspring with a longer gestation time (Dang & Anh 1997). A gestation period of 80 days is more advantageous and infants are seen to be more developed (thicker fur, genitals are more developed, noses less pink and they exhibit more robust behaviour) (Rosenthal 1999).

Weight gain during pregnancy becomes noticeable up to a month before birth and in the days immediately prior to birth the female's nipples will become elongated and the surrounding area slightly swollen (Rosenthal 1999, Roberton pers obs). At this time the female will rest more than normal and the day before birth has been heard meowing (Roberton pers obs). Nest building has been reported at Hanoi Zoo (Dang & Anh 1997) but this has not been observed at the OCP. The male will often leave the nest box and rest on the logs in the days immediately prior to birth (Rosenthal 1999, Roberton pers obs).

Births mainly occur in the night but have also occurred in the early evening and middle of the day. Birth has been observed inside the nest box and on the cage floor (Rosenthal 1999, Roberton pers obs). Delivery time is around one hour to one and a half-hours. Throughout the night and the night before giving birth, some females have been heard to make a grumbling vocalisation (Roberton pers. obs.). Contractions are strong, lasting 30-45 seconds in which time the female's body is arched, her head tucked down and vagina protruding (Rosenthal 1999). This has been observed while she is standing and lying down. The female licks her vagina and nipples throughout giving birth and has been observed licking continuously from when the baby is first seen (Rosenthal 1999, Roberton pers. obs.).

Babies have been expelled whilst the female is resting on her side and once from a standing position (Rosenthal 1999, Roberton pers obs). Once born the mother grooms the baby extensively and eats all afterbirth, including the umbilical cord. The young start milk feeding immediately. Birth weights of 80g – 135g were recorded at Hanoi Zoo (Dang & Anh 1997).

When stressed, the mothers will move the infants around cage and from nestbox to nestbox (Rosenthal 1999, Roberton pers obs). The babies are held in the mother's mouth across their backs. Infanticide has not occurred in captivity to date.

2.6.5 Hand Rearing

The original founders to the OCP were young infants and had to be hand raised on powdered cow's milk for the first week. Pablum, milk and banana followed this for a further three weeks and finally, worms and other solids, with milk/banana given for another five weeks.

None of the captive-bred Owston's palm civets have been hand reared as infants.

2.6.6 Infant Care and Development

The following observations are from animals at the OCP. They are presented as a rough guide to what we have observed in our animals.

1 day	Milk feeding
4-15days	Eyes open
10-14 days	Wobbly walking
4-6 weeks	Emerging from the nest box and starting to explore cage with mother who moves them back to bed box at any slight disturbance
7 weeks	Independent cage exploration, mother still vigilant
8-10 weeks	Playing and eating adult food. Preferences for eating grapes and sucking worms.
12-13 weeks	Catching grasshoppers and stick insects on their own.
12-18 weeks	Weaned. Although one sole offspring continued to suckle until week 21.
16-21 weeks	Eating adult food

Female Owston's palm civets have four nipples that produce milk. The lower two teats are preferred by the young and as there have never been more than two offspring in a surviving litter, there has been no competition observed for teats. The female will feed her offspring either laying on her side or more often reclined on her back against the wall of the nestbox or a log (Rosenthal 1999, Dang & Anh 1997, Roberton pers obs).

The young civets demonstrate an impressive array of vocalisations. From birth they are able to purr, meow, growl and chuff (Rosenthal 1999, Roberton pers obs). Chuffing is used by the mother to draw the offspring in and vice versa in the infants. Civets have also been observed to chuff at other civets in neighbouring or adjacent cages (Rosenthal 1999, Roberton pers obs).

Up until around seven weeks of age, when presented with a frightening situation, the young would not spit or bite but will either lay flat to the ground or run away (Rosenthal 1999).

It is important to monitor the development of infants, in particular recording their weight using the least invasive methods. In many cases of two offspring, one will gain weight better than the other will. It is important to monitor this and, if necessary, provide food for the underweight animal in isolation.

Owston's palm civets' reach sexual maturity between 18 months and two years (Rosenthal 1999). At this age animals will have the characteristic long face and males will develop the orange coloration, of varying brightness, on their undersides.

2.6.7 Parental Care

The female will spend a lot of time grooming the infants, and eats their defecation.

Bi-parental care has been observed to varying extents. One father was seen to groom the infants and react to their chuffs whereas another would take little interest in them. There has never been any serious aggression by fathers remaining in the same enclosures as infants, nor have there been any obvious behavioural differences in infants that were raised by both parents or just the mother.

2.6.8 Reproductive Life-span

As longevity is not known and estimating ages of wild animals is inaccurate, it is difficult to estimate reproductive life span.

2.7 Population Management

2.7.1 Captive Population Status

Institution	Male	Female	Unknown	Captive-bred	Wild origin	Total
OCP	11	11		13	9	22
Singapore Zoo	1	2			3	3
Frankfurt Zoo		1			1	1
Hanoi Zoo	1	4		4	1	5
TOTAL	13	18		17	14	31

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2.7.2 Species Management Programs

An international breeding loan program for the species is currently under development and a studbook is being completed as this document is being written.

2.7.3 Animal Identification and Sexing

The civets are easily sexed through differences in external genitalia. Sexual dimorphism is not very clear although the brightness of orange coloration on the undersides of females is duller and less pronounced that in that of males (Rosenthal & Roberton pers obs).

The following photographs are also taken of each animal to help in identification purposes:

Left Head/Shoulders	Right Head/Shoulders
Above Head/Shoulders	Left flank
Right flank	Full Dorsal
Whole Left side	Whole right side
Full Ventral	

A Coat Markings sheet is also filled in to assist in quick identification of the animal, and for research on variance in coat markings in the species.
The following are recorded:

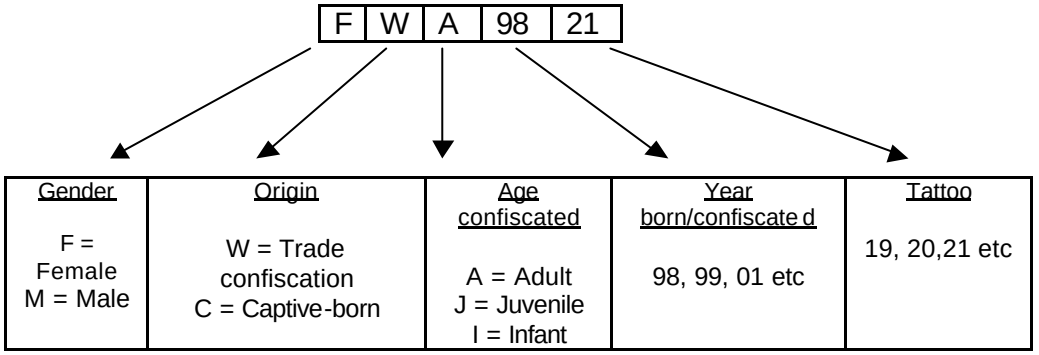
a) Colour and definition of dorsal bands, front leg markings, rear leg markings, neck markings, and lower flank markings
b) Number and shape of front leg markings, rear leg markings, neck markings, and lower flank markings
c) Background coat colour
d) Underside colour

Tattoos are used in addition to the above method to ensure the correct identification is made. Microchips and transponders would be the preferred choice of identification but current funding restricts this option. Tattooing is carried out with the animal under anaesthesia and made on the inner left ear after carefully shaving the area.

All animals are given a local identification number that is displayed on the relevant cage door and in all records. The ID number is designed to give information about the animal (Fig 1).

Figure 1: Identification numbers in Captive Owston's Palm civets held at Cuc Phuong National Park.

Example: FWA9821



2.8 Nutrition

As natural a diet as possible should be provided and designed to represent seasonality. Insects must be live when fed; if they are dead the civets will not eat them and they offer far less to enrichment. Dietary preferences may vary from animal to animal (Rosenthal 1999, Roberton pers obs). Owston's palm civets also take a variety of market-purchased fruits, vegetables, fish and meat (Rosenthal 1999). Although a planned diet is used at the OCP it is a very flexible, and varies with food availability and season.

2.8.1 Basic Diet

The table below shows the food groups the OCP selects its daily diet from. In general, one item is chosen from each group at a time. Nonetheless, this is a very flexible diet and a number of items are often used from each group and split proportionally over the daily amount needed.

Live food is plentiful in Cuc Phuong outside the winter season, and during the summer months provided on a daily basis in varying quantities. A winter vegetable is only used throughout the dry season when insect populations have dropped.

Group	Item	Daily Amount	Notes
Meat	Pork	30g	Raw, minced
	Beef	30g	Raw, minced
	Chicken	30g	Raw, minced
Egg	Duck	1 per week	Raw/boiled and Chopped
	Chicken	1 per week	Raw/boiled and Chopped
Winter Vegetable	White sweet potato	50g per week	Cooked and mashed/chopped/shredded
	Red sweet potato	50g per week	Cooked and mashed/chopped/shredded
	Sugar Beet	50g per week	Cooked and mashed/chopped/shredded
Fruit	Apple	30g	Chopped
	Pear	30g	Chopped
	Papaya	30g	Chopped
	Custard Apple	30g	Chopped
Grape		30g	Whole
Banana		1 medium-sized	Skinned and chopped
Worms		150g	Live
Live food	Stick insects	Ad lib	Live
	Grasshoppers	Ad lib	Live
	Locusts	Ad lib	Live
	Crickets	Ad lib	Live
	Geckos	Ad lib	Live
	Centipedes	Ad lib	Live
	Tadpoles	Ad lib	Live
	Preying Mantis	Ad lib	Live
	Small snails Frogs	Ad lib 1 (week)	Live Live
	Small fish	2 (week)	Live
	Beetles	Ad lib	Live
	Moths	Light trap	Live

2.8.2 Feeding Regime

Feeding is carried out three times a night, a method thought to maintain an extended foraging time.

The three components are as follows:

a) Fruits, meat, egg (scattered)
b) Worms, insects (scattered)
c) Enrichment feeding devices

There is no strict rule as to what order the components are given and it is changed on a random basis. The time that each is given varies between 6:00pm to 8:30pm. Food bowls are only used in quarantine cages as it is felt that these offer little to enrichment, and by scattering the food around the cage the animals spend more time foraging.

2.8.3 Water

Water bowls are provided in all enclosures and the water replaced daily. Shallow pools can also be used and provide a location for the animals to hunt for fish and frogs. The pools must be easily cleaned as some animals may use them as toilets.

2.8.4 Monitoring

Animals are weighed on a weekly basis. Dietary changes are made if an animal becomes underweight or overweight.

Although difficult to carry out in enclosures that contain more than one animal, monitoring food intake is important. This requires the keeper to spend adequate time getting to know the needs of each animal, and to spend time watching them after feeding to ensure all are receiving adequate amounts of food.

2.8.5 Special Dietary Requirements

From the time that infants are weaned until they are around eight months old, the food given to their enclosure should be chopped smaller than for adults. This will allow them to chew the food more easily (Rosenthal 1999, Roberton pers obs).

The amount of live food given to females is increased during pregnancy and parturition until the infants are weaned

All enclosures should be planted with bamboo, or plants with a similar leaf structure (e.g. grasses). All animals eat these leaves on a regular basis, and will also take the tips of wild ginger plants. It is thought that these plants could be to assist in passing earth that lies in the stomach after eating worms, and as an intestinal scourer (Rosenthal 1999, Roberton pers obs, Hill 1999).

Section 3 Veterinary Guidelines

The success of captive breeding of the species is a priority. Concerns of stressing the animals through invasive monitoring and treatment techniques thus have modified all practices and always the least invasive method is chosen.

3.1 Routine Observation

Animals should be monitored daily for any health problems by the animal keeping staff. Observations are best achieved during feeding time but checks are also made in the nest boxes in the morning. This is particularly important in cages containing animals that have been put together recently. These animals may have injured each other through the night. Nestbox controls are likewise important for pairs throughout the breeding season where animals have been observed to be more aggressive. When checking the nest boxes it is important to do this quietly and quickly to avoid unnecessary disturbance. Nest boxes of animals with litters should only be checked if it seems absolutely necessary.

Mirrors, video cameras or glass backed nest boxes have been suggested as possibilities to control the nest boxes without disturbance of the animals. These options are currently investigated.

A basic health check comprises the following aspects:

Alertness

☑ The animal is alert and holds its head upright

☒ The head is sunken to the chest
☒ The animal seems sleepy
☒ The animal cannot support its head straight and wobbles

Eyes

☑ The eyes are bright and actively looking around

☒ There is blood, puss or other secretions from one or both eyes
☒ Animal is unable to open both eyes fully
☒ There is swelling around the eye
☒ Eyes seem greyish, dull or sunken

Nostrils

☑ The nostrils are clean and the animal breathes normally

☒ There is blood, puss or other secretions from one or both nostrils
☒ The animal is breathing heavily
☒ Breathing is accompanied by sounds

Ears

☑ The animal can move its ears and responds to sound

☒ There is blood, puss or other secretions from one or both of the ears
☒ One ear is hanging
☒ There are injuries or swellings around the ear

Coat
☑ The coat is dense, closed and shining

☒ There are injuries, wounds or scars
☒ There are bald patches
☒ The fur seem dull, thin
☒ The animal is excessively scratching

Body shape
☑ The animal has a normal body shape and moves freely

☒ There are swellings or lumps visible from the outside
☒ The animal holds its body or limbs in an abnormal position
☒ The animal shows lack of function of a limb

Tail
☑ The animal can move its tail freely

☒ There are swellings or lumps visible
☒ The animal holds the tail in an abnormal position
☒ Animal shows lack of motility in the tail

3.1.2 Behaviour
It is important to monitor the general behaviour of each the animal; this can be aided through intimate knowledge of individual animals' behavioural traits, characteristics and temperament, which are often markedly different from one animal to another.

3.1.3 Bodyweight
Animal weights are recorded once a week using a baited weighing scale inside the enclosures. Controlling the bodyweight of growing infants seems to be extremely important for insufficient weight gain until the onset of the cold season in December might result in severe problems. Separation growing animal for supplementary feeding for a while might become necessary if their weight gain is not satisfactory.

3.1.4 Faeces
Faecal colour, composition and amount are observed daily and when anything abnormal is observed a sample is retained for examination. As the animals defecate in water bowls, in cages with more than one animal unless defecation is observed it is difficult to determine which animal has produced which faeces in paired cages. In this situation the animals should be separated to determine which is ill.

3.2 Clinical Examination - Anaesthesia
Anaesthesia is necessary for close examination of Owston's palm civets. The capture and administration of anaesthesia is best achieved when the animal is in the nestbox during the day.

Animals brought to the OCP after confiscation from the illegal wildlife trade are anaesthetised during their period in quarantine. This is generally done half way through the quarantine period, but earlier if the animal has any severe injuries requiring immediate treatment that cannot be successfully completed while the animal is awake, or surgery. All captive-bred animals are anaesthetised at two years of age, when they have reached adult size.

A combination of Xylazine and Ketamine is used for anaesthesia. Vomiting might occur in initial stages of anaesthesia. There is good relaxation of the muscles and little salivation. An average dose of 1.9 mg/kg Xylazine and 9.5mg/kg Ketamine is necessary to anaesthetise animals to a surgical level, but excited animals might need higher doses. The anaesthetic effect is achieved usually after 4-10 minutes and the duration of anaesthesia varied between 30 minutes an 2 hours. The animal should be put on an insulating surface and the head should be covered. Though we have never experienced any problems the usual precautions for respiratory problems should be taken. If a long period of anaesthesia is required, sterile eye drops should be applied.

During anaesthesia the following records are taken: Weight (kg), Time hit, Time out, Time reversed, Time up, Dose (ml), Dose (mg/kg), Respiration rate, Heart rate, and Body Temperature(C°).

During this routine anaesthesia, the following records are taken:

Dentition:	Dental formula, plaque/tartar build-up, tooth-wear, and length of upper/lower, right/left canine (taken from tooth gum line to the tip of the tooth)
Head/body length:	Taken from the tip of the nose from the outstretched head to the base of the tail.
Tail:	Taken from the base of the tail to the tip of the outstretched tail.
Head Circumference:	Taken around the head immediately in front of the ears.
Neck length:	Taken from the base of the skull to the shoulder blades
Right ear length**:**	The longest point on the outside of the ear
Girth behind shoulders:	Taken around the chest immediately behind the front legs
Shoulder height:	Taken from the tip of the outstretched right front leg to the top of the shoulder.
Male Scent patch length:	Longest length from front to rear.
Male Scent patch width:	Longest length from the left side of the animal to the right
Female Scent patch length:	Longest length from the scent patch on the right side of the vulva
Female Scent patch width:	Widest length taken from the scent patch on the right side of the vulva
Right front foot length:	Longest point from the bottom of the footpad to the tip of the paw.
Right front foot width:	Widest point of the footpad
Right hind foot length:	Longest point from the bottom of the footpad to the tip of the paw.
Right hind foot width:	Widest point of the footpad
Testis length:	Distance from the base of the testes to the top of the testes
Testis Width:	By pinching just above the testes measure across both testes
Nipple Length:	Left and right lowest nipples

In addition to taking these measurements, a hair sample for DNA analysis is taken once from each animal. This consists of approximately fifty hairs with root bulbs, and is stored in an envelope in a dry place. Plastic gloves must be worn when collecting hair samples

to prevent human DNA contamination. These samples are used for ongoing studies of Viverrid phylogeny, and an investigation into the existence of subspecies within the *Chrotogale* genus(Contact Geraldine Veron: veron@mnhn.fr).

3.3 Treatment

In most cases treatment can be carried out leaving the animal in its enclosure. However, if the animal's condition suggests an infectious disease that might be transferable to other animals it is necessary to separate the animal. A quarantine/ treatment cage must be available to avoid spreading of diseases and disturbance of the other animals, when treating the ill animal. The quarantine cage should be located away from the main keeping area and not accessible by unauthorised people.

3.3.1 Antibiotics

A five-day course of antibiotics has been sufficient in all cases. Treatment has been administered by injection (subcutaneous or intramuscularly) and orally. Oral treatment is usually preferred for it does not require handling of the animal. Antibiotics should be mixed with treats and given to the animal individually. Mixing it with the food is only possible if animals are housed separately. The following daily dosages are recommended:

Penicillin	0.1ml
Streptomycin	0.1ml
Enrofloxacin	5mg/kg
Sulfonamide	15-30mg/kg
Trimetoprim	15-30mg/kg

Antibiotic sprays and creams are used to treat bite wounds and sores and provide a very quick and easy way to administer treatment.

3.3.2 Fluid Replacement

Animals that have been in transport for an extended period of time without water or an animal with diarrhoea can become dehydrated very quickly. In these situations, fluid replacement or rehydration to no less than 10% of their bodyweight is necessary and can be administered in two ways:

Oral rehydration:	Fruit flavoured rehydration solution offered alongside untreated water
Systemic rehydration:	Sodium Chloride (NaCl) or Ringer's lactate injected subcutaneously, intravenously or intraperitoneally

In the past, animals have become overheated during the summer months when temperatures can soar to above 40°C and stay at that level for several days. Overheating is suspected when the animals pant, and move out of their nestboxes to rest on the logs or the cooler concrete cage footings in the daytime. On hot days, the nestbox lid is partially opened to allow increased airflow, but if panting is observed a bowl of fruit flavoured rehydration solution is offered to the animals in addition to untreated water. In extreme cases (accompanied by disorientation or collapse), it may be necessary to remove the animal from the cage to open shade or a cool room, and fan the animal until recovered.

3.3.3 Anti Parasitic Treatment

Faecal samples are taken every six months and checked for parasites. Samples are collected after treatment to ensure that treatment was successful. If samples cannot be taken to confirm presence of absence of parasites, then treatment should be routinely administered twice a year following the following doses:

Fenbendazol	20mg/kg	Orally 3 subsequent days
Mebendazol	20mg/kg	Orally 3 subsequent days
Ivermectin	0.2mg/kg	Orally or subcutaneous

3.4 Quarantine

The quarantine period for Owston's palm civets follows that of all carnivores, being no less than thirty days. If rabies is suspected (a common illness in animals in Vietnam) then the quarantine period should be extended to six months. In the case of an international movement of the species, it is important to refer to the destination country's specific quarantine protocols.

At present the health screening during quarantine only comprises faecal examination for endo –parasites a check for ecto-parasites and a clinical examination under anaesthesia. There are at present no possibilities for serological screening.

Basic requirements for quarantine facilities:

- Located separate from main keeping area
- No public access
- No access for dogs, cats, rodents
- Easy to clean and disinfect
- Sufficiently large
- Separate set of cleaning tools and food bowls

Basic rules for quarantine management

- Access only for authorised staff
- Wash and disinfect hands and shoes after working in the quarantine area
- No movement of food bowls, tools from quarantine cage to other cages

3.5 Post Mortem

Complete post-mortem examinations should be carried out on all animals. The skull and skeleton should be preserved and the skin conserved for future studies. Tissue samples should be taken and suitably stored (in 70% alcohol or formalin) for further diagnostics (histology). Samples should be taken from spleen, liver, lungs, heart muscle, kidney, brain and lymphnodes. Extra specimens of any observed lesions or abnormalities should always be included.

A post-mortem report should be written outlining the results of the section and distributed to institutions involved in the breeding program.

Characteristics to be described:

1) location
2) size
3) weight
4) shape
5) rims, margins
6) surface
7) colour
8) consistence
9) characteristics of cut

Note: Some diseases are transmissible from animals to humans and can result in life-threatening infections. Make sure to wear gloves and a protective gown during post-mortal examination and dispose carcass and rubbish carefully.

3.6 Sterilisation

There has never been permanent sterilisation carried out on Owston's palm civets in captivity. To prevent breeding temporary measures such as separating pairs are at the moment the preferred option. Any permanent sterilisation of animals should be discussed with the species management committee and international studbook keeper.

3.7 Preventative Measures

In addition to the monitoring and routine examinations explained above, a high level of hygiene is important in preventing the introduction and spread of pathogens. The following rules must be strictly adhered to:

- All uneaten food removed from enclosures in the morning
- Fruits, meat and eggs stored in a fridge and prepared immediately prior to feeding
- Vegetables stored in sealed containers out of contact with rodents, insects, birds or domestic animals
- Water bowls washed daily and water replaced. Bowls washed with mild detergent on a weekly basis
- Hand and foot washes used before entering a cage block. Towels regularly cleaned.
- Constant live-trapping regime for rats and mice in and around the vicinity of the enclosures.
- No domestic animals, particularly dogs and cats, allowed access to the cages.
- Toilet bowls cleaned daily with mild detergent and water replaced.
- Daily checks for rotten logs, loose wire, toilet sites and problem remedied immediately

3.7.1 Preventative Dentistry

There are obvious safety concerns with carrying out regular dental checks in Owston's palm civets. The opportunity should be taken to record dental formula; tooth-wear and plaque build up when animals are under anaesthesia.

There is very little known about the nutritional and functional diets of the species in the wild and the diet provided has been based on trial and error. It is important to provide a diet with a range of textures and consistencies to help prevent periodontal diseases and inflammation of the gingival tissues, a particular problem in felids. Providing whole live food such as fish, frogs and insects as well as chunks of fruit are particularly good in providing abrasive action and dental stimulation.

3.8 Vaccinations

Viverrids are susceptible to diseases contracted by felids and canids. Although it has never been recorded in Owston's palm civet, it is thought that rabies, canine distemper, feline panleukopenia, canine leptospirosis and canine hepatitis all pose health threats to the species. For distemper, it has been recommended to use the live chick-embryo-origin canine distemper vaccine that has proved safe in most species.

3.9 Essential Veterinary Equipment

Antibiotica	Baytril (for injection) Penicillin/Streptomycin (for injection) Amoxycillin/Doxycillin/Penicillin (tablets) Antibiotic Spray Antibiotic Cream
Antiparasitica	Ivermectin (for injection/oral) Fenbendazol (tablets) Ectoparasite powder or spray
Anaesthesia	Xylazine 2% Ketamine 10%
Infusions	Ringer lactate (with infusion kit) NaCl (Sodium Chloride) Fruit flavoured Diarolyte
Syringes	1ml, 2ml, 10ml
Canullas	26, 23, 20 GA

3.11 Common Disorders

3.10.1 Moulting period

From approximately March through to June or July the animals go through a moulting period (Rosenthal, Roberton pers ob). During this period the animal's coat condition deteriorates, and there is some loss of definition in the markings. The animals are particularly susceptible to ecto-parasites at this time. Close attention should also be paid to the hindquarters where sores can be a common problem. Multi-vitamin supplements are given to those animals with particularly poor coat condition and sores. Sores can be treated with antibiotic spray.

3.10.2 Sores

Old animals and animals with locomotory problems e.g. amputated legs are inclined to get sores above the tuber coxae. These can be prevented with thick layers of straw in the nest boxes.

Section 4 Recommended Research

Acoustic Communication

The vocalisations of Owston's palm civet are many and varied. There have been calls identified that appear to be communication between mother and baby (Rosenthal 1999, Roberton pers obs). Much of the work to date is qualitative descriptions of calls and when they occurred. Recordings should be made of the vocal repertoire of the species and specific responses and reactions recorded. The use of infrasound in communication has also been speculated due to the amount of 'mouthing' observed in captive animals (Roberton pers obs). A comparison of Owston's palm civets communication to that of other viverrids would also be interesting in identifying any relationships between vocal repertoire, life history and habitat use.

Scent Marking

It is recognised that olfactory communication is important throughout the viverrid family, and Owston's palm civet is no exception. However, the precise functions of scent marking in Owston's palm civet other than playing a role in communicating territory and relationships to others of the species is not well understood. Further research on the function of scent marking in Owston's palm civet (and other viverrids) would assist a better understanding of field behaviour, and would also have important implications for captive programs.

Field Studies

Surveys to determine the distribution of Owston's palm civet are needed throughout its known range countries. An assessment of this species and the status of other small carnivores (including trade review) are required throughout Indochina. Improved understanding of the life histories and behaviour of these elusive animals will assist a more thorough assessment of the threats they face, and aid conservation planning for their future survival.

Environmental Enrichment Assessment and Development

It is critical that institutions maintain a constantly evolving environmental enrichment-monitoring program. This is not only important on a welfare level where activities aim to decrease behavioural abnormalities and provide the animal a stress-free life, but it is also important to help the animals maintain diverse behaviours that may be important to survival in the wild, especially if the species reintroduction's are carried out in the future. Furthermore, a zoo exhibit where visitors can see an animal actively foraging around the cage or interacting with cage mates is far more enjoyable than watching a pacing or resting animal.

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Section 6 Contributors

This document would not have been possible without the following people who have dedicated their time and efforts not only to the production of this these guidelines but to the conservation of this amazing species:

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Thrigby Hall Wildlife Gardens
Columbus Zoo and Aquarium
Fauna & Flora International
Valerie White Memorial Trust
Cleveland Metroparks Zoological Society
Melbourne Zoo
Alice Noakes Charitable trust
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Appendix 1: Enrichment Devices used at the Owston's palm civet Conservation Program

Bamboo Feeders Take one section of bamboo still sealed at both ends and drill holes of different sizes in it. Fill with live food (grasshoppers, worms, beetles, mealworms) and it will release its' contents slowly throughout the night.
Blood bombs Freeze a mixture of blood and water with worms and/or meat (inc. liver, heart, kidneys) in a plastic container with a string passing through it. Once frozen, remove the plastic container and hang with the string in the enclosure. Throughout the night the bomb will melt away giving pieces of meat every now and again.
Plant pots Bury a plant pot in the ground to its lip. Put animals (baby mice, insects and lizards) inside the plant pot at feeding time. This provided a good way to introduce the white mice to the enclosures without worrying about escape.

Light trap
Hang a bright white light in one corner of the enclosure. Ensure that the majority of the light projects out of the enclosure. This will attract flying insects into the cage for the animals to eat. This can be developed with the addition of challenging perching in the area underneath the lamp that will test the animal's agility when catching flying insects.

Leaf piles
Dig a small hollow in the cage floor (~20cm) and cover with leaf litter (or hay). When feeding hide foods under the leaves and the animals will seek it out.

Worm droppers
Drill holes of different sizes into a bowl that will allow worms to drop through. Fill the bowl with worms and fix to the cage roof. The worms will slowly find their way out dispersing throughout the night. This can also be developed for mealworms.

Wobbly bamboo bridge/walkways
Suspend some of the log walkways with rope allowing them to swing slightly. Arrange in such a way that the animals are forced to use these walkways, e.g. By placing food at one end. These walkways will keep the animals' muscles toned.

Log tunnels
Hollow logs and tunnels constructed with lots of smaller logs provide a good way to enrich the enclosure perimeters. Animals will often rest under these or forage on top of them.

Caves
Caves constructed of rocks and filled with leaf litter not only provide a good place to hide food, but a good place for live food to hide!

Scent marked rocks
On a random basis introduce rocks from other cages that are known scent marking rocks. This will excite the animal (particularly if from cage of opposite sex) and the animal will often increase their own scent marking as well as a more active foraging of the cage searching out the smell.

Log/branch piles
Piles of logs and sticks provide another good place to hide food and for live food to hide. In general a lot of variation in ground cover is encouraged (leaf piles, cut grass, hay, mud, gravel), offering different foraging substrates to keep the animal actively foraging longer.

Shallow Pools
For some animals the addition of a shallow pool adds a new and interesting place to search for fish, tadpoles and frogs. However, for many animals they offer a more interesting toilet site and more work for the keeper. Nonetheless, they are used in the cages at the OCP as we feel the improvement to the captive animals' lives and the live animal hunting opportunities they offer out weigh the extra work it can entail.

Appendix 2: Hand-rearing guidelines for Small Carnivores

Stewart Muir, Shaldon Wildlife Trust

The need to handrear

Hand rearing may be necessary for a variety of reasons – rejection by the parents, ill health of the mother or weakness of the offspring.

Careful consideration must be given as hand rearing requires a great deal of time and commitment. Unless the individuals are of genetic importance subsequent problems in hand reared adults may be undesirable. With careful re-introduction they can, and do, breed normally, but can develop behavioural abnormalities and may become extremely aggressive towards their keepers. If the babies have been abandoned by their mother they may be in danger from infanticide so it is best to remove them sooner rather than later.

If the offspring are being cared for but receiving no milk they will be restless, possibly calling continuously or conversely may be hyperthermic and scattered around the enclosure. Another point to look for is females running around with offspring in their mouths for long periods, an indication that they do not feel secure enough with the denning provided.

If it is necessary to remove offspring because of an exceptionally large litter size it is best to remove at least two of the largest infants. The temptation is often to take the smallest but these stand the best chance with their mother. Hand rearing singletons is more likely to lead to imprinting problems than if they have conspecifics to play with.

Physical condition of the infant

An incubator is the best source of warmth. Heat lamps are not suitable, the heat is too intense and will dehydrate the babies. If an incubator is unavailable hot water bottles are good, but use caution and wrap them in several layers of towelling. Small babies die very quickly if too hot. 26.5°C-29°C (80-85°F) is ideal. Heated plant propagators are useful for older youngsters but are not usually warm enough for new-borns. In a real emergency a domestic iron on the lowest setting wrapped in towelling in a box can be used as a heat source.

Should the baby be hypothermic when you remove it, you can raise its body temperature gently by holding it against your own body or holding it in your hand in a bath of warm water.

Hot water bottles do have one advantage in being easily transportable. They can be placed in a basket or carrier if you have to take the young ones with you anywhere.

The babies will feel more secure if covered with a couple of layers of towelling and this will also help to keep them warm.

Feeding regime

A syringe with a small teat on the end is the best thing for feeding. Dolls' bottles are usually too large and glass ones are awkward to use. Syringes also have the advantage of being calibrated so the amount of each feed can be recorded.

There are many accounts of milk formulae and various additives but personally I have found goats milk to be the most successful, I buy this frozen and unpasturised. Small carnivores

can not absorb the fat globules in cows milk, other alternatives are powdered cat and dog formulas, both of which have been used successfully. It is now possible to get a powdered formula based on goats milk rather than cows milk but I have not tried this myself so far.

Start by feeding the baby every 2 hours. The milk must be warmed to blood temperature, gauge this by holding the syringe against your cheek or wrist. Babies will not take milk which is too hot or too cold. It is best to wait a little while if they have been taken directly from the parents as they may be distressed and will accept an artificial teat more readily if hungry. Hold the baby in an upright position to feed it, not lying on its back. This will help stop milk being inhaled and going into the lungs which can lead to pneumonia. If they sneeze it out of the nose dab it with tissue to prevent it being inhaled. Introduce the teat to the mouth and if the baby suckles immediately, release the milk slowly! If not try putting a drop on the lips to see if the baby will lick it or put the teat directly into the babies mouth (not too far down its throat as it will choke). If using a powdered formula the first feed can be of just glucose or honey and water to start the system gently, the second feed diluted milk and thereafter as per the mixing instructions. If using goats milk start them on this at the first feed. The baby may take very small amounts at first, 0.5ml being average for the first few days. Feed only when the baby is hungry and suckling vigorously, encouraging it to keep taking more milk will be fatal. Babies will not die of being slightly underfed, but overfeeding will kill them. As the volume of the feeds increases the frequency can be reduced; 3 hourly 2nd week, 4 hourly 3rd week, etc. Babies will be very hungry at some feeds, less at others, but this is quite normal.

After each feed stimulate the baby to urinate and defecate by gently rubbing the anus and genitals with some tissue or cotton wool which should be moistened with warm water. The first motion is normally very thick and dark after which they will be pale yellow. Should the baby become sore around the base of the tail use a little baby cream.

Monitoring progress

Weighing the babies daily and keeping a record of their weight gain is important. The weight should increase steadily, though not necessarily daily (a little weight loss may occur in the first couple of days). If there is gradual weight loss while they are still being fed milk consult your vet or seek further guidance. When the babies begin to wean and you start withholding bottle feeds a slight weight loss is normal.

Minor stomach problems can occur. Constipation, if the babies have not defecated after a couple of feeds, might be remedied by replacing a milk feed with glucose and water. Diarrhoea may be helped by using water that has had a handful of rice boiled in it to make up the milk feed. The starch in the rice has a binding effect. If diarrhoea is severe and persistent feed the baby an electrolyte solution to ensure it does not dehydrate. If this is done for a couple of feeds it may solve the problem otherwise consult your vet. Be very cautious when using kaolin based remedies as they can block the stomach.

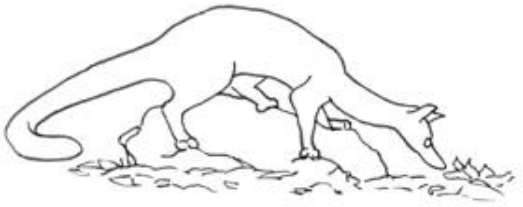
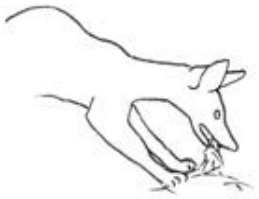
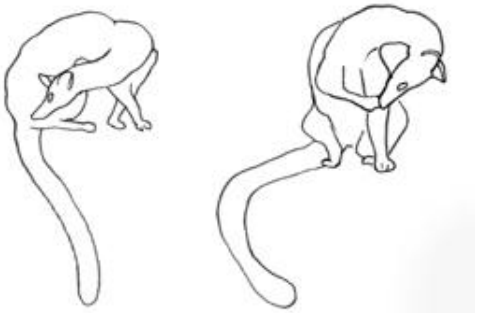
After the first week the baby will not need feeding at night – 6.00am – 12.00pm being sufficient. At 5-6 weeks of age start offering very finely ground lean steak mixed with milk directly from your fingers when the babies are hungry (mind your fingers!). Then gradually encourage the infants to start taking this from a shallow bowl gradually increasing the ratio of meat until they are fully weaned onto their adult diet. You can try this with chicken but I found this gave the babies diarrhoea and had better results with beef steak. Even when the babies are taking their adult diet continue to give them milk in a bowl for as long as they want it, it wont do them any harm and it will build up their calcium.

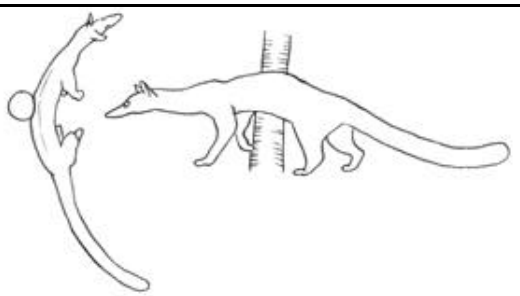
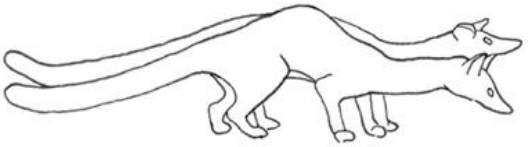
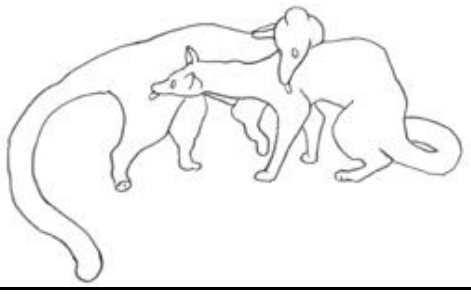
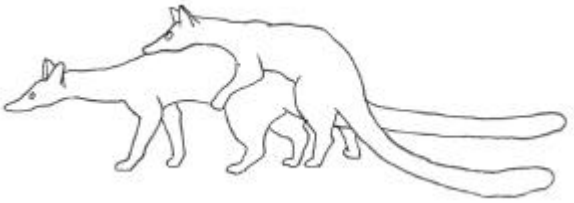
Introduction to conspecifics

If the species is social it is not advisable to try to introduce hand reared animals to established groups, it is better to introduce them to young individuals of a similar age or single adult animals depending on the species. Those that are solitary or live in pairs similarly should be paired as appropriate to young animals if this is possible at the earliest opportunity.

Appendix 3: Ethogram developed and used in captive behaviour research at the Owston's palm civet Conservation Program.

Appendix 3: A basic ethogram for Owston's Civet, *Chrotogale owstoni.*

Name	Description	Drawing
Out of Sight	The behaviour of the animal cannot be determined because it is partially or fully out of sight. If the animal is on the bed box and its behaviour cannot be determined it should be recorded as 'Out of sight: Bed box'	
Foraging	The animal in locomotion either on the cage floor, logs or perimeter	
Eating	When the observer can actually see the animal chewing or attacking a prey, rooting through the leaf litter is not eating this would be 'foraging'	
Water Bowl	The animal drinks from the water bowl	
Toilet Ground	The animal urinates or defecates on the ground	
Toilet Bowl	The animal urinates or defecates in the toilet bowl	
Resting	Resting is when the animal is sitting down. The back legs are bent and the posterior of the animal is resting on the floor	
Allo-grooming	The animal is licking/grooming itself	
Scent Marking	This is defined as when the animal lays a scent in either of the following two ways: 1) The animal rubs the external anal scent patch on the substrate.	

	2) The animal flanks an object in the location. This is not a proved method of scent marking and may be a grooming device but for the purposes of this study it was classed as one and samples will be sent for analysis to confirm.	
Attempted Mount	When one animal attempts to mount the other animal	
Chase	A chase describes one animal (the chaser) in pursuit of the other animal at high pace.	
Attack	This describes the attack of one animal to another.	
Flank Rub Mutual Grooming	When one animal rubs it flank against the flank of the other animal The animal is licking/grooming the other animal	 
Copulation	When the two animals are copulating. The female is not resisting.	

Suckling infants	The infants are suckling milk from the female	
Parturition	The animal is giving birth.