

Post mortem and genetic study of an  
Eurasian Otter (*Lutra lutra*) carcass collected in Hong Kong SAR China



Published: October 2018

Kadoorie Farm & Botanic Garden Publication Series No.16



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October 2018

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**Document citation**

Kadoorie Farm and Botanic Garden 2018. Post mortem and genetic study of an Eurasian Otter (*Lutra lutra*) carcass collected in Hong Kong SAR China. Publication Series No. 16, Kadoorie Farm & Botanic Garden, Hong Kong SAR. 13pp.

## Introduction

The Eurasian otter (*Lutra lutra*) has a wide geographical distribution from Europe to the Russian Far East, including Korea, Japan, North Africa, Middle East, Central Asia, India, Sri Lanka, China, Taiwan and Indochina and Southeast Asian countries (Nowak 1991, Roos *et al.* 2015). Remnant populations also persist in areas where wetland habitats are intact and hunting is controlled. Locally, the species is restricted to Mai Po and the inner Deep Bay (Shek 2006). Little is known about these amphibious mustelids in the Hong Kong SAR because of their elusive behaviour and apparently small population. Studies in Europe indicate that *L. lutra* occupy 14 - 19 km along coastal habitat, and up to 34.8 km of inland watercourse between individuals (Kruuk and Moorhouse 1991). They are reported as generally territorial and solitary in character, with the home range of males markedly larger than that of females, and their territories often overlap (Kruuk and Moorhouse 1991). Depending on prey availability, *L. lutra* will take fish, amphibians, birds, small mammals, and aquatic invertebrates (Clavero 2003, Shek 2006, Allen 2010).

*L. lutra* was once ubiquitous throughout China, including Hong Kong. Unfortunately, thousands of individuals were harvested yearly for their fur and were sold as traditional medicine (Li and Chan 2017). Although hunting has been prohibited by law in China since 1989, *L. lutra* populations continue to decline due to habitat loss, water pollution and other threats (Hung and Law 2014, Roos *et al.* 2015, Li and Chan 2017). *L. lutra* are categorised as Near Threatened (NT) on the IUCN Red List and as Vulnerable in the China Red Data Book. While locally, the species is protected under the Wild Animals Protection Ordinance Cap.170 and is recognised as a species of conservation concern (Shek 2006).

The Conservation China Department at Kadoorie Farm and Botanic Garden has conducted a 5-year study to evaluate the status of otters in China and confirmed that the number of otters is critically low, although relict populations persist in nature reserves where poaching is forbidden (Li and Chan 2017). Previous species conservation programmes have suggested that otter species can re-establish from small population size (Saavedra and Sergatal 1998, Koelewijn *et al.* 2010), if given the opportunity, therefore, the otter population in Hong Kong might also re-establish if immediate and effective measures are imposed to protect the animals and their habitat.

Considering the rarity of *L. lutra*, it was an unusual opportunity to obtain an otter specimen from the wild. On the 5<sup>th</sup> March 2013, staff of Asia Ecological Consultants Limited (AEC), discovered a fresh otter carcass in a compensatory wetland at Lok Ma Chau, where regular site management work was being undertaken. Understanding the importance of the discovery, the staff contacted the Wild Animal Rescue Centre at KFBG where an autopsy was undertaken by the resident veterinarian. Examination of the carcass suggested that the cause of death resulted from fatal wounds inflicted by feral dogs. This finding underlines the need to strengthen feral dog management practices especially in protected areas. Standard measurements and a morphological examination of the specimen suggested that it was an Eurasian Otter (*Lutra lutra*).

## Section 1: Post Mortem Examination

The otter carcass was that of a small male (4.4 kg) perhaps of sub-adult age. Gray (1837) describes the resident otter species in Hong Kong and Southern China to be *Lutra lutra chinensis*, however literature differentiating the local race to subspecies appears to be absent or unreliable. Body measurements (Table 1) and photos were taken for record (Figures 1 – 5), and DNA samples were collected to confirm the species identity. . Full body radiographs were also taken at the rescue centre prior to post-mortem examination (Figure 6 and 7).

The carcass was later passed to the Agriculture Fisheries and Conservation Department (AFCD) for preservation and mounting as a specimen at the Hong Kong Wetland Park.

Table 1. Morphometric measurements of the specimen.

Body measurements	(cm)
Total body length	107
Skull length (Including muzzle)	12.5
Skull width	7
Head length (Eye centre to muzzle tip)	4.4
Upper canine length (Gum to tip)	1.45
Lower canine length (Gum to tip)	1.2
Ear length	1.4
Fore foot length	6.5
Front foot span	5.8
Hind foot Span	6.6
Hind foot length	7
Tail length	42



Figure 1. Dorsal (Left) and ventral (right) view of *L. lutra*.





*Figure 2. Side view of the head*



*Figure 3. Front view of the head*





*Figure 4. Plantar aspect of the front foot*



*Figure 5. Lateral aspect of the hind foot*

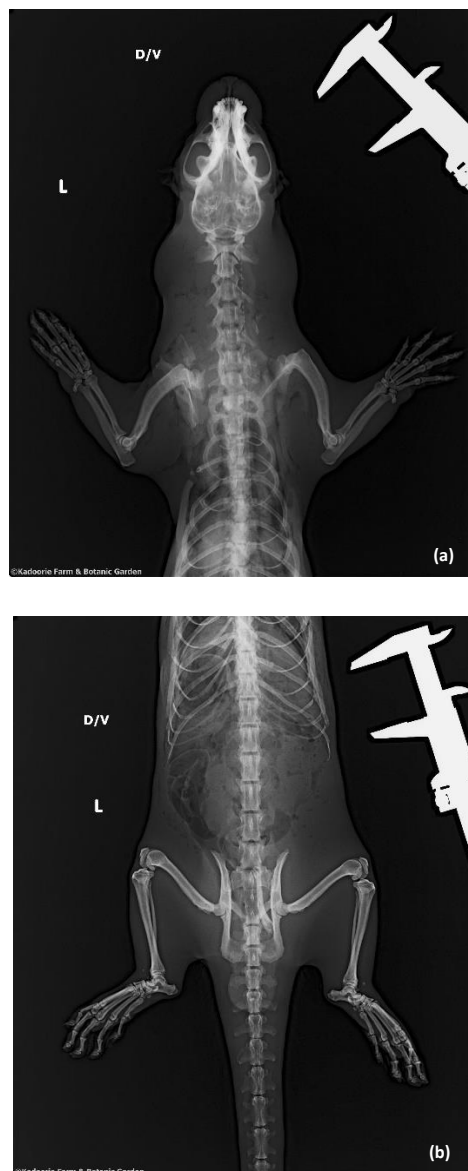


Figure 6. DORSO-VENTRAL view: a) head and cranial chest area; b) caudal chest and abdomen

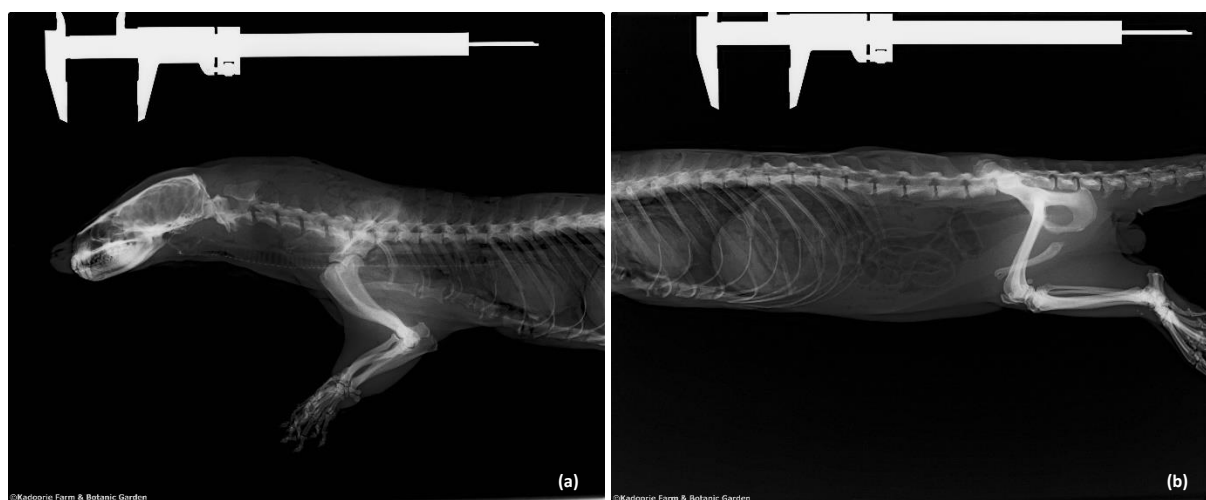


Figure 7. LATERAL view: a) head and chest area; b) abdomen

## Section 2: Genetic analysis confirms taxonomic identity of the otter

Muscle tissue from the otter was transferred to the Conservation Genetics Laboratory at KFBG, where DNeasy Blood and Tissue Kits (Qiagen) were used to extract the DNA. The amplification of Cytochrome c oxidase subunit I (COI) gene followed Ivanova et al. (2007), using the universal primer for mammals. The amplification products were checked on 1.5% agarose gels and then sent to BGI Tech Solutions (Hong Kong) for purification and sequencing.

Species identification was conducted by BLAST searches of the sample DNA sequence within the GenBank database. Phylogenetic analysis was used to confirm the species identity by comparing COI sequences of three otter species found in Southeast Asia (i.e. *Lutra lutra*, *Lutra sumatrana* and *Aonyx cinerea*). The COI sequences of the Hong Kong Otter sample were aligned with GenBank sequences for phylogenetic analysis, and all of the sequences were trimmed at the same region with 516 bp. Bayesian analysis of the final dataset was conducted in Geneious software (Biomatters Ltd.). *Aonyx cinerea* (KY117536) was selected as the outgroup.

BLAST search of the sequence revealed that the Hong Kong sample was *L. lutra*, with a 99%–100% similarity to the GenBank sequences of *L. lutra*. Phylogenetic analysis clearly separated *L. lutra* from *L. sumatrana*, and clarified that the Hong Kong sample belonged to *L. lutra* (Figure 8).

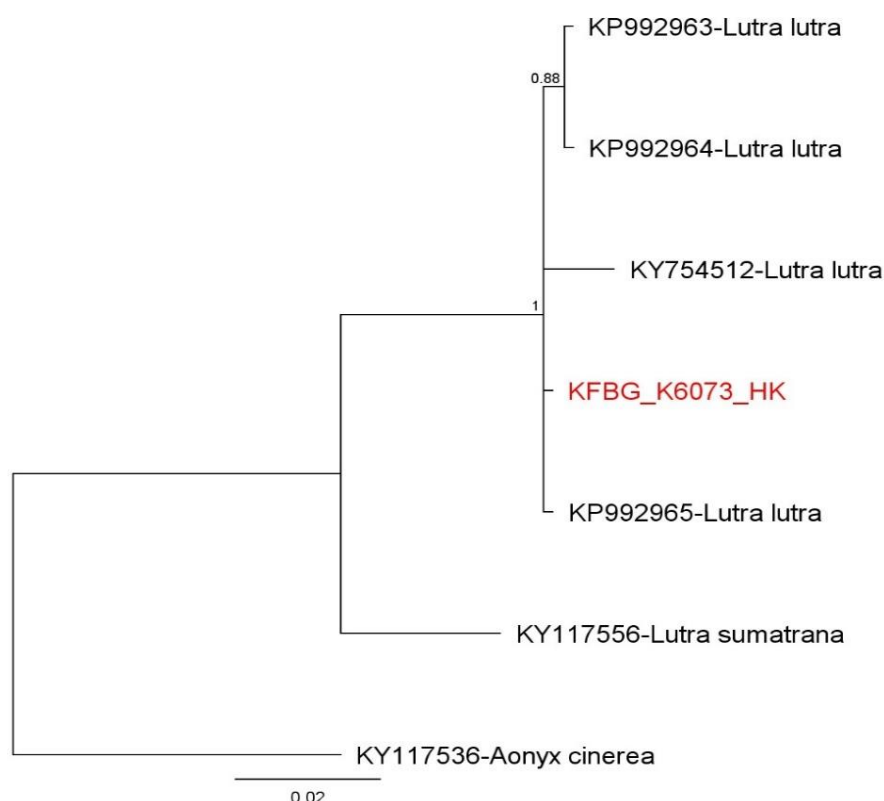


Figure 8. The Hong Kong sample (KFBG\_K6073\_HK) was 99-100% genetically similar to reference samples of *L. lutra* from GenBank using COI gene



## Conclusions

The carcass received by the KFBG Wild Animal Rescue Centre in March 2013 was confirmed to be that of an Eurasian Otter (*Lutra lutra*). To the best of our knowledge this was the first time the local species had received positive taxonomic identification through DNA analysis. The discovery of the *L. lutra* specimen and anecdotal sightings of individuals in the New Territories suggests that the species continues to survive locally, however, conservation actions need to be undertaken to assure that the small local population continues to be present in Hong Kong. The local population is also important given the precarious situation facing *Lutra lutra* survival in the region. Potential risks to *L. lutra*, such as predation by feral dogs, can be reduced by understanding better the ecological requirements of the local population and also controlling feral dogs in areas that are inhabited by otters. Local studies and protection measures can take reference from the global efforts undertaken to protect this species. .

## Conservation

The post mortem examination revealed lesions compatible with dog bite. Multiple punctures holes were present on the chest area and most of the abdominal organs carried severe lesions. The abdominal cavity showed pooling of clotted blood compatible with severe bleeding due to major organ rupture. Reference has been made to cases of other native mammals being attacked by feral dogs and these include barking deer, Malayan porcupines and masked palm and small Indian civets (Dudgeon et al. 2011). Globally, feral dogs have been reported to harm wild predator and prey species through predation, competition and disease transmission (Van't Woudt 1990, Young et al. 2011, Lessa et al. 2016). Considering the wide distribution of feral dogs in Hong Kong (Dudgeon et al. 2011) and their potential threat to wild mammals, there is a pressing need to investigate the impacts that the dogs are having on Hong Kong fauna, develop management strategies and policy in protected areas, and increase public awareness about wildlife-feral dog conflicts (Foster-Turley et al. 1990, Young et al. 2011). Any future species action plan for the Eurasian Otter should consider the effect of feral dogs on the local otter population.

Beside feral dogs, *L. lutra* also faces many anthropogenic threats, such as habitat degradation, water pollution and wildlife trade (AFCD 2013, Roos et al. 2015, Gomez *et al.* 2016). These problems can be mitigated through a multifaceted approach as demonstrated in Denmark, Netherland, Poland and South Korea which succeeded in conserving *L. lutra* (Foster-Turley et al. 1990, Elmeros et al. 2006, Romanowski et al. 2012, Kim et al. 2011). These successful cases shared some similarities regarding their conservation outputs, they (1) built a positive attitude towards otters among the public and stakeholders, (2) implemented strong regulations regarding water quality, and (3) maintained safe and healthy habitats for the species (Elmeros et al. 2006, Romanowski et al. 2012, Kim *et al.* 2011, Hong et al. 2018).

It is important that measures are taken to address the requirements for this near threatened species, especially as the regional populations are likely to be further impacted by habitat loss in Southern China. A local Species Action Plan is urgently required for the Eurasian Otter (*Lutra lutra*). Information gained from studies about *L. lutra* will facilitate the formation of conservation strategies and public education programmes for *L. lutra*, which can be executed in educational and conservation facilities such as Mai Po Nature Reserve and the Hong Kong Wetland Park. A local otter specialist group could also be established to help design a biotope

management plan and to regularly review the conservation status of the otter population. Riparian habitat conservation and water quality improvement should also be considered as part of the wider ecosystem requirements in order to create and maintain favourable habitat and an appropriate food supply for *L. lutra*.

### Acknowledgements

The Fauna Conservation Department would like to thank staff at aec Ltd for passing the otter carcass to KFBG when it was discovered, and therefore allowing this detailed examination to be conducted. We also appreciate the assistance from the vet team at KFBG for undertaking the post mortem study and the analysis undertaken by the Conservation Genetic Laboratory at KFBG which helped to confirm the species identity. Dr Bosco Chan provided important suggestions for the final manuscript. The Agriculture, Fisheries and Conservation Department provided permission for handling the otter carcass through the wild animal rescue centre permit.

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## About KFBG

Kadoorie Farm and Botanic Garden (KFBG) is situated in Hong Kong, China, in the rural New Territories, on the northern slopes of Tai Mo Shan, which is Hong Kong's highest mountain. Two steep spurs enclose its deep-set valley. Within KFBG are streams, woodlands, orchards, vegetable gardens, walking trails, live animal exhibits, floral exhibits, sustainable agriculture demonstration plots, art exhibits, a wild animal rescue centre, a native tree nursery, and, other conservation and education facilities.

In the post-war years, Hong Kong was flooded with immigrants. Many had traditional knowledge of crop production and livestock farming but no stock, others had land but no experience. They required support to rebuild their lives. In 1951, in response to these pressing human needs Lawrence and Horace Kadoorie established the Kadoorie Agricultural Aid Association (KAAA), which became a key partner of the Hong Kong Government in devising and implementing a plan to help Hong Kong feed itself. The Kadoorie brothers, part of a well-established business family, saw wealth as a sacred trust to benefit mankind. With such aid, thousands of people received agricultural training; thousands of pigs, chickens and ducks were bred and given to farmers or sold to them on credit; thousands received micro-loans; and numerous wells, irrigation channels, roads, footpaths, bridges, pigsties and farm houses were built. The farm site at Pak Ngau Shek was established in 1956 as a base for livestock breeding and distribution, agricultural research, farmers training, public education and recreation. The barren slopes were terraced and planted with orchards and vegetable gardens. The development of the botanic garden began in 1963 and the plant conservation programme from 1972.

On 20th January, 1995, the Legislative Council of Hong Kong passed an Ordinance (KFBG Chapter 1156) incorporating KFBG as a non-profit corporation designated as a conservation and education centre with a new mission. It is a unique public-private partnership, for while the KFBG Corporation is a public corporation, it is, kindly, privately funded to a large extent by the Kadoorie Foundation (over HKD 110 million per year); these funds are supplemented by donations from the public and project-related grants from the Hong Kong Government, partner organizations and foundations. These grants enable us to extend our work.

Since 1995, KFBG has been conducting a wide range of nature education, nature conservation and sustainable living programmes both on-site, and, throughout Hong Kong, South China and more recently extending into South-east Asia (Laos and Cambodia).

In a time of severe global crisis – including the inter-related issues of widespread disconnection from nature, each other and self; the ever-increasing exploitation of, and unwise over-reliance on the world's dwindling resources to support unsustainable lifestyles; climate change; shrinking of natural habitats and species loss— KFBG, as an organisation, raises awareness, undertakes rigorous science-based species conservation and ecosystem restoration, and offers new ways of thinking and living to respond to the world's problems. Hence, our work brings hope and improvement by focusing on nature conservation, sustainable living and holistic education that re-connects people with nature. By working together with the public, Governments, academia, NGOs, businesses and volunteers we can protect our common future.