N O T E   F R O M   T H E   E D I T O R

NOTE FROM THE EDITOR

Dear Friends, Colleagues and Otter Enthusiasts!

2018 is really an interesting year for the IUCN OSG Bulletin. Not only will we have 4 regular issues in one year – new record – but also 2 special issues. However, I do have even better news!!

Since early September the IUCN OSG Bulletin is indexed in Scopus! I can hardly describe how happy I am about this decision from Scopus. It shows that much of what we all did in the last years was right and scientifically sound. Much more important is the fact that this makes it more attractive to publish in the IUCN OSG Bulletin, which in turn has positive effects on the journal and the published articles.

At the end of this issue you will find information on a new book dealing with the biology and management of animal welfare. I have read it with great interest. I want to remind all the readers that this could be an interesting point for a review paper or a viewpoint, although in this case I am sure that we will not find very opposing opinions. I say this as several years ago "Viewpoints" were invited manuscripts where two persons would elucidate their viewpoint on a controversial issue in one article each.

Finally, I want to inform all patient authors that have waited to see their manuscripts published, that the situation will improve. The reason for some delays is due to the fact, that Lesley has developed a new layout for the IUCN OSG Bulletin that soon will go online. I will come back to this in more details once the new website is online.

Merci villmols, Lesley for all your work with the Bulletin. Only I know how much time you spend!

A R T I C L E

THE CONSERVATION STATUS OF OTTERS IN SOUTHWEST TANZANIA[1]

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Abstract: Two species of otters are confirmed in Tanzania, the African clawless (*Aonyx capensis*) and the spot-necked (*Hydrictis maculicollis*). Both are listed as 'near-threatened' in the IUCN Red List, with the main threats linked to pressures exerted on their habitat and food resources by a growing human population. Despite scant details of their Tanzanian distributions, our recent work shows that both species are more widespread than previously believed. We investigated distribution and conservation status in two highly populated areas in southwest Tanzania, Mt. Rungwe and Sao Hill. Rainy and dry season surveys for spraint sites included rivers, lakes and swamps, with data collected on associated dietary items and habitat features. Results indicated that species presence and distribution are not significantly affected by seasonality and that they can thrive as long as retaliatory hunting is prevented. Habitat quality should be monitored to avoid deterioration of escape cover. The nature of threats and the conservation of both species are discussed.

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INTRODUCTION

Otters are top predators in a variety of aquatic and semi-aquatic habitats (Foster-Turley et al, 1990; Kruuk, 2006). In sub-Saharan Africa among the three species present (*Aonix capensis, Aonyx congica* and *Hydrictis maculicollis*), two *A. capensis* and *H. maculicollis* are confirmed in Tanzania (Nel and Somers, 2002; Somers and Nel, 2013; Foley et al., 2014.). *Aonyx* prefer walking in shallow waters where they feed on crabs and other crustaceans, insects, frogs, and sometimes fish. *Hydrictis* meanwhile, has webbed feet for swimming in lakes and marshes or large rivers while feeding predominantly on fish. The absence of competition between the two sympatric species is due to their dietary specialisations (Somers and Nel, 2013; d'Inzillo Carranza and Rowe Rowe, 2013).

African clawless and spot-necked otters are both listed as 'near-threatened' in the IUCN Red List (Jacques et al., 2015; Reed-Smith et al., 2015). However, *A. capensis* is becoming extirpated in many localities and *H. maculicollis* is declining across its range. With the exception of South Africa (Nel and Somers, 2007; d'Inzillo Carranza and Rowe-Rowe, 2013; Somers and Nel, 2013) details on distribution, status and ecology are poorly known (Nel and Somers, 2002). In Tanzania, there is limited

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information about otter ecology (Kruuk and Goudswaard, 1990; Amulike et al., 2012), although some information on species presence and distribution is available from inventories (De Luca and Mpunga, 2005; 2006; 2013; Pettorelli et al., 2009; Foley et al., 2014). Despite sketchy details, our most recent distribution maps reveal that *A. capensis* is more widely spread than assumed (Foley et al., 2014). The presence of *H. maculicollis* is linked to permanent water with fish, and in Tanzania it is found in all major lakes, but only in the less disturbed areas (Foley et al., 2014).

The main threats are linked to an increasing human population (Rowe-Rowe, 1986; Nel and Somers, 2002) resulting in habitat fragmentation and degradation through removal of riparian vegetation. Morever, overgrazing and unsound agricultural practices (Mason and Macdonald, 1986; 1990; Rowe-Rowe, 1986; Kruuk, 2006; Somers and Nel, 2013) can pollute rivers and affect the prey base (Kubheka et al., 2012). African otters are not persecuted substantially for their fur, except in Ethiopia (Nel and Somers, 2002), but retaliatory and subsistence hunting occurs, and the use of body parts for medicines continues (De Luca and Mpunga, 2004; 2006). The challenge for conservation is to understand if/how African otters can adapt to increasing anthropomorphic pressures and how much habitat destruction and degradation they can tolerate. This study addressed these issues by assessing the status, distribution and ecology of both species in two areas of southwestern Tanzania, with emphasis on the threats facing the species.

METHODS

Study areas

The first area was in and around Mt. Rungwe Nature Reserve including parts of the Kitulo Plateau National Park. This comprised 150 km^2 between 9°03’- 9°12’South and 33°35’ - 33°45’ East with elevation from 1500-2981m . Rainfall ranges between 1550 and 1850mm/y, with the dry season between June and October. The habitat along Mt. Rungwe’s rivers is of two main types: a mosaic of dense, high secondary riparian vegetation deriving from re-colonisation of abandoned cultivation or fire climax grassland, and cultivation extending to the bank and mixed with planted trees. Bushed, woodland, and in less disturbed areas montane forest, may occur along the rivers. Above 1900m, montane grassland reaches the river banks. At lower altitudes, large strips of reeds and tall grasses are found. No resident large carnivore species were present except for transient leopards that do prey on otters (De Luca and Mpunga, *2018*).

The second area was Sao Hill, in Mufindi District, Iringa Region, approximately 2500km^2 between 8°25’- 8°95’ South and 34°76’ - 35°74’ East. This is a highland area including plateau, and has one of the coolest and wettest climates in Tanzania. The landscape is dominated by tea plantations including intact and well-preserved clusters of natural forest (relict patches of ‘Eastern Arc Mountain’ forest), and some commercial pine, eucalyptus and cypress plantations. Large natural and man-made lakes, swamps, and about one hundred small man-made (tea estate) dams linked to a network of small rivers offer a rare opportunity to study these co-existing otter species. No large predators are resident.

Surveys

Mt. Rungwe

Using a map of the Mt. Rungwe/Livingstone/Kyela Basin, developed from ASTER Global Digital Elevation Model (30m) (Fig. 1), four water catchments were chosen to investigate otter presence and distribution. These were Kiwira, Lufirio, Mbaka, Ruaha; the first three entering Lake Nyasa/Malawi. In each catchment, different portions of rivers were intensively searched for otter signs (holts, rolling places, runs, spraint sites and tracks) between January and March 2010 (wet season) and August and September 2010 (dry season) (Table 1). Only two of the river sections surveyed were within protected areas: the Kalambo river, and the upstream part of Ndala river in Kitulo NP. Half of continuous river sections surveyed were between 2-3km, 28% were 1-2km and around 20% were 3-3.8km in length, following Rowe-Rowe's (1992) recommendations. In each catchment, sections at low, medium and high altitude were surveyed ranging from 600m to 1200m and 1800m asl except for Kilasi at Ruaha which reached 2500m (mean 1465 m; min 580 and max 2570 SD 501).

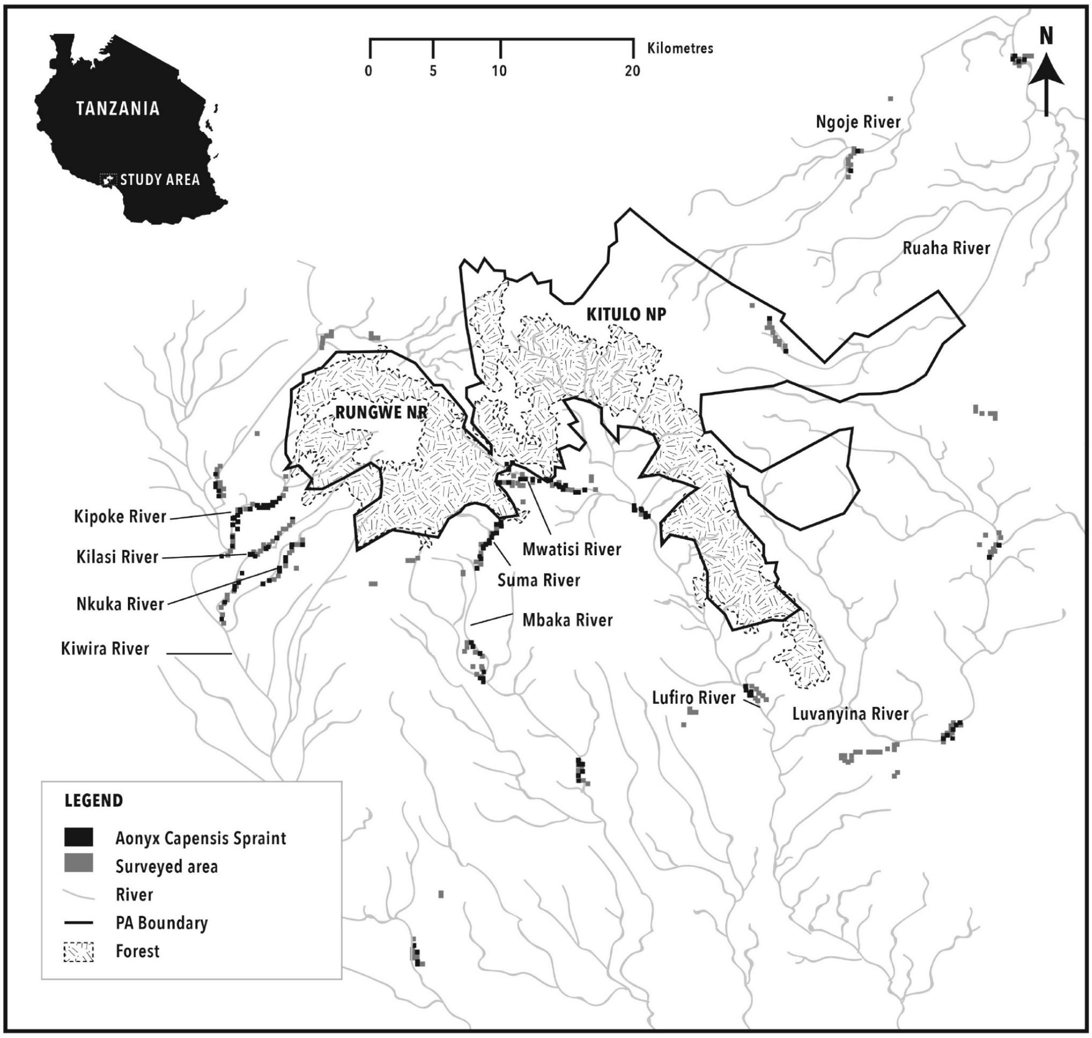

Figure 1. Distribution of *A. capensis* spraint sites during the wet and dry season in Mt. Rungwe

Both river banks were surveyed by teams of two/three trained observers and all otter signs were recorded. These consisted of spraints diagnostically identified by size, diameter, shape and smell (Rowe-Rowe 1977a). Spraint sites were categorized as 'latrine' or 'non-latrine' according to the number of scats found together (1 or more clustered within 50 cm^2). Spraint age was recorded as very fresh (1 day old), fresh (2-3 days old) or old (more than 3 days). The diameter of intact spraints (mostly the very fresh and fresh ones) was measured with calipers.

In order to identify factors associated with habitat preference, we recorded: site location (river bank, island, other), river configuration (riffles, water surrounding island, deep flowing water, junction, pool, shallow flowing water and rapids), substrate of deposit area (vegetation, mixed, bare soil, rock, litter), habitat (vegetation types; grassland, woodland/grassland mosaic, swamp, weeds, marsh, rocks) and cover type, human disturbance (roads or paths close to the river, human activities in and along the river). River characteristics (width, depth, bottom, speed), bank height and slope, and distance to water were also noted.

Table 1. Mt. Rungwe area: *Aonyx capensis* spraint sites density within each water catchment, for 42 river sections surveyed in the wet season, and 39 surveyed in the dry season.

River Catchment	N. of Transects (T)	Altitude	N.Spraint sites (S)	Km surveyed	Density	Ts/Ttot	S/T
WET SEASON							
Kiwira 15	1776(a)	42 1247(b)	37.27	1.127 (a)	73.33 0-4.35(b)	2.80	
Mbaka	7	1100(a) 1007(b)	15	12	1.26(a) 0-5.56(b)	71.43	2.14
Lufirio	14	1635(a) 1450(b)	21	29	0.72(a) 0-3.66(b)	64.29	1.50
Ruaha	6	1885(a) 1100 (b)	4	16.9	0.23(a) 0-1.02(b)	33.33	0.67
Total	**42**		**82**	**95.17**	**0.86**	**64.3**	**1.95**
DRY SEASON							
Kiwira 13	1430(a) 1216(b)	26	23.83	1.10 0-4.14	54.55	2.00	
Mbaka 6	1075(a,b)	28	19.63	1.43 0.67-1.57	100.00	4.67	
Lufirio 14	1695(a) 1591(b)	35	42.46	0.82 0-4.5	64.29	2.50	
Ruaha 6	1870(a) 1100(b)	4	19.2	0.21 0-1.52	33.33	0.67	
Total 39		**93**	**105.12**	**0.88**	**59.00**	**2.38**	

Key: Altitude: a) mean altitude along all transects and b) mean altitude along transects with spraint sites; density: n.of spraint sites/1km with each catchment ; Ts/Tt: percentage of transect with positive presence of otters; S/T: measure of relative abundance or number of spraint sites/n. transect sites.

Sao Hill

A map of Sao Hill, developed from ASTGTM Global Digital Elevation Model (30m), was used for survey planning (Fig. 2). Work was divided into three sessions. Large lakes and swamps (n=5) in Sao Hill, Lake Ngwazi, Ruaha Marsh, Lake Inzivi, and Lake Kyanga spending an average of 3 days in each site. Surveys were carried out on foot along the shore but canoes were also used to access island shores and 'floating islands' of grass. Large parts of the lakeshores consisted of dense riparian grasses, natural thick bush and shrub land. Other parts were short grasses, accessible to humans and cattle. Marshes created a transition zone between water and land.

Secondly, a small swamp connected to the large Ruaha Marsh, and a sample of small man-made dams in the tea estates and private tourist lodge (Fox's Farm) were surveyed. Finally, 12 other small tea estate dams were surveyed by canoe. A sample of river sections (n=7 of 1 km in length), part of a wide and complex network of rivers (permanent and seasonal), belonging to two water catchments and connected to the small dams and the large Ruaha marsh, were surveyed for otter sign on both riverbanks on foot. In each catchment, 1 to 3 river portions (1 per river) were visited (Fig. 2). The altitude ranged from 1200-1300m asl in the river sections and 1700-1900m asl in the swamps and lakes, man-made dams, and rivers on the high plateau of Sao Hill. The average water depth of large lakes and swamp, excluding Mkewe Swamp, was 2.15 ± 1 (range: 0.6-3.8m; bimodal: 1m and 3m; 80% between 1 and 3m). Differences in site density between dry and wet seasons were tested for significance using the t-test.

Initially to verify activity patterns of both species, we deployed 6 Leaf River (Leaf river outdoor products) camera traps along the lake Ngwazi shore for 5328 hours, they were set at 300m interval distance from each other.

Interviews

Structured interviews were carried out to compile complementary data on otter presence and behaviour, and threats. The first part of the interview assessed villagers' perceptions and exploitation. The second part investigated river exploitation by fishermen and the presence of fish and crab species. The third part of the interview dealt with agricultural up to the river edge. This type of interview was adapted to Sao Hill fisherman but originally developed for Mt. Rungwe.

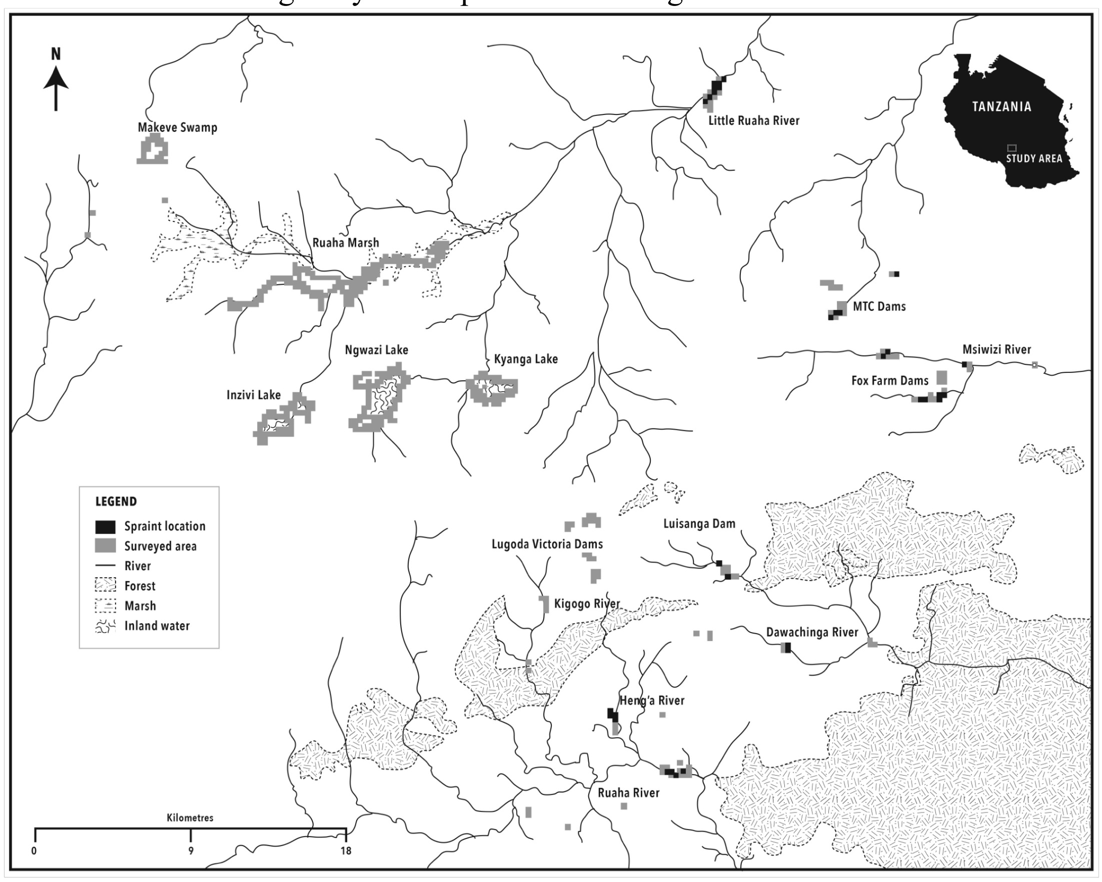

Figure 2. Distribution of *A. capensis* spraint sites during the wet and dry season in Sao Hill

RESULTS

Distribution and site density of *A. capensis* spraints in Mt. Rungwe

Clawless otter sites were found on 64.3% of the 42 river sections in the wet season and on 59% of 39 river sections in the dry season; overall 62% of the transects surveyed were positive for the presence of *A. capensis* (Table 1). *A. capensis* distribution along the rivers showed the richest sites in terms of density (Table 1, Fig. 1). Otter site density above 1 per 1 km was recorded between 700 and 1650m asl, with the highest densities recorded at 1000 and 1500m (Table 1). Site density values did not differ significantly between the two seasons (t-test two sample for mean =0.42, df 41, P=NS). For spraint site abundance or frequency of sprainting, the difference was not statistically significant between seasons (t-test, two samples for mean =-1.13, df 4, *P*=NS). The mean altitude of the transects surveyed was 1600m asl in the wet and 1520m asl in the dry season, however, otter sites were concentrated around 1200-1245m asl.

Features and habitat description of *A. capensis* spraint sites

During the wet season, of the 81 spraint sites located on 42 river sections within 10 different rivers, 80% were in latrines. Of these, 45% were regularly used, and about a third were found along Kipoke River (Fig. 1). Only 17% were isolated scats, mainly old. During the dry season, the number of isolated scats doubled to 34.85%. Out of 3 holts found, during the study only one was recorded as in use; located on the bank of Kipoke River under large rocks in dense vegetation. Two other holts were found, one along Suma and the other along Lufirio.

The habitat features of the sites did not differ significantly between wet and dry season (all t tests paired: type of scats: latrine /single scat t=-0.63, df1, *P*=NS; site location: river bank, island, others, t=-0.33, df 2, *P*=NS; configuration: riffles, water surrounding, island, deep flowing water, several, junction, pool, shallow flowing water, rapids t=-0.43, df 7, *P*=NS; substrate: vegetation, mixed, bare soil, rock, litter, t=-0.54, df4, *P*=NS; vegetation type: rocky bushed grassland, bushed grassland, grassland, bamboo, eucalyptus, agriculture, riverine forest, weed grasses, reeds vegetation, tangled bush vegetation, tangled bush grassland, pine woodland; secondary riverine forest with or without tangled vegetation t=-0.3, df12, *P*=NS; distance to water: <5,6-10 m, 17-90 m, 60-90m, t=-1.38, df3, *P*=NS).

Spraint sites were mainly located on river banks and associated with three river configurations: beside rivers, a riffle configuration (rockier bottom), water surrounding islands and deep flowing water. Otters mainly deposited spraints in ‘bushed grassland’, ‘grassland’, and ‘rocky bushed grassland’ but some were found amongst eucalyptus and cultivation.

***Aonyx capensis* distribution and density in Sao Hill**

In the wet season 46% of transects around ponds, dams and along rivers were positive for *A. capensis* (N=26 transects), while in the dry season 50% showed signs of *A. capensis* (N=22 transects). Signs were found on only four out of 12 dams surveyed (Table 2). In both seasons around 70% of the scats were found in latrines hence there was no significant difference between seasons (t-test =3, df1, NS). No statistically significant difference was recorded in density and abundance of *A. capensis* between seasons (density: t-test =0.41, df 41, *P*=NS) (abundance: t-test: two samples for mean =2.53, df 1, *P*=NS). Figure 2 shows the spraint sites on rivers and dams. The mean altitude of transects and that of sites with otter scats in the wet and dry seasons did not differ more that 60m in altitude, however the altitude of the sites ranged from 1200-1950m asl in both seasons.

Habitat description of *A. capensis* sites in Sao Hill

For none of the features was there a significant difference between wet and dry seasons: (all t-tests paired: type of scats: latrine/single scat t=3, df1, *P*=NS; site location: river bank, swampy edge, island, path t=-1.28, df 6, *P*=NS; configuration: swampy river, shallow flowing water, pool, junction, riffles, unknown, t=1.17, df 6, *P*=NS; substrate: vegetation, rock, bare soil, mix, litter t=-1.57, df4, NS; vegetation type: woodland grassland mosaic, montane forest grassland mosaic, swamp, weeds, marsh, rocks and grassland, rocks, t=-0.77, df7, *P*=NS; distance to water: <4 m, 4-10 m, 15+m, t=-1.8, df ,2 *P*=NS; distance to cover: <1 m;1-2.5m, 30-80m, t=-1.9, df2, *P*=NS). In both seasons, sites were found mainly in latrines, on the river banks, on vegetation as a substrate, at less than 4m from water and at less than 1m from cover. In the wet season, sites were found in a variety of habitats whereas in the dry season, they were mainly in woodland grassland mosaic and grassland. The river configurations were deep-flowing water and swampy river. Human disturbance (fishing, tourism, canoeing and timber gathering) was present at all times.

Table 2. Sao hill area: *A. capensis* spraint sites density within each water catchment recorded in during the wet and dry seasons.

River Catchment	N. of Transects (T)	Altitude	N.Spraint sites (S)	Km surveyed	Density	Ts/Ttot	S/T
WET SEASON	**River**						
Mpanga (8), Ruaha(2)	10	1574(a) 1534(b)	12	8	1.5(a) 0-8(b)	70.00	1.20
	Pond/Marsh						
Mpanga	16	1869(a) 1830(b)	13	18.55	0.70(a) 0-0.33(b)		
Total	**26**		**25**	**26.55**	**0.94**		**0.96**
DRY SEASON	**River**						
Mpanga (8), Ruaha(2)	10	1510(a) 1464(b)	24	12.35	**1.94**(a) 0-4.05(b)	70	2.40
	Pond/Marsh						
Mpanga	12	1850(a) 1790(b)	16	12.65	1.26(a) 0-7.91(b)		
Total 22		**40**	**25**	**1.60**		**1.82**	

Key: Altitude: a) mean altitude along all transects and b) mean altitude along transects with spraint sites; density: n. of spraint sites/1km with each catchment; Ts/Tt: percentage of transect with positive presence of otters; S/T: measure of relative abundance or number of spraint sites/n. transect sites.

H. maculicollis spraint site distribution and density in Sao Hill

Figure 3 shows the distribution of spraint sites in Sao Hill along lakes, swamps and marshes. In the wet season all sites visited were positive for *H. maculicollis*, while in the dry season 80% in the lakes and 83% in the marshes were positive. Towards the end of the wet season, 133 *H. maculicollis* spraint sites were distributed between the three lakes and the two swamps surveyed (Table 3). Also for *H. maculicollis* site density and abundance or frequency of sprainting, there was no significant difference between seasons (density: t-test =0.92, df 24, *P*=NS), (abundance: t-test two samples for mean =1.6, df1, *P*=NS). The areas (lakes, Ruaha Marsh, and the swamp) where *H. maculicollis* presence was recorded ranged from 1826-1857m asl, with a mean altitude of 1845m asl (Table 3).

Habitat description of *H.maculicollis* spraint sites in Sao Hill

For none of the habitat features there was a significant difference between seasons (all t test paired: sign location: island, swampy edge, lake shore, marsh t=1.77, df 3, *P*=NS; substrate type: vegetation, rock, litter t=0.99, df3, *P*=NS; vegetation type: marsh, grassland, woodland grassland mosaic, rocks t=0.21 df 4, *P*=NS; water depth: t= 0.68, df 3, *P*=NS).

H. maculicollis spraint sites were found in latrines in 76% of the cases during the wet season (N=130), and for 62% in the dry season (N=99). Spraints were deposited in both seasons on the islands and small floating islands within the lakes, on vegetation in marshes and swamps. In the swamp, sites were found on waterlogged grassland between 12 and 40m from the main water body. Signs of otter activity were often observed and most were in the vicinity of human disturbance (fishing or cattle grazing) or paths, but none were found on the vicinity of cultivated land against the water's edge.

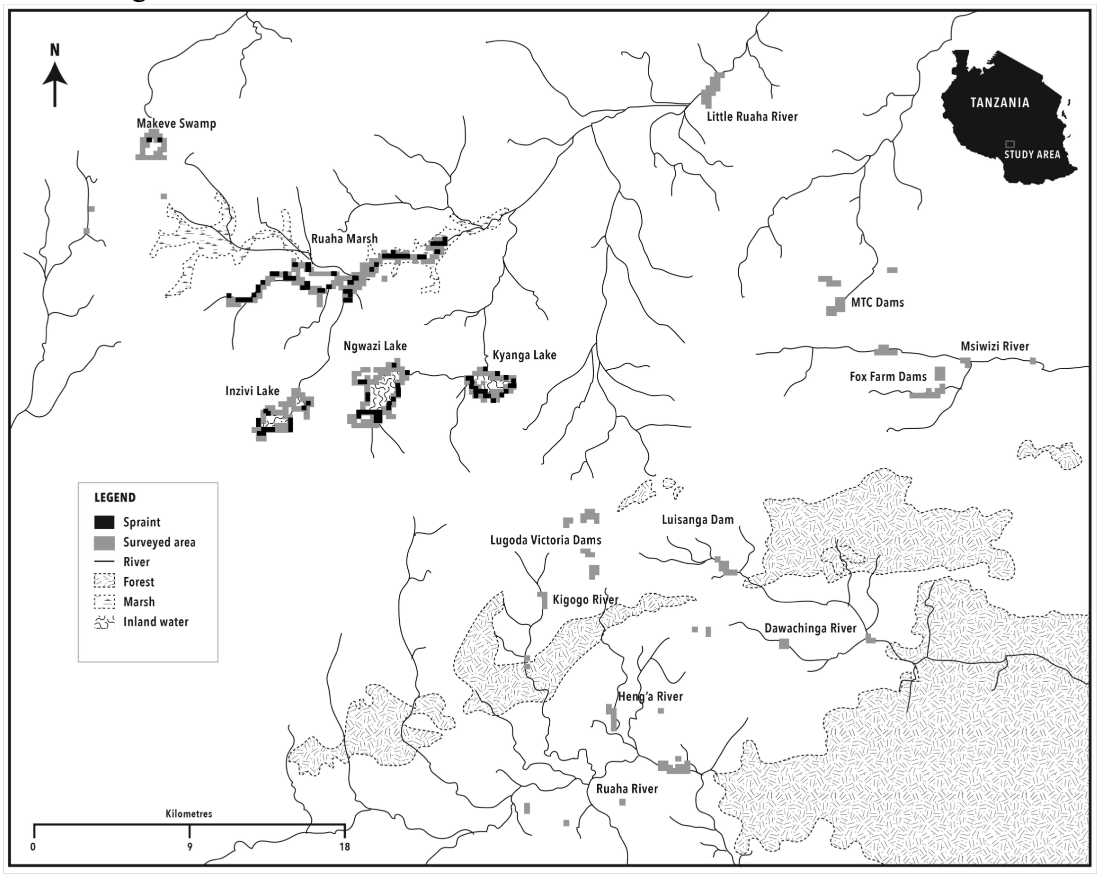

Figure 3. Distribution of *H. maculicollis* spraint sites during the wet and dry season in Sao Hill

Spraint diameters

The mean diameter of *A. capensis* spraints in Mt. Rungwe measured 24.7 ±0.45mm (n=25; range 15-35mm). In Sao Hill the diameter (N=23) ranged between 20 and 28mm. In the small dams, *A. capensis* mean spraint diameter measured was 22.4mm ±2.1 (n=5; range 20-25 mm) and, for the rivers, mean spraint diameter measured was 22.8mm ±2.1 (n=18; range 20-27 cm). Confirming that *H. maculicollis* is occupying the lakes and swamps in Sao Hill, the mean spraint diameter was 16 ±4.2mm (n=10; range 10-23mm) with only one scat having a diameter >20cm.

Preliminary food contents observations in Sao Hill

In the small dams within tea estates, *A. capensis* spraints (N=5) containing fish only, were found as well as spraints containing only crabs (*Potamonautes* sp.) (N=4). Five contained both fish and crabs. Fewer species of fish inhabit the small dams, and they belong to the family and genera below, except for one dam (on the Fox Farm), which had introduced rainbow trout (*Oncorhynchus mykiss*). *A. capensis* was observed (Fox Farm) eating trout.

The majority of *H.maculicollis* spraints in large lakes and swamps contained fish (scales, bones) and jelly. On the islands fish remains were found. During the wet season in Lake Inzivi 23 spraints, and in Lake Kyanga 9 spraints contained fish and crabs. By collecting fish specimens and by interviews, we identified 5 fish families: Kneriidae (*Kneria* sp.), Cyprinidae (*Barbus* sp.), Cichlidae (*Tilapia* sp.), Clariidae (*Clarias* sp.), Centrarchidae (*Blackbus* sp.) in the four major lakes and swamps. Local fisherman identified the fish remains as catfish, *Clarias* sp. (n=7), and *Tilapia* sp. (n=4). The same fish genera were present in surveyed rivers (except for *Kneria* sp. and *Blackbus* sp.).

Table 3. Sao Hill area: *H. maculicollis* spraint sites density within each water catchment recorded in during the wet and dry seasons.

River Catchment	N. of Transects (T)	Altitude	N.Spraint sites (S)	Km surveyed	Density	Ts/Ttot	S/T
WET SEASON	**Lakes**						
Mpanga	13	1845(a,b)	98	29.15	3.36(a) 1-7(b)	100.00	7.54
	Marshes						
Ruaha	5	1837(a,b)	35	19	1.84(a) 0.45-3.83(b)	100.00	7.00
Total	**18**		**133**	**48.15**	**2.76**		**7.39**
DRY SEASON	**Lakes**						
Mpanga	6	1834(a,b)	61	21.35	2.86	83	10.17
	Marshes						
Ruaha(4), Mpanga(1)	5	1828(a) 1825(b)	38	21.4	1.78	80	7.60
Total 11			**99**	**42.75**	**2.32**		**9.00**

Key: Altitude: a) mean altitude along all transects and b) mean altitude along transects with spraint sites; density: n.of spraint sites/1km with each catchment ; Ts/Tot: percentage of transect with positive presence of otters; S/T: measure of relative abundance or number of spraint sites/n. transect sites.

DISCUSSION

This study provides detailed information on the distribution, abundance and ecology of *A. capensis* and *H. maculicollis* in southwest Tanzania. The use of spraints to monitor distribution and abundance, despite being questioned (Kruuk and Conroy, 1987), is effective, repeatable and sustainable, providing there are trained technicians (Mason and Macdonald, 1987). With some precautions, the density of signs can be used for broad comparisons of populations. Otters use spraints for signaling to other individuals about resource availability, and thus more are deposited when resources are already being used in *Lutra lutra* (Kruuk, 1992). Both sexes deposit spraints at the same rate on territory boundaries (Kruuk, 1992) and a decrease in sprainting activity has been observed by Carss and Parkinson (1996) during the mating season. Seasonal cycles in sprainting activity linked to marking behaviour and food availability can affect the number of signs found. Results from this study showed no significant difference between seasons on the number of *A. capensis* and *H. maculicollis* spraint sites in both study areas. Our minimum transect length was above 200m and often exceeded the 600-1000m used in European surveys (Mason and Macdonald, 1987). Being the first study of these species in these areas we searched a minimum of 1km (mean transect length 2.5km) on both banks of the rivers in Mt. Rungwe and Sao Hill to confirm presence of *A. capensis*, and >3 km (3.3km mean) for *H. maculicollis*.

Mt. Rungwe catchment areas

Mt. Rungwe is the wettest area in Tanzania and an evergreen forest (Davenport et al., 2010). Heavy rains and floods may affect the probability of finding sites in the wet season (Rowe-Rowe, 1992), indicating that our data from the wet season may have been underestimated. In Mt. Rungwe, many *A. capensis* sites were recorded in every stretch of river surveyed. Over the two sessions an average of 0.875/km otter sites was found in non-protected areas, in a highly human dense part of Tanzania, unlike studies in South Africa (Perrin and Carugati, 2000a).

We recorded an altitudinal interval of species distribution in the area: spraint sites ranged from 1041-1520m asl, having sampled from 580-2570 m asl. A similar association between presence and altitude mid-river was recorded in South Africa with presence linked to higher central productivity (Nel and Somers, 2007). The number of spraint sites recorded as latrines did not change between seasons but those sites recorded as single, doubled in the dry season. It is possible that being the time of dispersal, single individuals were roaming further from holts. Dry-season sampling was conducted in mid-August and September, which is the time that after 'winter', temperatures are increasing. This period is known to be when mating and dispersal occurs in South Africa (Perrin and Carugati, 2000a;b; Rowe-Rowe, 1992).

Perrin and Carugati (2000a) emphasized the role of dense cover provided by tall grasses and sedges rather than bushes over riverbanks for both species. Similar results were found in habitats in southern Africa (Kamberg Nature Reserve, Natal, Rowe-Rowe 1992; Eastern Zimbabwe: Butler and Du Toit 1994). In this study, riparian vegetation was heterogeneous with large parts of riverbanks covered by dens, tangled vegetation and tall grasses offering cover. Other features recorded in other studies (Perrin and Carugati, 2000a) are river types such as the riffle (rockier bottom), in which *A. capensis* can easily see and chase prey, and water surrounding islands which provide cover to rest, hide and a location for holts.

Threats in Mt. Rungwe

The threats to *A. capensis* in Mt. Rungwe are of two types, persecution by hunters, and habitat destruction (including water quality) linked to agricultural practices. Information concerning hunting was provided voluntarily by 3 people out of 22, who admitted hunting otters opportunistically. Around 50% of those interviewed mentioned that hunting was common more than five years before. In a carnivore study in Mt. Rungwe in (De Luca and Mpunga, 2013), 56 (44.4%) of interviews answered questions about hunting. They claimed hunting for carnivores occurred mainly in the 1970s and 1980s. *A. capensis* was hunted with log traps, its skin valued for medicinal and witchcraft uses, the former included treating neck and back pain, epilepsy, convulsions and mental illness. Otter blood is believed to increase fighting strength of children. In South Africa otter blood is used to increase fighting strength, but of dogs (D'Inzillo Carranza pers. comm.). Until the 1980s in Mt. Rungwe members of some royal clans used to be buried in otter skins (De Luca and Mpunga, 2012).

Habitat destruction is caused by cattle grazing, wood cutting, charcoal production and fires set to clear old cultivation. These activities increase the risk of erosion and water siltation, and interfere with otter holts, water clarity and prey visibility. Rivers in Mt. Rungwe are often illegally cultivated up to the banks. Some cultivations are not cleared yearly favouring the regrowth of tangled vegetation, which provides cover to otters. Once the crop is harvested in the dry season and the fields are left to rest, our data (84.7% of spraints) suggest that otters did not deposit spraints near cultivated land. Otters are able to live between cultivated lands in riverbank pockets, which provide enough cover. Here, *A. capensis* does not appear to be affected by human activities such domestic laundry and dish washing, and constant human presence on paths along the rivers. In all spraint sites, except for four in the wet and five in the dry season, human activities were recorded.

As in many other otter species (*L. canadensis; L. longicaudis*; L. *lutra*; *A. cinerea*; A. *capensis*, *H. maculicollis*) which inhabit areas where rivers pass through cities, or scavenge around fishing boats (Kruuk, 2006; Somers, 2001), Mt. Rungwe otters are able to withstand, if not benefit from some degree of disturbance. They do not necessary need an undisturbed and clean habitat. Their tolerance to disturbance can be expected to change when the habitat become ecologically inadequate and their escape cover is no longer available (Macdonald and Mason, 1990).

Sao Hill

This was the first time that *A. capensis* has been investigated in Sao Hill. Density and frequency values were slightly higher (0.94-1.6 spraints/km) than recorded in Mt. Rungwe (0.86-0.88 spraints/km) where there was more human disturbance. Tourism, fishing, canoeing and timber collection did not seem to have an impact on *A. capensis* presence.

Sightings of *H. maculicollis* occur in early mornings or at night while fishing, and it was captured on our camera traps (set on a 24hr interval) on the shore at night (De Luca et al., unpublished data). Its presence in the lakes, marshes and swamps of Sao Hill, is a new distribution record and the most southern record in Tanzania before Lake Nyasa. Tanzania has many wetlands with fish that could support *H. maculicollis*, suggesting that species distribution may still be underestimated.

Although not statistically significant, the density estimate of *H. maculicollis* spraint sites in Sao Hill was higher (2.76/km) in the wet season than the dry. The lakes had greater densities of *H. maculicollis* spraint sites than marshes probably due to fish abundance. From interviews with fishermen and naturalists, *H. maculicollis* is often seen in large lakes and swamps in groups of 2 to 10 individuals in both seasons. One naturalist (S. Johnson pers. comm.) once counted 14 otters together on Lake Ngwazi.

The most suitable habitats for *H. maculicollis* are open water such as large lakes (Rowe-Rowe and Somers, 1998), where fish availability affects abundance and density (Procter, 1963; Kruuk & Goudswaard, 1990; Lejeune and Frank, 1990). In this study, we found that the majority of signs were on floating grass islands in lakes, and on lakeshores and swamps. The value of these islands was supported by fishermen's observations. Each day otters are seen catching fish in the lake, often in the fishnets, and returning to islands to eat, and shelter. After fish availability, the occurrence of dense vegetation cover for resting or dens is the other limiting factor, whether otters are on floating islands, lakeshores, streams or river banks (Rowe-Rowe,1992; Perrin and Carugati, 2000b). In Sao Hill preliminary observations revealed that 72% of spraints contained only fish from Lake Inzivi and 28% contained fish and crabs from Lake Kyanga. This would indicate less availability in Lake Kyanga.

Sao Hill threats to otters

Fishing and the retaliatory trapping of otters are the main threats in Sao Hill, especially near the Ruaha Marsh. Overfishing may affect prey availability and otters are seen as competing with humans. Fishing was common in some river sections and amongst the bigger lakes but not in tea estate dams where it is forbidden. Lake Ngwazi was the most intensely fished (50-100 fishermen) whereas the smaller Mkewe swamp was less used by fishermen. Fishing techniques included traps, lines and nets set over a period of at least 24hrs. All fishermen questioned perceived otters as a threat to livelihoods. Many denied hunting otters, however, in the dry season we encountered 12 snap traps, placed in water or in the bank next to otters paths and spraint sites in Ruaha Marsh, and one had a dead *H. maculicollis* in it. According to fisherman, catching otters is difficult and only between 0-3 otters per year were killed. Undoubtedly this figure is underestimated.

Other proximal human activities included cattle grazing and mud collection for bricks. These threaten otters indirectly as they can alter habitat and escape cover. Little cultivation occurred right to the riverbanks, and dense, high herbaceous or shrubland vegetation often covered them. Nevertheless, cultivation was often close and the burning of riverbanks for ploughing was observed in the dry season. Our interviews revealed that the tea estate companies apply herbicides twice a year, and fertilizer once a year but no information on the amount of pesticide use was provided.

Human activities such as farming and pollution can affect *A. capensis* more due to the species reliance on detritivorous freshwater crabs (Perrin and Carugati 2000a,b; Rowe-Rowe, 1977a,b; Somers and Purves, 1996; Mason and Rowe-Rowe, 1992) rather than the more piscivorous *H. maculicollis*. Even if otters are able to tolerate disturbance they still remain vulnerable because cubs take a year to become independent (Lariviere, 2001), and as with other mustelids have short reproduction spans (Kingdon, 1997; Weigl, 2005). Recovery from even a small increase in mortality or an increase in natural predation, is slow.

This study indicated that *A. capensis* and *H. maculicollis* populations in southwest Tanzania can thrive as long as the main threats are managed. Monitoring using the same sites should provide information on the status of these species through time. Persecution and hunting should be prevented, especially in Sao Hill, and in both sites the deterioration of habitat quality in escape cover should be carefully avoided.

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RÉSUMÉ

LE STATUT DE CONSERVATION DES LOUTRES DANS LE SUD-OUEST DE LA TANZANIE

Deux espèces de loutre sont présentes en Tanzanie, la loutre à joues blanches (*Aonyx capensis*) et la loutre à cou tacheté (*Hydrictis maccullicolis*). Toutes deux sont considérées comme «quasi menacée» sur la liste rouge de l'IUCN, avec les principales menaces liées aux pressions exercées sur l'habitat et les ressources en nourriture de par la croissance de la population humaine. Malgré le peu d'information sur leur distribution en Tanzanie, notre travail récent montre que les deux espèces sont davantage présentes qu'on ne le pensait précédemment. Nous avons étudié la distribution et l'état de conservation de deux zones fortement peuplées dans le sud-ouest de la Tanzanie, le Mt Rungwe et la colline de Sao.

Les relevés en période pluvieuse et en saison sèche sur les sites de marquage comprenaient des rivières, des lacs, et des marais, avec des informations sur l'alimentation et la typologie des habitats. Les résultats ont mis en évidence que la présence et la distribution des espèces ne sont pas significativement affectées par la saison et qu'elles peuvent se développer aussi longtemps qu'une chasse repressive peut être évitée. La qualité de l'habitat devrait être l'objet d'un suivi afin d'éviter la détérioration du couvert végétal protecteur. La nature des menaces et la conservation des deux espèces sont analysées

RESUMEN

EL ESTADO DE CONSERVACIÓN DE LAS NUTRIAS EN EL SUDOESTE DE TANZANIA

En Tanzania hay dos especies de nutrias confirmadas, la nutria africana sin garras (*Aonys capensis*) y la nutria de cuello manchado (*Hydrictis maculicollis*). Ambas están listadas como "casi amenazadas" en la Lista Roja de la UICN, estando las principales amenazas ligadas a las presiones ejercidas en su hábitat y recursos alimentarios por una población humana creciente. A pesar de los muy escasos detalles disponibles sobre sus distribuciones en Tanzania, nuestro trabajo reciente muestra que ambas especies están más ampliamente distribuidas que lo que se creía previamente. Investigamos la distribución y estado de conservación en dos áreas altamente pobladas en el sudoeste de Tanzania, el Monte Rungwe y Sao Hill. Los relevamientos tanto en estación lluviosa como seca, buscando sitios con fecas y marcas, incluyeron ríos, lagos y pantanos, colectando datos sobre items alimentarios y rasgos del hábitat. Los resultados indicaron que la presencia de las especies y la distribución no están significativamente afectadas por la estacionalidad, y que pueden prosperar en tanto se evite la caza retaliatoria. Se debería monitorear la calidad del hábitat para evitar el deterioro de la cobertura para escape. Se discuten la naturaleza de las amenazas, y la conservación de ambas especies.

REPORT

OBSERVATIONS OF THE VARIATION IN GROUP STRUCTURE OF TWO URBAN SMOOTH-COATED OTTER *Lutrogale perspicillata* GROUPS IN THE CENTRAL WATERSHED OF SINGAPORE

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ABSTRACT
The population and distribution of the smooth-coated otter *Lutrogale perspicillata* in Singapore have increased since 1998. In recent years, the species has established itself in urban areas with high human exposure within the Central Watershed of Singapore. The ease of following *L. perspicillata* in such areas has facilitated the monitoring of two urban groups, allowing the temporal variation in their group structures to be scrutinized. Field observations from two studies, and observations from the ground between December 2014 and December 2017, were compiled. Breeding pairs from both groups each gave to a total of seven litters of pups, with a mean litter size of 4.86. A change in group behaviour from pre-pregnancy, pre-natal and to post-natal were observed. Natural mortality resulting from intraspecific aggression and other natural causes, and an instance of anthropogenic mortality, were observed. Wild records of parturition, litter size, movement pattern and mortality are rare for this species from anywhere in its world range.

Key words: smooth-coated otters, Singapore, group structure, home range, breeding

INTRODUCTION

The Smooth-coated otter *Lutrogale perspicillata* re-established itself in Singapore since 1998, after their apparent absence from the country for three decades (Theng and Sivasothi, 2016). Since then, the population of *L. perspicillata* has increased and its distribution has widened. This includes establishing in and adapting to urban areas with high human exposure, as observed nowhere else in the world (Theng and Sivasothi, 2016). Within these urban areas in Central Watershed of Singapore, the ease of following *L. perspicillata* has facilitated its monitoring compared with the challenges of such tracking for groups in wilder habitats. As such, the large numbers of records for two groups of urban *L. perspicillata* over the years allow temporal variation in group structures to be scrutinized.

STUDY AREA

The Central Watershed of Singapore (Fig. 1) consists of a series of rivers that have been modified into stormwater channels and four reservoirs that drains (Public Utilities Board, n.d.). Two groups of *L. perspicillata* occupied the Central Watershed area during the study period. In 2014, one group established in Marina Reservoir (1.286°N, 103.8673°E), a freshwater estuarine reservoir created by barraging the river mouth. In 2015, second group established in Bishan-Ang Mo Kio Park (1.3634° N, 103.8436° E), an urban park with a naturalised river. The three kilometer stretch of river in this park was once a concrete canal, and was naturalised and de-concretised in 2012 to form a meandering river with vegetated banks (National Parks Board, 2018).

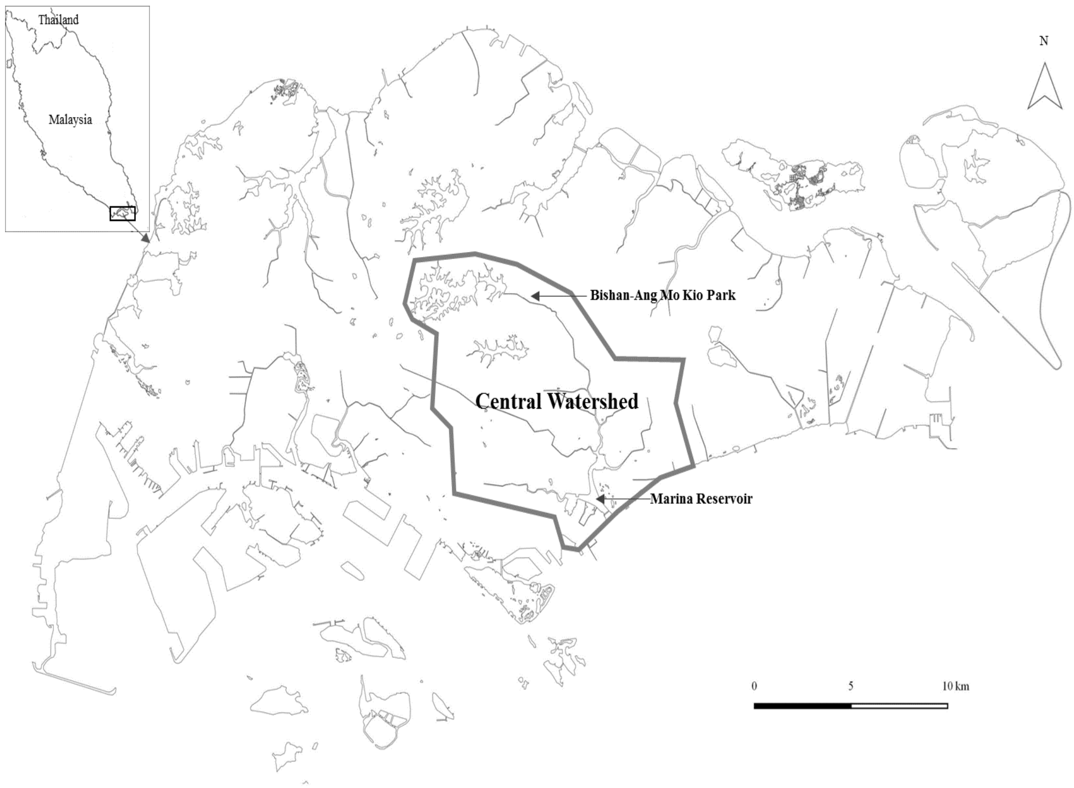

Figure 1. Map of Singapore showing the Central Watershed and the two areas where the two *L. perspicillata* groups established.

METHODS

Observations from this study were mainly opportunistic observations from a home range and population structure of *L. perspicillata* study in June–December 2015 and August 2016 - April 2017. In addition, photographic and videographic records between December 2014 and December 2017 were compiled. The bulk of these records were obtained from a group of 15 otter enthusiasts and photographers, and were verified either by matching the observations to the photographic or videographic evidence, or through ground-truthing by the authors to ensure their accuracy.

RESULTS

Breeding activities

All emergence periods of the seven litters of pups from the natal holt occurred between November and June (Fig. 2), which suggests that parturition occurred between October and May, based on the six week pre-emergence period (see below). Four of the interval periods between parturition were between ten months to 11 months, and one period was 48 months.

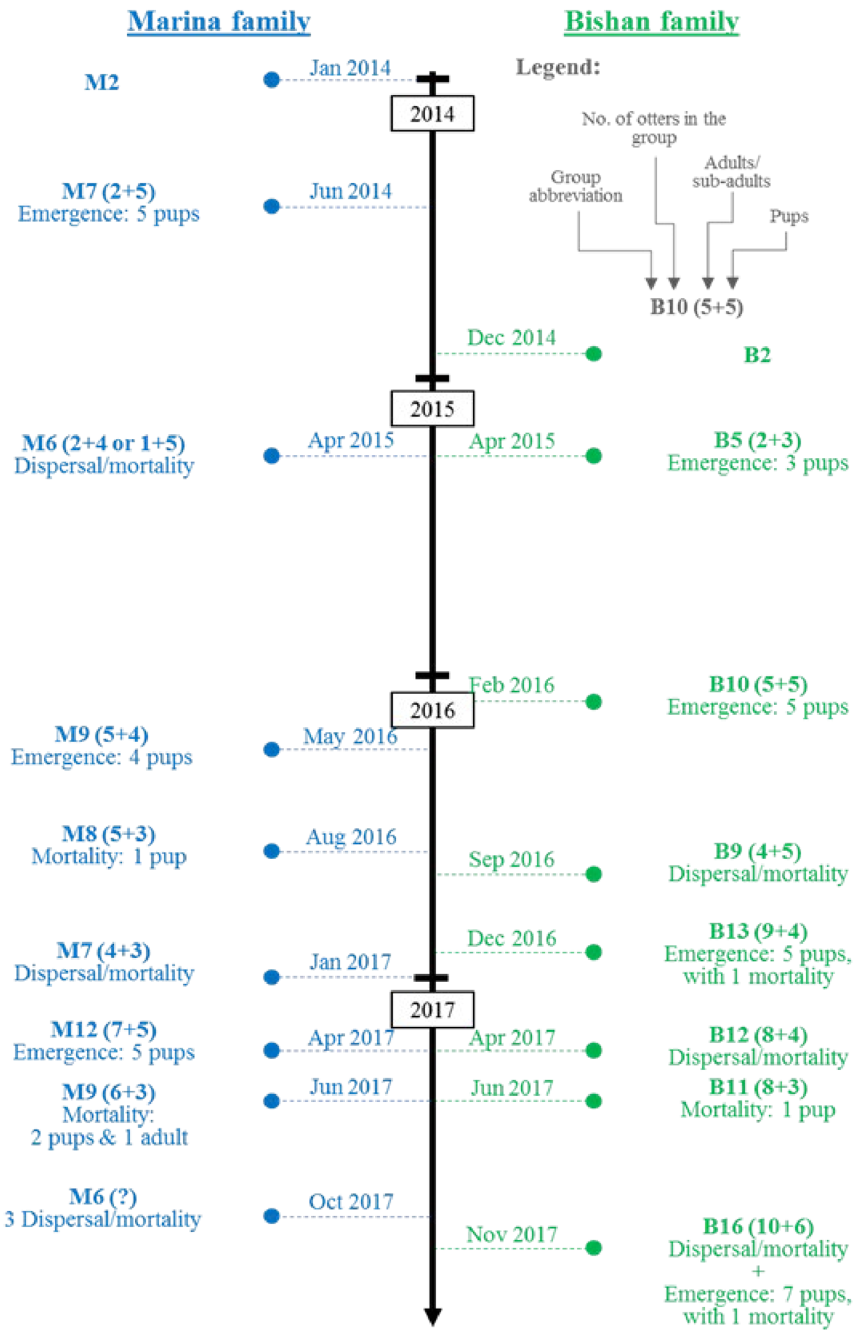

Figure 2. Timeline of the variation in group structure of Marina and Bishan *L. perspicillata* groups

Litter sizes

Breeding pairs from the Marina and Bishan groups gave birth to three and four litters respectively, with a mean litter size of 4.86 ± 0.459 (SE) (n=7, range: 3-7).

Differences in group behaviour between pre-pregnancy, pre-natal, and post-natal periods from four litters

L. perspicillata groups were observed to typically travel and go on foraging trips as a whole group when none of the females in the group were pregnant. They changed their holt frequently as well (at least once every three days). During the pre-natal stage (as observed by the increase in size of the females' belly), which lasts for approximately 62 days (Yadav, 1967; Desai, 1974) , groups still travelled and foraged as a whole, but were observed to return to the same holt when the expected parturition date draws close. This is followed by a sudden change in group behaviour, where adults within the group no longer went on foraging trips as a whole, but at least one individual stayed in the natal holt at all times. When this change in group behaviour occurred, it was inferred that parturition have taken place. During the post-natal stages after parturition, pups remained in the natal holt for approximately 6 to 6.5 weeks before emergence. A week after emergence, pups were observed learning how to swim. Also, groups were observed shifting away from their natal holt. After the pups emerged, till they were approximately 10 weeks old, adults were observed to go on some foraging trips without pups and some foraging trips with part litters of pups. After the pups were 10 weeks old, the typical behaviour of the *L. perspicillata* group travelling in a group was resumed.

Mortality

Mortality occurred for both natural and anthropogenic reasons. One form of natural mortality that occurred was intraspecific aggression. Three pups from the second and third litters of the Marina group, estimated to be between 3.5 to 4.5 months old, died due to intraspecific aggression between the Bishan and Marina groups. Another form of suspected natural mortality of a pup was where it was no longer recorded with the group after its litter's first emergence from the natal holt. This occurred in the third and fourth litters of the Bishan group. This was assumed to be natural mortality instead of anthropogenic because the holt was in a secluded area that is hard to be reached by humans. Lastly, suspected natural mortality of a male adult otter (estimated age: 7 years old) in the Marina group, suspected to be the alpha male, occurred. It was first observed to be straining during defecation, with blood in its spraints. Tests from its faecal blood sample did not reveal any infectious disease. The alpha male looked thin and sluggish, but still followed the group although it was barely keeping up. Regurgitation of food was observed six days after blood was observed in its spraints, and it disappeared (suspected mortality) from the group seven days after blood was first observed.

Only one case of anthropogenic mortality was recorded: this was for a seven-month-old pup from the Bishan group's third litter. It was found dead in a fishing bubu trap (Fig. 3) that was found floating in the water. A vet determined the pup to have died of heatstroke.

Dispersal

Various times an adult or sub-adult *L. perspicillata* was recorded to have disappeared from each group permanently, but it was unclear when this was from dispersal and when from mortality. On two accounts of suspected dispersal, it was observed that the individual periodically left and joined the group for a few days or weeks before permanently leaving.

Movement patterns

Movement patterns were categorised by Hussain and Choudhury (1995) into either small-scale movement for foraging in an area or extensive movement between foraging sites and holts. In this study, four accounts of long-distance movements in canalised rivers across large areas of each group's home range were recorded within a short time frame (Table 1).

Figure 3. The dead otter pup in a fishing bubu trap (Public Utilities Board, 2017)

Table 1. Records of long distance movements within short time frames for Marina and Bishan groups of Smooth-coated Otters *Lutrogale perspicillata*, Singapore.

Group name	**Date**	**Group structure**	**Distance travelled (km)**	**Canalised river width (m)**	**Time taken**	**Average speed (km/hr)**
Bishan	18 Dec 2015	Two adults, three 9.5-month-old pups	7.91	5 – 100	5hrs	1.58
	9 Jul 2016	Five adults, five six-month-old pups	8.97	5 – 100	11hrs 58mins	0.75
Marina	14 Dec 2016	Four adults, three 9.5-month-old pups	1.79	25 – 50	1hr 9mins	1.56
	1 Jun 2017	Seven adults, five three-month-old pups	3.3	25 – 50	1hr 30mins	2.20

DISCUSSION

Records of parturition periods for *L. perspicillata* are rare, with these being the first in Singapore. In the National Chambal Sanctuary of India, Hussain (1993) recorded *L. perspicillata* to be a winter (October – February) breeder. In Bangladesh, two studies reported this species to be non-seasonal breeders instead (Feeroz et al., 2011). Singapore's seasons comprises of two main monsoon periods (December to early March (higher rainfall), and June to September (lower rainfall)) with inter-monsoon periods in between (Meteorological Service Singapore, n.d.). Hence, it is likely that *L. perspicillata* in Singapore are non-seasonal breeders as well since current parturition periods (between October and May) falls within both monsoon and inter-monsoon periods.

The litter size of seven pups from the fourth litter of the Bishan group is the largest wild-born litter so far, with litter sizes of wild and semi-captive groups ranging between two and five (Hussain 1997; Feeroz et al., 2011). In captivity, there has been one record of seven pups in a litter: from Prague Zoo (Johnston, 2017).

After parturition, the time during which pups stay in their natal holt before emergence was similar to the only record available from a zoo, where pups emerged from the holt 1.5 months after parturition (Yadav, 1967). The change in group behaviour during pregnancy to post-natal stages, where the group sticks to a single holt, and all adults may not go on foraging trips together, may be used as an indicator where parturition has occurred.

Data on *L. perspicillata* movement are severely lacking, with only two studies on home range (in India and Malaysia) and one on movement pattern (in India) (Wayre, 1974; Hussain and Choudhury, 1995). Even then, the study on movement pattern recorded *L. perspicillata* as loners and duos, but not in any larger groups. The longest distance travelled by a group in this study, of 8.97 kilometers in under 12 hours, exceeds the longest distance recorded by a sub-adult male, of 7.75 kilometers (Hussain and Choudhury, 1995).

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RÉSUMÉ

OBSERVATIONS SUR LA VARIATION DANS LA STRUCTURE DU GROUPE AU SEIN DE DEUX POPULATIONS DE LOUTRE À PELAGE LISSE *Lutrogale perspicillata* DANS LE BASSIN HYDROGRAPHIQUE CENTRAL DE SINGAPOUR

La population et la distribution de la loutre à pelage lisse *Lutrogale perspicillata* est en augmentation depuis 1998. Ces dernières années, l'espèce a colonisé des zones urbaines fortement exposées à l'homme dans le bassin hydrographique central de Singapour. L'aisance du suivi *L. perspicillata* dans de telles zones a facilité le monitoring de deux groupes urbains, ce qui a permis de contrôler la variation temporelle de leurs structures de groupe. Nous avons compilé les observations de terrain des deux études et les observations au sol entre décembre 2014 et décembre 2017. Les couples reproducteurs des deux groupes ont donné chacun un total de 7 portées de loutrons, avec une portée moyenne de 4,86. Un changement dans le comportement du groupe a été observé avant la gestation, avant et après la naissance. Nous avons observé une mortalité naturelle résultant d'agression intraspécifique et d'autres causes naturelles, ainsi qu'un cas de mortalité lié à l'homme.
Des relevés dans le milieu naturel de la parturition, de la taille de la portée, du schéma de déplacement et de la mortalité sont rares pour cette espèce où que ce soit dans son aire de répartition mondiale.

RESUMEN

OBSERVACIONES SOBRE LA VARIACIÓN EN LA ESTRUCTURA GRUPAL DE DOS GRUPOS URBANOS DE NUTRIA LISA *Lutrogale perspicillata* EN LA CUENCA CENTRAL DE SINGAPUR

La población y la distribución de la nutria lisa *Lutrogale perspicillata* en Singapur, han aumentado desde 1998. En años recientes, la especie se ha establecido en áreas urbanas con alta exposición a los seres humnos, en la Cuenca Central de Singapur. La facilidad para seguir a *L. perspicillata* en tales área, posibilitó el monitoreo de dos grupos urbanos, permitiendo analizar a fondo la variación temporal en sus estructuras grupales. Compilamos las observaciones de terreno de dos estudios, y otras observaciones, entre Diciembre 2014 y Diciembre 2017. Las parejas reproductivas de ambos grupos, cada una dió a luz un total de siete camadas de crías, con un tamaño medio de camada de 4.86. Se observó un cambio en el comportamiento de grupo en la pre-preñez, pre-nacimiento y post-nacimiento. Observamos mortalidad natural resultante de agresión intraespecífica y otras causas naturales, y un caso de mortalidad antropogénica. Los registros en la naturaleza de partos, tamaño de camada, patrones de movimiento y mortalidad son raros para esta especie -en cualquier sector de su área mundial de distribución.

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SHORT REPORT

EVIDENCE OF THE PRESENCE OF *Lutra lutra* IN TALEQAN, ALBORZ PROVINCE, IRAN

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Abstract: Little information is available for the Eurasian otter (*Lutra lutra*) in Iran. According to previous data in national environmental organization of Iran, they are distributed near rivers and water source of northern, north eastern provinces and some areas of southern provinces. Their population is decreasing due to environmental hazards.
Citation: Mohtasebi , S and Tabatabaei, F (2018). Evidence of the Presence of *Lutra lutra* in Taleqan, Alborz Province, Iran . *IUCN Otter Spec. Group Bull*. **35** (3): 156 - 158

INTRODUCTION

The Eurasian otter (*Lutra lutra*) and the smooth-coated otter (*Lutragale perspicillata*) are the two otter species occurring in Iran (Tajbakhsh, 1995). Like in other countries, *Lutra lutra* has an aquatic life-style in Iran. They can be found in wet lands and rivers of Mazandaran, Azarbayejan, Tehran, Kordestan, Kermanshah, Markazi, Isfahan, Khorasan, Chaharmahal-Bakhtiari, Fars, Khozestan, and Lorestan provinces (Etemad, 1978).

They mostly feed on aquatic animals and fishes (Macdonald, 2006). In recent years, their population has been declining. Drought and loss of water sources, starvation and the contamination of their life environment such as entrance of agricultural residues in rivers and lakes are the major reasons of their population decrease. Also farmers hunt them while they enter their gardens and fish farms (Macdonald and Mason, 1983; Mason and Madsen, 1993) . Therefore, *Lutra lutra* is an endangered mammal in Iran. Previously distribution of otters in Iran has been studied in some areas (Karami et al., 2006; Ziaie and Gutleb, 1997) but, the presence of otters in many areas of Iran is still unknown.

REPORT

Taleqan is a rural area located in mountains of Alborz province at the height of 1820 meters above sea level with a cold climate. Some areas have been remained wild and unaffected from human alterations. Some rare and endangered mammals like the Persian leopard (*Panthera pardus saxicolor*), brown bear (*Urus arctos*) and Eurasian otter (*Lutra lutra*) have been observed recently.

An adult *Lutra lutra* was observed in the Kulej River of Taleqan (36°11′12″N 50°45′40″E) in autumn 2015 (Fig. 1). At this location they feed on fishes, crustaceans and rodents. *Cyprinidae* fishes like *Capoeta gracilis and Barbus cyri* are the most common fishes in the river. It seems that the major part of their diet is depending on this family of fishes (Fig. 2).

Figure 1. Kulej River, habitat of *Lutra lutra* in Taleqan

Figure 2. Cyprinidae fish of Kulej River captured by local fishers

On January 2014, two corpses of *Lutra lutra* were found in a fish farm pond in Hasan Jun village 36°13′00″N 50°45′00″E and confirmed as being *Lutra lutra* by the environmental officers in Taleqan. The reason of death was hypothermia (Fig. 3).

Figure 3. Corpses of *Lutra lutra* in Hasan Jun village adapted from www.iew.ir

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RÉSUMÉ

PREUVE DE LA PRÉSENCE DE *Lutra lutra* À TALEQAN, PROVINCE D'ALBORZ, IRAN

Peu d'informations sont disponibles sur la loutre eurasienne (*Lutra lutra*) en Iran. Selon ces données venant de l'organisation environnementale nationale d'Iran, elles sont localisées près des rivières et ressources en eau des provinces du nord, du nord-est et par endroits dans les provinces du sud. Leur population est en décroissance en raison de risques environnementaux.

RESUMEN

EVIDENCIAS DE LA PRESENCIA DE *Lutra lutra* EN TALEQAN, PROVINCIA DE ALBORZ, IRÁN

Hay disponible poca información sobre la nutria euroasiática (*Lutra lutra*) en Irán. De acuerdo a datos previos de la organización nacional ambiental de Irán, están distribuuidas cerca de los ríos y fuentes de agua de las provincias del norte y noreste y algunas áreas de las provincias del sur. Su población está disminuyendo debido a amenazas ambientales.

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ARTICLE

ANALYSIS OF THE STEROID HORMONE LEVELS IN THE EURASIAN OTTER (*Lutra lutra*) BY USING FECAL SAMPLES

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ABSTRACT: The population of the Eurasian otter has declined due to habitat destruction, pollution and urbanization. Studying reproductive physiology is one of the most essential things for conservation. However, there is no report which aims to understand basic reproductive physiology of this species in Korea. Hence, fecal

samples of 6 Eurasian otters kept in Korea were collected for 7-12 months to analyze steroid hormone levels to understand their basic reproductive physiology. It was succeeded to identify individual feces by fecal markers for the first time in this species in Korea. A young female otter showed clear increases in fecal estradiol and progesterone levels and both of hormone levels were much higher than that of a subadult and old female otters. The average of interval period of each peak in progesterone of a young female was 43.5 days. Pseudopregnancy was not observed. Fecal testosterone level of an old male otter was as high as that of a young male otter. However, fecal testosterone level of a subadult male otter was very low. Steroid hormone levels of otters rose between January and November in this study, which mostly coincides with a study that reports the reproductive season of Eurasian otters in Korea is from January to September. Attempt was successful in monitoring endocrine traits by using fecal samples and breeding season of Eurasian otters in Korea. This study represents the first comprehensive examination of endocrine traits of Eurasian otters in Korea, and these findings may contribute to the conservation and management of this species.
Citation: Okamoto, Y., Jung, S-Y, Han, S-Y, Han, H-D, Shimizu, K, Kim, H-H, Eo, K-Y, Park, K-W, Oh, H-T, Park, K-W and Kimura, J (2018). Analysis of the Steroid Hormone Levels in the Eurasian Otter (*Lutra lutra*) by using Fecal Samples. *IUCN Otter Spec. Group Bull.* **35** (3): 159 - 170
Keywords: breeding season, Eurasian otter, fecal steroids, noninvasive monitoring

INTRODUCTION

The Eurasian otter (*Lutra lutra*) is distributed in Eurasia and Northern parts of Africa (Sjoasen, 1995, Lee, 1996, Ruiz-Olmo et al., 2001, Kruuk, 2006, IUCN, 2014). The population of the Eurasian otter, however, has been decreasing rapidly in recent decades due to habitat destruction, pollution or urbanization (Sjoasen, 1995, Lee, 1996, Koelewijn, 2010). The Eurasian otter is currently designated as a Near Threatened species on the IUCN Red List and listing on Appendix Ⅰ of the Convention on international trade in endangered species (CITES) (IUCN, 2014, CITES, 2014). Among East Asian countries, this situation is much more serious. In Japan, it was declared in August 2012 that the Japanese otter (*Lutra lutra nippon*) has already become extinct (Kruuk, 2006, Ando, 2008, IUCN, 2014, Kushimoto, 2014), and the number of Eurasian otters in China and Taiwan is declining (Lee, 1996, Li, 2005, Piao et al., 2011). The population of the Eurasian otter in Korea has also declined rapidly during the last several decades even though it had once been abundant throughout the country (Ando, 2008, Kim et al., 2011, Seo et al., 2014). Therefore, Eurasian otters in Korea were designated as Natural monument No.330 in 1982 and Korean endangered species I in 2004 in order to conserve them, and several studies about the population of Eurasian otters in Korea have been carried out (Ando, 2008, Kim et al., 2011, Han and Yoon, 2012).

With wild otter populations in crisis, captive otters have become more important as a research resource to better understand basic otter biology and as a potential genetic reserve for otter conservation (Bateman et al., 2009). In particular, a comparative data set of basic reproductive information also would benefit development of reproductive technologies, such as artificial insemination and genome resource banking, as population management tools (Bateman et al., 2009). Through prior studies, several basic reproductive characteristics of the Eurasian otter were revealed. The age of sexual maturity of this species seems to be quite variable (Melissen, 2000), however, it was assumed that most of Eurasian otters produce their first litter by the age of 2 years (Kruuk et al., 1991). Furthermore, there is no delayed implantation in the Eurasian otter (Sandell, 1990). After a gestation period of about 63 days, on average 2-3 cubs are born (Kruuk, 2006). Eurasian otter cubs may be born at any time of the year (Heggberget and Christensen, 1994, Melissen, 2000), however, in the wild, seasonal birth peaks of the Eurasian otter may vary among different parts of habitat range, probably related to the seasonality of food resources (Kruuk, 1991, Heggberget and Christensen, 1994, Kruuk, 2006).In Korea, it was reported that the reproductive season of wild Eurasian otters as starting from the end of January and ending at the end of September (Han, 1997).

In many nondomestic species, reproductive endocrine traits may be characterized, without requiring frequent capture and anesthesia, by using noninvasive monitoring of urine or fecal metabolites (Schwarzenberger, 2007, Bateman et al., 2009, Kummrow *et al*., 2010). For example, reproductive characteristics of the Small-clawed otter (*Aonyx cinereus*), the North-American river otter (*Lontra canadensis*) and the Sea otter (*Enhydra lutris*) were studied by using their fecal samples (Larson et al., 2003, Bateman et al., 2009). In the Eurasian otter, steroid hormone levels of fecal samples collected in the wild were analyzed to know the population structure in the specific area (Kalz et al., 2006) and the effect of the environmental hormone to reproduction (Jansman et al., 2001). Also, there is a paper which aims to understand basic reproductive physiology of the Eurasian otter in captivity (Tschirch et al., 1996). Therefore, steroid hormone levels of Eurasian otters in Korea were analyzed for the first time by using fecal samples to understand reproductive characteristics in this study.

Although to get individual feces without contamination is very important for the fecal hormone analysis, zoo exhibits are not generally designed with ease of sample collection (Fuller *et al*., 2011). A common approach to this problem is to feed animals fecal markers that subsequently appears in feces (Fuller et al., 2011). It was succeeded to get individual feces by using this method in the Small-clawed otter (*Aonyx cinereus*) and the North American River Otter (*Lontra canadensis*) (Fuller et al., 2011) and in the Eurasian otter (Grohmann and Klenke, 1996, Kalz et al., 2006). Hence, fecal marker was used for the hormone analysis in this study as other reports.

MATERIALS AND METHODS

For fecal hormone analysis, a total of 4 adult and 2 subadult Eurasian otters housed at Seoul grand park (Seoul Zoo) and Korean otter research center (KORC) were assessed in this study. All otters were born in the wild and rescued within 2 months after they were born, therefore, only rescued date or estimated birth date are known (Table 1). Of these 6 Eurasian otters, 1 male and 2 females were paired for breeding, whereas the remaining 2 males and 1 female were housed alone. Although husbandry programs differed between two institutions, the feeding of Eurasian otters were generally comprised of Channel catfish (*Ictalurus punctatus*), Weather loach (*Misgurnus anguillicaudatus*), Horse mackerel (*Trachurus japonicus*) or Landlocked salmon (*Oncorhynchus masou masou*). Feeding was offered from one to three times per day.

Fecal samples were collected noninvasively after natural voiding from once to fifth per week for time spans ranging from 7 months to 1 year. For animals housed in pairs, fecal samples were identified by feeding one or more individuals nontoxic glitter powders (Glitter powder-Metal Color, Igonji, Seoul, Korea) mixed in the diet and collecting only samples containing that specific marker. Fecal samples were transferred into a labeled plastic bag and immediately stored frozen at -20 ℃.

Fecal Marker

To get the individual feces of No.3, nontoxic colored glitter powder was put into the Horse mackerel and it was given to No.3 consecutively with regular feedings. The glitter particles were less than 1mm in diameter and did not affect food intake or digestion of the Eurasian otter.

Table 1. The individual characteristics of captive Eurasian otters used in this study.

Number	Name	Sex	Facility	Birth/Rescued date	Reproductive history
No.1	Hyo-joo	F	Korean Otter Research Center	2011.06.11 (Rescued)	None
No.2	Bok soon-i	F	Korean Otter Research Center	2013.09 (Estimated birth)	None
No.3	Busan	F	Seoul Zoo	2004.12 (Rescued)	None
No.4	Jindal	M	Korean Otter Research Center	2010.06 (Rescued)	Once*
No.5	Joon-ki	M	Korean Otter Research Center	2013.06 (Rescued)	None
No.6	Samcheok	M	Seoul Zoo	2003.09.01 (Rescued)	None

*A female otter kept with Jindal (No.4) became pregnant in August 2013.

Fecal sample extraction

First, samples were dried at -85 ℃ for 24-48 hours in the freeze drier (FDU-2100, EYELA, Tokyo, Japan). After drying, 0.2g of fecal powder in a 17×120mm tube containing 2ml of phosphate buffered saline and 10ml of ether were vortexed for 1min. Then samples were shaken slowly on the dancer machine (Stovall Belly Dancer Shaker, Cole-Parmer, Illinois, USA) for 10min and centrifuged at 3×100rpm, 4 ℃ for 10min by a centrifugal separator (TOMY MX-301, Tomy Seiko, Tokyo, Japan). For extracting hormone metabolites, samples were stored frozen at -75 ℃ for 24hr. Next day, ether liquid was evaporated completely by using nitrogen gas. Therefore, 1ml Tris-HCl was added into the each tube with hormone metabolite, and all these tubes were vortexed for 1 min and stored in the refrigerator at -30℃ until the analysis.

Fecal Hormone Analysis

Time-resolved Fluoroimmunoassays (FIA) Progesterone

Fluoroimmunoassay Progesterone analyzing kit (DELFIA Progesterone kit, PerkinElmer, Massachusetts, USA) was used to analyze Progesterone levels of Eurasian otters in this study. First, 25 µl standards and samples were put into the each well, and 100 µl tracer dilution and antiserum dilution were added. Then, the plate was incubated on the slow shaking plate shaker for two hours. The plate was washed off by the plate washer (1296-026 DELFIA Platewasher, PerkinElmer, Massachusetts, USA) and 200 µl enhance liquid was put into the plate. The plate was shaked slowly on the plate shaker for five minutes. At last, the concentration of Progesterone was calculated by the plate reader (Victor 2D, Perkin Elmer, Massachusetts, USA). According to the manufacture instructions, the sensitivity of the DELFIA Progesterone assay was better than 0.00025ng/ml and the cross-reactivities tested by Progesterone FIA were as follows: Progesterone 100%, 5β-Dihydroprogesterone 90.0%, 5α-Dihydroprogesterone 13.0%, Corticosterone 2.4%, 17α-Hydroxyprogesterone 1.26%, Pregnanolone 0.80%, 11-Deoxycortisol 0.12%, 11-Deoxycorticosterone and 20α-Dihydroprogesteron <0.1%.

Time-resolved Fluoroimmunoassays (FIA) Estradiol

Fluoroimmunoassay Estradiol analyzing kit (DELFIA Estradiol kit, PerkinElmer, Massachusetts, USA) was used to analyze Estradiol levels of Eurasian otters in this study. First, the plate was washed off by a plate washer. After washing, 25 µl standards and samples were put into the each well and 100 µl antiserum dilution was added. Then, the plate had been incubated on the slow shaking plate shaker for thirty minutes and 100 µl trace dilution was put into the plate. The plate was shaked and incubated on the plate shaker for two hours. After incubation, the plate was washed off by the plate washer and 200 µl enhance was put into the plate. Then, the plate was shaked slowly on the plate shaker for five minutes. At last, the concentration of Estradiol was calculated by the plate reader. According to the manufacture instructions, the sensitivity of the DELFIA Estradiol assay was better than 0.0136ng/ml and the-cross reactivities were as follows: Estradiol-17β 100%, 16-Oxoestradiol 1.8%, Estrone 1.5%, Estradiol-3-glucuronide 1.1%, Estriol 0.8%, Estradiol-3-sulphate 0.28%, 16-Hydroxyestradiol 0.08%, Estrone-3-sulphate 0.04%, 2-Hydroxyestradiol 0.04%.

Enzyme Immunoassay (EIA) Testosterone

First, 50µl of Testosterone anti-body was put into the each well and the assay plate was incubated overnight at room temperature. After incubation, the assay plate was washed 3 times by the plate washer (MR-96CR, BioTek, Tokyo, Japan). 50µl of assay buffer was put into all wells, and the assay plate was shaken slowly for 30min on the plate shaker (NR-10, TAITEC, Koshigaya, Japan). 50µl standards, controls and samples were added to each well. Then, 50µl Testosterone-HRP were added to each well and the assay plate was incubated overnight at room temperature. The assay plate was washed 3 times by the plate washer after incubation and 100µl of OPD substrate were added to each well. Then, the assay plate was shaken fast for 30min on the plate shaker. At last, 50µl of stop solution was added into each well and the concentration of Testosterone was calculated by reading absorbance at the plate reader (Sunrise rainbow, TECAN, Mannedorf, Switherland). The sensitivity of this assay was better than 0.015ng/ml and the cross-activities were as follows: Testosterone 100%, 5-Dihydrotestosterone 7.0%, 4-Androstenedione 2.0%, Androsterone 0.2%, 5-Androstene-3B, 17B-diol 0.15%, 5a-Androstane-3a, 17B-diol 0.10%, 5B-Androstane-3a, 17B-diol, Cortisol 0.02%, Corticosterone, Pregnenolone, Progesterone, 17a-Hydroxypregenolone, Aldosterone, Dehydroepiandrosterone and Estradiol <0.01%.

RESULTS

Of the three female Eurasian otters monitored for this study, the 4-year-old female otter (No. 1) showed clear increases on February 24th, April 4th and May 4th in fecal estradiol levels and on February 27th, April 4th and May 24th in fecal progesterone levels (Figure 1). Both of hormone levels of this individual were 0.17-67.28 ng/g and 6.15-1441.26 ng/g, respectively. The average of interval period of each peak in progesterone of No.1 was 43.5 days. Compared to the results of No.1, both of the hormone levels of the 1-year-old (No. 2) and 10-year-old female (No. 3) otters were very low and no clear increase was observed (Fig. 2, 3). The fecal estradiol and progesterone levels were 0.18-9.74 ng/g and 2.65-411.34 ng/g for No.2, and 0.08-7.89 ng/g and 1.98-337.55 ng/g for No.3, respectively. None of the Eurasian otters became pregnant. Although the fecal estradiol and progesterone levels of No.1 and No.2 became higher from January-February to August-October, the progesterone level of No. 3 rose slightly only from the beginning of October to the end of November.

Horse mackerels with glitter powder were eaten by No. 3 without hesitation, allowing for the collection of uncontaminated fecal samples. Furthermore, No. 3 did not experience any health problems during this study.

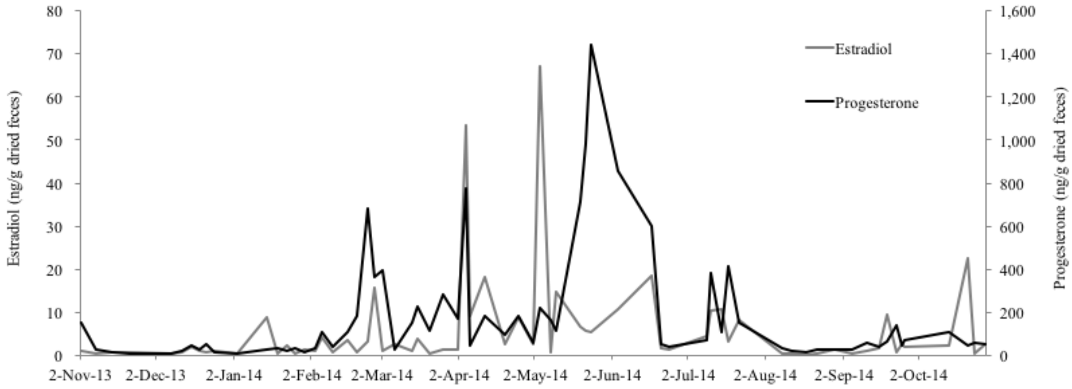

Figure 1. Fecal estradiol and progesterone profile of No.1 (Hyo-joo, 4-year old, female).

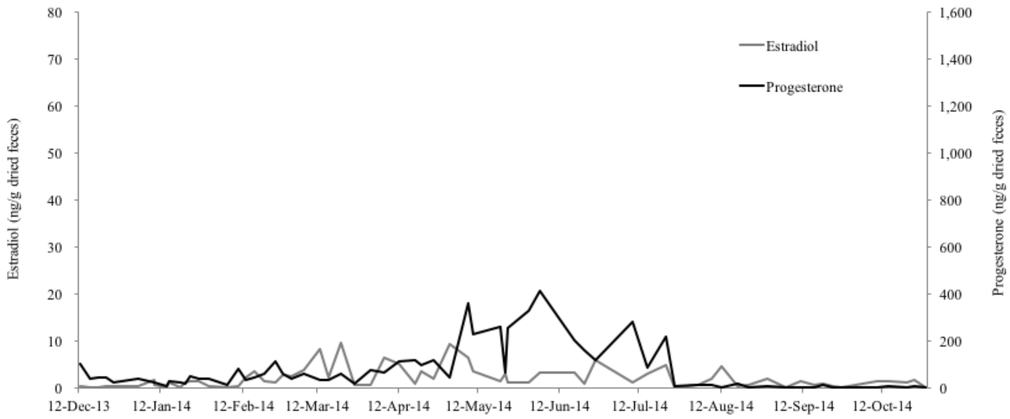

Figure 2. Fecal estradiol and progesterone profile of No.2 (Bok soon-i, 1-year old, female).

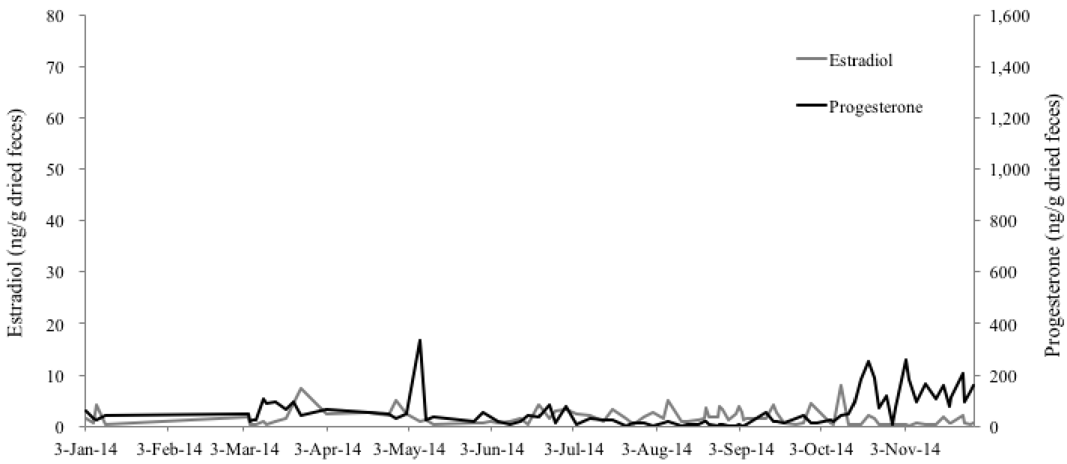

Figure 3. Fecal estradiol and progesterone profile of No.3 (Busan, 10-year old, female).

Among the male otters, the fecal testosterone levels of the 4-year-old male (No. 4), 1-year-old male (No. 5) and 11-year-old male otter (No. 6) were 0.25-391.64 ng/g, 0-157.45 ng/g, and 0.00-211.67 ng/g, respectively (Figure 4-6). In particular, No. 4 and No. 6 showed clear increases in fecal testosterone levels from March-May to September-October. However, the fecal testosterone level of No. 5 rose slightly only from April to May, and its overall level was very low compared to No. 4 and No. 6.

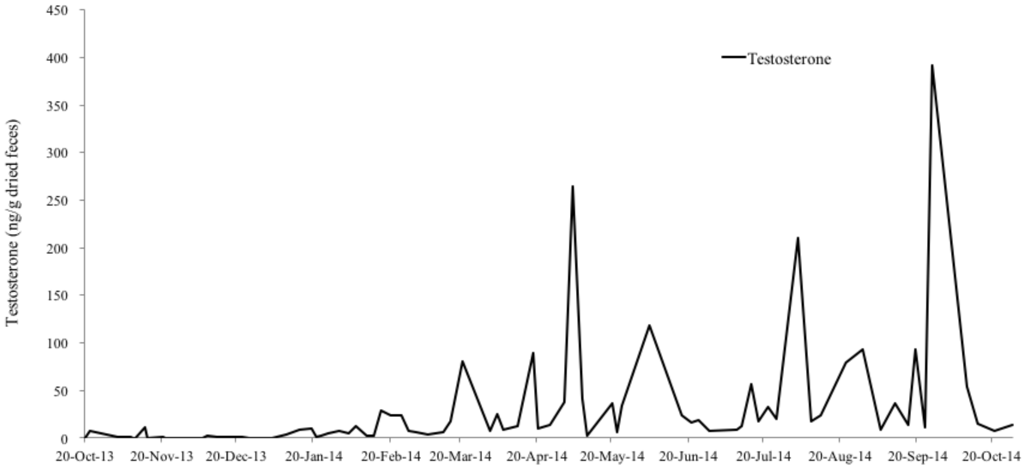

Figure 4. Testosterone profile of No.4 (Jindal, 4-year old, male).

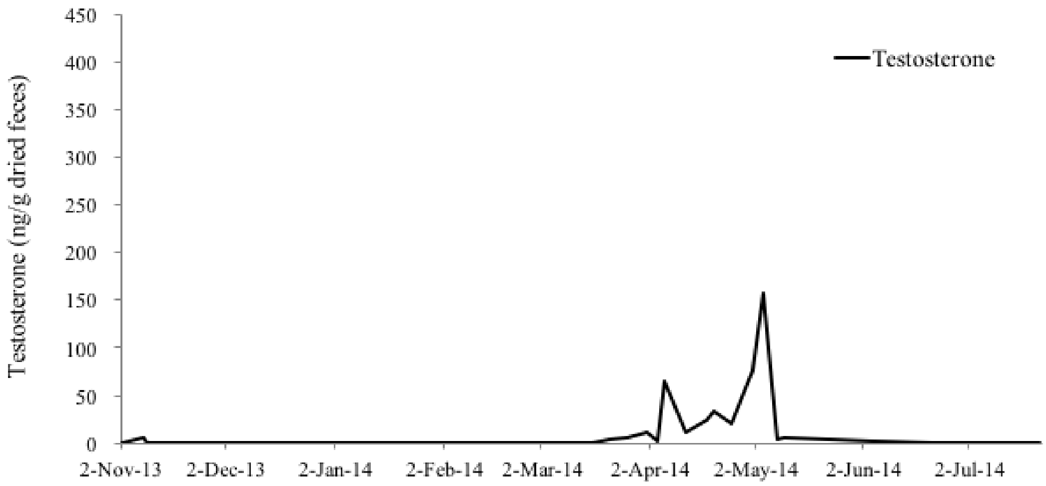

Figure 5. Testosterone profile of No.5 (Joon-ki, 1-year old, male).

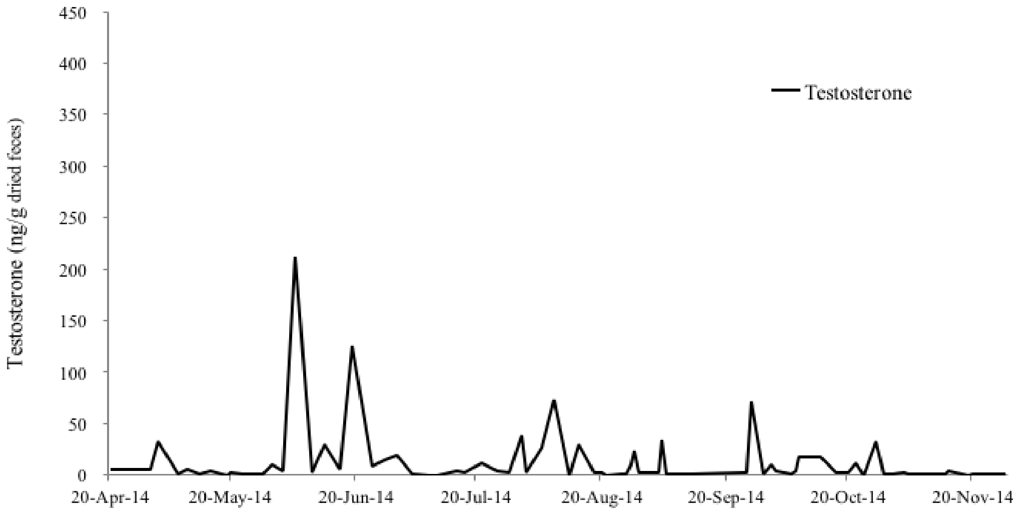

Figure 6. Testosterone profile of No.6 (Samcheok, 11-year old, male).

DISCUSSION

In mammalian female animals, ovarian activities (follicular growth-ovulation-formation of corpus luteum) are repeated after reaching sexual maturity. The blood concentration of estradiol increases during the follicular growth period, because the dominant follicle produces great amount of estradiol. Then, corpus luteum produces substantial progesterone (Schillo, 2009). The estradiol level of No. 1 rose significantly in the beginning of April and May, and its progesterone level rose significantly three times: at the end of February, the beginning of April, and the end of May. Therefore, it was thought that follicles grew and ovulation occurred at least two times during this study. Although no ovulation occurred in No. 2, the growth of follicles seems to have been occurred from February to August and this ovarian activity indicated that this subadult female otter was reaching sexual maturity. It was shown that fecal estradiol and progesterone levels of No. 1 were much higher than No. 2 and No. 3. Otters produce their first litter by the age of 2 years, as they become sexually mature during their second year (Kruuk et al., 1991). Therefore, it was thought that the low hormone level of No.2 could be explained by the fact that the age of this individual was under the breeding age. There is a report that the average life span of otters in the wild is 4 to 5 years (Melissen, 2000). However, another hormonal study on two 17-year-old female Eurasian otters found that, while the fecal estradiol level of one was very low, that of the other 17-year-old female was as high as younger otters (Nishimori, 2014), which results show that the ovary of the latter was still working actively (Nishimori, 2014). In addition to that, it was reported that the average life span of captive Eurasian otters is 12 to 14 years and the longevity record in captivity belongs to a female individual that was 18.2 years of age when it died (Weigl, 2005). Hence, it can be suggested that female Eurasian otters in captivity can join reproduction much longer than wild otters. The result of low hormone level of No.3 can be related to the old age, however, the reproductive status of a female Eurasian otter differs depending on its individual conditions, more researches are necessary to reveal it.

In the case of pregnancy, progesterone is produced by the *corpus luteum* or placenta to maintain the pregnancy (Schillo, 2009). In addition to that, some mammalian species show high progesterone concentrations after copulation without pregnancy, which is called pseudopregnancy (Schillo, 2009). It is said that, while pseudopregnancy occur in the North American river otter and the Small-clawed otter (Bateman et al., 2009), it does not seem to occur in the Eurasian otter (Nishimori, 2014). Any female Eurasian otter did not show high concentration of progesterone for long period, therefore, pseudopregnancy was also not observed in this study.

In this study, the fecal estradiol and progesterone levels of No. 1 and No. 2 rose from January-February to August-October, which mostly coincides with the results of the study that report that the reproductive season of wild Eurasian otters in Korea starts from the beginning of January and ends at the end of September (Han, 1997).

It was confirmed that glitter powder has no effect on the health of the Eurasian otter, and this fecal marker was effective in collecting individual feces from otters in captivity without contamination. Although the uses of fecal markers for hormone analysis on the Eurasian otter were already reported (Tschirch et al., 1996, Kalz et al., 2006), it was also successful to identify individual feces in this study.

It was revealed that the elevation of fecal estradiol levels coincided with copulation behavior in the Sea otter (Larson et al., 2003). However, the elevation of fecal estradiol and androstenedione levels had no relevance to reproductive behavior in the Eurasian otter (Nishimori, 2014). Reproductive behavior such as copulation, vocalization or chasing could not be observed in this study because the installation of surveillance cameras in the otter enclosures for the sole purpose of this study was not allowed.

It was reported that the fecal testosterone levels of the small-clawed otter were correlated with seasonal changes in serum testosterone concentrations and testicular volume (Bateman et al., 2009). Hence, it was thought that the fecal testosterone levels of the Eurasian otter also indicate serum testosterone concentrations and testicular activity (Nishimori, 2014). In the Black-footed Ferret (*Mustela nigripes*), testes and seminal quality are indistinguishable among males from 1 to 5 years old ages, with progressive reproductive aging occurring thereafter (Wolf et al., 2000), however, age influence to the production of testosterone in the Eurasian otter is unclear. A study reported that the fecal testosterone levels of a 26-year-old male Eurasian otter was higher than that of a 7-year-old male otter (Nishimori, 2014). In this study, the concentrations of fecal testosterone of a 11-year old male otter (No. 6) was similar with that of a 4-year old male otter (No.4). Therefore, it was assumed that the influence of aging on fecal testosterone levels is negligible in the Eurasian otter.

As mentioned before, otters produce their first litter by the age of 2 years as they become sexually mature during their second year (Kruuk et al., 1991). Hence, it was believed that the fecal testosterone level of the 1-year old male otter (No. 5) was very low because this otter had not yet reached sexual maturity. Sperm is produced in male Small-clawed otters when their testosterone level is elevated (Bateman et al., 2009). However, it was reported in male cynomolgus monkeys (*Macaca fascicularis*) that fecal testosterone levels can be affected by other reasons like social rank stress (Czoty et al., 2009). In this study, all male individuals are not kept with any other male otters, it seems that stress effect is not so big. Therefore, it can be suggested that the elevation of fecal testosterone levels of male Eurasian otters also indicates the testes are active. In this study, the concentration of fecal testosterone of No. 4 and No. 6 rose from March-May to September-October and that of No. 5 rose from April to May, which also supports the claim that the reproductive season of wild Eurasian otters in Korea spans the beginning of January to the end of September (Han, 1997). Hence, it was thought that male Eurasian otters in Korea are also seasonal breeders, and their breeding season coincides with female otters.

A longitudinal assessment of fecal progesterone, estradiol, and testosterone has proven useful for understanding the reproductive physiology of the Eurasian otter. The reproductive status of otters such as the presence of ovulation and pseudopregnancy, sexual maturity, and breeding season could be monitored. However, pregnancy and estrus behavior could not be observed in this study, and the sample size was also relatively small compared to other hormone analyzing studies using wild animals in captivity (Larson et al., 2003, Bateman et al., 2009). Difficulties in securing a large sample set stemmed from physical and logistic complications such as the size of the enclosures, the clinical death of an otter, and the transfer of otters to other institutions.

This study represents the first comprehensive examination of endocrine traits of Eurasian otters in Korea, and these findings may contribute to the conservation and management of this species. However, further studies are necessary to improve endocrine monitoring of steroid hormones to further explore pregnancy, age of sexual maturity, ovulation mechanism and, the relationship between steroid hormones and estrus behavior in the Eurasian otter.

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[Note: The North American River Otter is identified erroneously as *Lontra felina*]

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RÉSUMÉ

ANALYSE DES CONCENTRATIONS EN STÉROÏDES CHEZ LA LOUTRE EURASIENNE (*Lutra lutra*) À L'AIDE D'ÉCHANTILLONS FÉCAUX

La population de loutre eurasienne a diminué à cause de la destruction de son habitat, de la pollution et de l'urbanisation. L'étude de la physiologie de la reproduction est une des priorités essentielles pour la conservation. Cependant, il n'existe aucun rapport qui a pour objectif de comprendre la physiologie reproductive de base de cette espèce en Corée. A cette fin, des échantillons fécaux de 6 loutres ont été prélevés durant 7 à 12 mois afin d'analyser les concentrations en hormones stéroïdiennes et comprendre la physiologie reproductive de base. Nous avons réussi pour la première fois à identifier des épreintes individuelles à l'aide de marqueurs fécaux sur cette espèce en Corée. Une jeune femelle a montré une nette augmentation de la concentration en estradiol fécal et en progestérone et ces deux concentrations en hormone étaient bien plus élevées que celles d'un subadulte et de femelles âgées. La moyenne de la période d'intervalle entre chaque pic de progestérone chez une jeune femelle était de 43,5 jours. Une pseudo gestation n'a pas été observée. La concentration en testostérone d'un vieux mâle était plus élevée que celle d'un jeune mâle. Cependant, la concentration en testostérone fécale d'un mâle subadulte était très basse. Les concentrations en hormones stéroïdiennes des loutres ont augmenté entre janvier et novembre dans cette étude, ce qui coïncide, la plupart du temps, avec une étude qui rapporte que la saison de reproduction de la loutre eurasienne se situe entre janvier et septembre. L'essai d'un suivi des caractéristiques endocriniennes a été couronné de succès grâce à l'utilisation d'échantillons fécaux durant la saison de reproduction de la loutre eurasienne en Corée. Cette étude représente la première analyse complète des caractéristiques endocriniennes de la loutre eurasienne en Corée et ces résultats pourront contribuer à la conservation et à la gestion de cette espèce.

RESUMEN

ANÁLISIS DE LOS NIVELES DE HORMONA ESTEROIDEA EN LA NUTRIA EUROASIÁTICA (*Lutra Lutra*) UTILIZANDO MUESTRAS FECALES

La población de nutria euroasiática ha declinado debido a destrucción de hábitat, contaminación y urbanización. El estudio de la fisiología reproductiva es una de las cosas más esenciales para la conservación. Sin embargo, no existen estudios dirigidos a entender la fisiología reproductiva de esta especie en Korea. Por ende, colectamos muestras fecales de 6 nutrias eurosiáticas en cautiverio en Korea, durante 7-12 meses, para analizar los niveles de hormona esteroidea, para entender su fisiología reproductiva básica. Tuvimos éxito identificando fecas individuales mediante marcadores fecales por primera vez para esta especie en Korea. Una hembra joven mostró claros aumentos en los niveles de estradiol y progesterona fecal, y ambos niveles hormonales fueron mucho más altos que el de un subadulto y una hembra vieja. El promedio del período de intervalo entre picos de progesteerona en una hembra joven fue de 43.5 días. No observamos seudo-preñez. En un macho viejo encontramos un nivel de testosterona fecal tan alto como el de un macho joven. Sin embargo, el nivel de testosterona fecal de un macho subadulto era muy bajo. En este estudio, los niveles de hormona esteroidea de las nutrias subieron entre Enero y Noviembre, lo que mayormente coincide con un estudio que informa que la estación reproductiva de la nutria euroasiática en Korea es de Enero a Septiembre. Nuestro intento de monitorear los rasgos endocrinos y la estación reproductiva en Korea utilizando muestras fecales, fue exitoso. Este estudio representa el primer examen abarcativo de los rasgos endocrinos de las nutrias en Korea, y estos hallazgos pueden cntribuir a la conservación y manejo de esta especie.

R E P O R T

POPULATION STRUCTURE, DISTRIBUTION, AND HABITAT USE OF SMOOTH-COATED OTTERS *Lutrogale perspicillata* IN SINGAPORE

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ABSTRACT: The population and distribution of smooth-coated otters (*Lutrogale perspicillata*) in Singapore has increased since their return in 1998, but their population structure, distribution, and habitat use have not been quantified. A nation-wide field study (land surveys, boat surveys and camera trapping) at 15 sites, along with the collection of *L. perspicillata* records from the public, were conducted for six months (August 2016 to January 2017). The current study reveals at least 79 individuals in Singapore from 11 groups. The population in Singapore is growing, and consists of 58.2% adults and 41.8% sub-adults or pups. The average group size is 7.2, with groups ranging from two to 14 individuals. *L. perspicillata* occupy a wide variety of aquatic habitats including mangroves, coasts, reservoirs, rivers, and canals. They have adapted to using urban structures, and have survived and reproduced in urban environments, which shows that they are urban adapters.

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Key words: population census, urban adapter, mammal, conservation management, citizen science

INTRODUCTION

Of the four Asian species of otters, the smooth-coated otter *Lutrogale perspicillata* and the Asian small-clawed otter *Aonyx cinereus* are native to Singapore (Sivasothi and Nor, 1994). Records prior to the 1960s indicated both species' historical presence in Singapore. However, records of either species were absent for three decades in the 1970s to 1990s, a period that coincided with intensive coastal and waterway developments (Theng and Sivasothi, 2016). In 1998, a pair of *L. perspicillata* established in the north-western region of Singapore, in the mangroves of Sungei Buloh Wetland Reserve (Theng and Sivasothi, 2016). Since 1998, the *L. perspicillata* population has increased, and its distribution has expanded throughout the island, with records in mangroves, coasts, reservoirs and even highly urban areas such as the tourist hotspot of Gardens by the Bay (a 101 hectares nature park adjacent to the Marina Reservoir). The reduced proximity of *L. perspicillata* to humans in many urban environments, coupled with high media attention, has resulted in an increased awareness of its presence in Singapore (Bailey 2016; Lee, 2016; Tan, 2016). This provided an opportunity to incorporate citizen science as a tool to study the local population of this species.

At present, there are limited studies on *L. perspicillata* both in Singapore and throughout its range. The ecology of *L. perspicillata*, especially in an urban context, is also poorly studied. This study attempts to determine the population structure (proportion of adults, subadults, and juveniles), distribution, and habitat use of *L. perspicillata*, to further the knowledge of its ecology, especially in an urban context, and to provide information vital for the conservation of this species.

STUDY AREA

Located one degree north of the equator and at the southern tip of Peninsular Malaysia, Singapore (1.3521° N, 103.8198° E) is an island city state of 719 km^2 in area. Singapore's coastlines are highly modified: large scale developments and reclamations happened between the 1970s and 1990s, and major estuaries are being barraged to form freshwater reservoirs for water supply. Most of Singapore's rivers have also been canalised to form stormwater channels for flood control (Hilton and Manning, 1995; Harris et al., 2013; Public Utilities Board, 2016). However, pockets of natural habitats remain, including primary forests (0.16%), secondary forests (21.01%), freshwater swamp forests (0.39%), mangroves (0.11%), and beaches (Yee et al., 2011).

MATERIALS AND METHODS

Data collection and site selection

Known methods for detailed population studies of otters include employing genetic methods (Park et al., 2011, White et al., 2013) or recruiting large numbers of volunteers in a fixed time period for a population census (Ruiz-Olmo et al., 2001; Garcia et al., 2009). However, genetic markers for *L. perspicillata* are still being developed (Sasaki H., personal communication), and it was not possible to recruit a large number of trained volunteers due to limited resources. Instead, in order to obtain a population estimate, field surveys were conducted and observational records of *L. perspicillata* groups in Singapore were compiled.

For a period of for six months between August 2016 and January 2017, field surveys were conducted and records were compiled. Field surveys involved camera trapping and visual observations on land and by boat at 15 sites around Singapore, selected based on site accessibility. Sixty visual observation land surveys of at least two hours each were carried out at 11 sites (total survey effort of 269 hours) (Fig. 1), and involved searching for *L. perspicillata* by foot, or by scooter or bicycle where terrain permitted. Eleven two-hour-long boat surveys were carried out at six sites (total survey effort of 22 hours), and involved searching for *L. perspicillata* on a boat in reservoirs or along the coast. Twenty-six camera traps were deployed at seven sites around Singapore (Fig. 1), with a total of 2069 potential trap nights (number of active camera traps x sum of active calendar nights). Potential trap nights was used as a metric of data collection effort as any battery depletion or camera glitches were not possible to ascertain (Vickers et al., 2017). Three models of traps (Reconyx™ PC800

Hyperfire™, Bestguarder SG990V, Bushnell NatureView HD) with either photograph or video capturing functions were used to capture either five photos or a 30-second video per trigger. Traps were fixed and secured to a support structure or tree between 0.3 to 1.5 meters off the ground. Traps were aimed at a spraint site, resting site, holt entrance or a travel path of the otters, and were triggered by an infra-red motion sensor. Camera traps were checked at least once every two months to extract images and renew batteries.

Record collection involved collating *L. perspicillata* records from online platforms, through informal interest groups, and those sent directly to the authors. Online platforms included Facebook pages and groups (OtterWatch and Nature Society (Singapore)), online databases (Mammal sightings in Singapore http://mammal.sivasothi.com and Biodiversity Environment Database System BIOME https://biome.nparks.gov.sg), and social media platforms (YouTube, Instagram and Straits Times Online Mobile Print). These data were collated opportunistically. Informal interest groups included a group of otter photographers and enthusiasts, and a private Facebook group (Birds, Insects & Creatures of Asia). Records sent directly to the authors were records from colleagues and friends. All records collected were verified through a filtering process where only records with a photo or video evidence that matches the number of otters reported were used.

Determining population structure of L. perspicillata in Singapore

Unlike other otter species with unique morphological markings (e.g. *Pteronura brasiliensis* and *Hydrictis maculicollis*) (Procter, 1963; Duplaix, 1980) which allow for identification between individuals, unique morphological markings are absent in *L. perspicillata*. Hence, a combination of methods was used to distinguish groups and obtain a population count. Groups of *L. perspicillata* were first separated based on consistent number of individuals (at least four records) in a group and at a geographically distinct location. To prevent double-counting of a group, other criteria such as the (i) presence of concurrent group sightings (ii) numbers of pups and adults in a group (iii) presence of a female within a suspected pregnancy or gestation period, were used to discern whether groups living in geographically adjacent areas were distinct (Fig. 2).

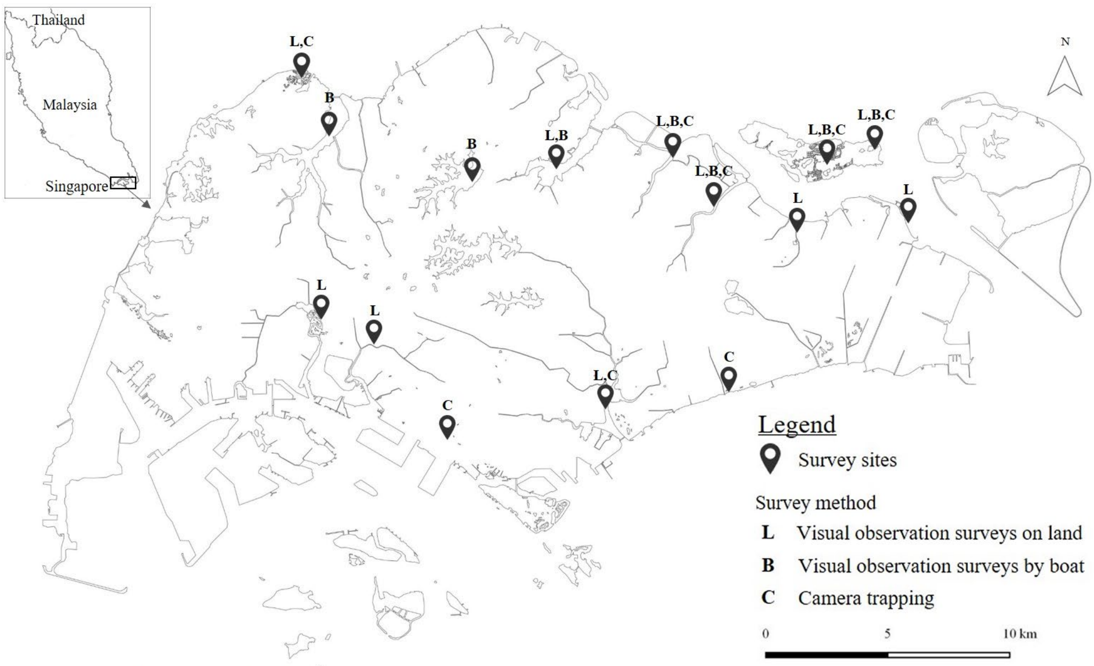


Figure 1. Map of Singapore showing the survey sites.

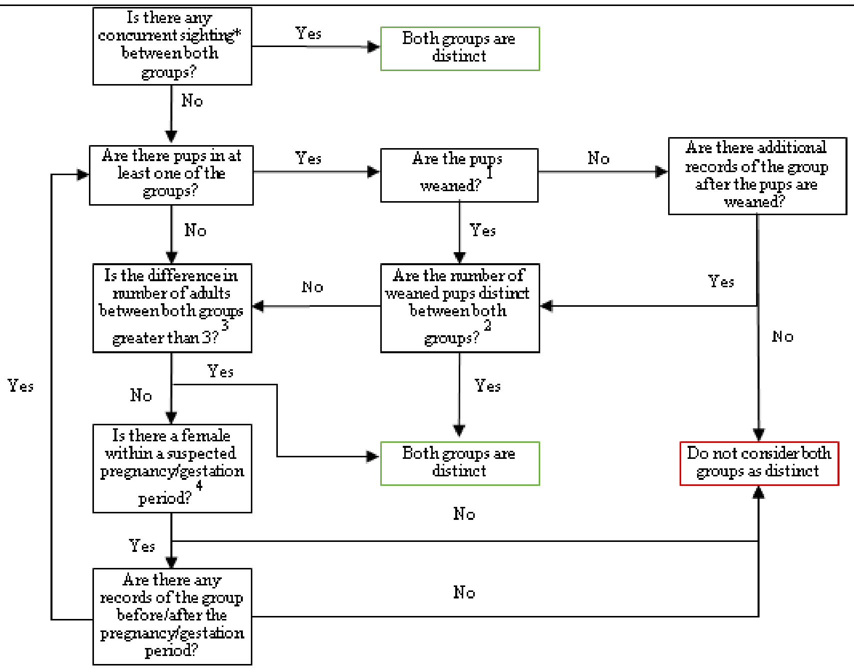


Figure 2. Flow chart used to determine distinct populations between geographically adjacent *L. perspicillata* groups based on the in-depth knowledge and detailed monitoring from three data groups observed over a period of 2.5 years.

Assumptions and definitions:

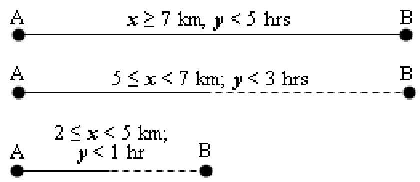
[1] Based on weekly observations of six litters from the pregnancy to weaning phase over 2.5 years.
Adults may go on pup-free foraging trips.
Adults may go on foraging trips without all the pups.
Weaning pups (approx. before 3.5months old) may die during this period.

[2] Based on weekly observations of six litters from the pregnancy to weaning phase over 2.5 years.
Weaned pups (approx. 3.5 months old) are unlikely to die
All pups will follow on foraging trips.

[3] Adults may disperse.
Adults may go on spatially separated foraging trips.

[4] Based on weekly observations of six litters from the pregnancy to weaning phase over 2.5 years.
When females are within pregnancy/gestation period, not all adult otters will go on foraging/exploratory trips together.

*Concurrent sighting definition:
If group A and B are sighted *x* kilometers apart, the time difference between both sightings must be less than *y* hours to consider both group as distinct. Numbers and figures determined based on Khoo & Sivasothi (manuscript in press).



Constructing a distribution map of *L. perspicillata*

To map the distribution of *L. perspicillata* in Singapore, each group's minimum linear home range was calculated in QGIS (version 2.18.2). Minimum linear home range (MLHR) is defined as a subset of the actual home range. MLHR was adopted because the data was pieced together based on records and surveys, which lacks the depth of conventional home range determination methods such as radio telemetry. To determine each group's MLHR, point locations obtained from records of each *L. perspicillata* group were first joined up linearly. The geographically extreme end point locations were then omitted in this MLHR unless the end point consists of more than one record. The omission is to provide a conservative estimate of the MLHR by omitting one-off areas that a *L. perspicillata* group was recorded in (Hussain and Choudhury, 1995).

Habitat use

The various types of aquatic habitats used by *L. perspicillata* were categorised. In addition, the degree of urbanisation for each habitat was categorised into one of the following: highly urbanised, urban, semi-natural or natural. Spraint sites, holts and resting sites used at least twice by *L. perspicillata* were identified and characterised based on standard methods suggested by the IUCN Otter Specialist Group.

RESULTS

Population structure

Eleven distinct groups of *L. perspicillata* were recorded, with a total estimated population count of 79 (Table 1). Group size ranged from two to 14, with an average of 7.2 ± 0.89 (SE). The maximum number of 14 *L. perspicillata* in a group (Bishan) was only recorded once, as one of the newborn pups disappeared (due to suspected mortality) after the first record. Of the 79 *L. perspicillata*, 46 were adults (58.2%), 21 were sub-adults (26.6%), and 12 were pups (15.2%). The group structures of the 11 groups consisted of a pair, and a pair plus up to three of their litters.

L. perspicillata were also recorded to use a wide range of habitats in an urban-rural gradient. An example of a highly urbanised environment used include rivers that are modified into concrete canals, where the riparian zone consists of very steep or vertical walls, and are near areas with high human traffic. Such urban habitats prevented *L. perspicillata* from directly climbing up to access land. Instead, they were observed to use steps and even vertical ladders to climb up.

Thirty-three spraint sites were recorded. Few of the spraint site characteristics were generally similar to those recorded in previous studies: close to a waterbody or escape cover (median distance: 4.2m), on a gentle slope (median angle: 2°), and above the highest water level mark (median height: 2.17m) (Anoop and Hussain, 2004; Theng and Sivasothi, 2012; Khan et al., 2014). In contrast, characteristics such as highly varied substrate composition, absence of sand within five meters, and high human accessibility (39.4%), are recorded in this study but contrary to what previous studies have found (Anoop and Hussain, 2004; Theng and Sivasothi, 2012; Khan et. al., 2014).

A total of five resting sites and 12 holts were recorded. All resting sites and holts were above the maximum water level (median height: 2.17m) and close to a spraint site (median distance: 1.45m). Distance from the nearest waterbody to each resting site and holt were varied (median distance: 1.45m, range: 1.3–62m). Almost half of all resting sites and holts (41.2%) were easily accessible to humans, especially in urban areas where a few *L. perspicillata* groups would sleep in a site visible to humans and that humans can walk up to. Most of the resting sites and holts were on or in man-made structures (76.5%). Focusing only on holts, all but one were in man-made structures. Examples of holts in man-made structures include gaps below a road, bridge, metal construction beams, or a building structure. There were at least two small entrances or one long entrance for all holts (holt entrance with the lowest height: 0.165m height by 1m length, largest holt entrance: 0.27m height by 0.35m length).

Distribution and habitat use

The distribution of *L. perspicillata* in Singapore and each group's MLHR is shown in Figure 3. Eight groups had distinct MLHR, while three groups had overlapping MLHR at two areas (Marina Bay and East Coast Park Area H). *L.*

perspicillata were recorded in a wide variety of aquatic habitats, including mangroves, coasts, reservoirs, rivers, and canals. However, they were not recorded in freshwater swamp forests and forested inland reservoirs (large waterbodies that are pre-dominantly surrounded by forests).

Table 1. Breakdown of the different *L. perspicillata* groups in Singapore as of 31 January 2017

No.	Group name	Habitat	No. of *L. perspicillata*				Group structure
			T	A	SA	P	
1	Lower Seletar (LS)	Reservoir	7	7	-	-	⚥ + 1 litter*
2	Seng Kang (SK)	Canal, reservoir, river	5	2	3	-	⚥ + 1 litter
3	Coney Island-Serangoon Reservoir (C)	Coast, reservoir, river	10	3	4	3	⚥ + 2 litters
4	Pasir Ris-Changi (PR)	Coast, mangrove, river	7	5	2	-	⚥ + 2 litters*
5	Tanah Merah (TM)	Coast, river	9	7	-	2	⚥ + 2 litters*
6	Marina (M)	Canal, coast, reservoir	7	4	3	-	⚥ + 2 litters
7	Bishan (B)	Canal, coast, reservoir	13	4	5	4	⚥ + 3 litters
8	Sentosa (S)	Coast	7	3	4	-	⚥ + 1 litter*
9	Ulu Pandan (UP)	Mangrove, reservoir, river	8	5	-	3	⚥ + 2 litters
10	Jurong Lake (JL)	Reservoir	2	2	-	-	⚥
11	Sungei Buloh (SB)	Mangrove	4	4	-	-	⚥ + 1 litter*
	Total:		79	46	21	12	
	Percentage (%):			58.2	26.6	15.2	

Legend: T: Total, A: Adult, SA: Sub-adult (1 to 2 years old, determined based on records), P: Pups (<1 years old).
⚥: Adult male and female pair.
*Assumed based on group size and structure

DISCUSSION

The largest group of 14 *L. perspicillata* recorded in Singapore is within the range of known group sizes for this species elsewhere, with the largest known group comprising of 16 individuals in River Palain of the Corbett Tiger Reserve, India (Nawab & Hussain, 2012). Groups with such sizes are also known for two other group-living and social otter species, *A. cinereus* and *Pteronura brasiliensis*, both of which can range up to 16 individuals per group, although not all individuals within a *P. Brasiliensis* group may be related (Wayre, 1978; Duplaix et al.., 2015; Groenendijk et al., 2015). This suggests that group sizes of *L. perspicillata* in Singapore resemble those of wild groups as opposed to overpopulated groups, where overpopulated groups usually have an increased food supply (through provisioning by humans etc.) and/or reduced mortality rates (Hayward et al., 2007; Mátyás et al., 2015; Riley et al., 2015). In addition, the average group size of 7.2 *L. perspicillata* in Singapore is within the reported range of average group sizes of 2.25 to 10.25 in four rural sites in Malaysia and India (Shariff, 1984; Hussain, 1995; Nawab and Hussain, 2012).

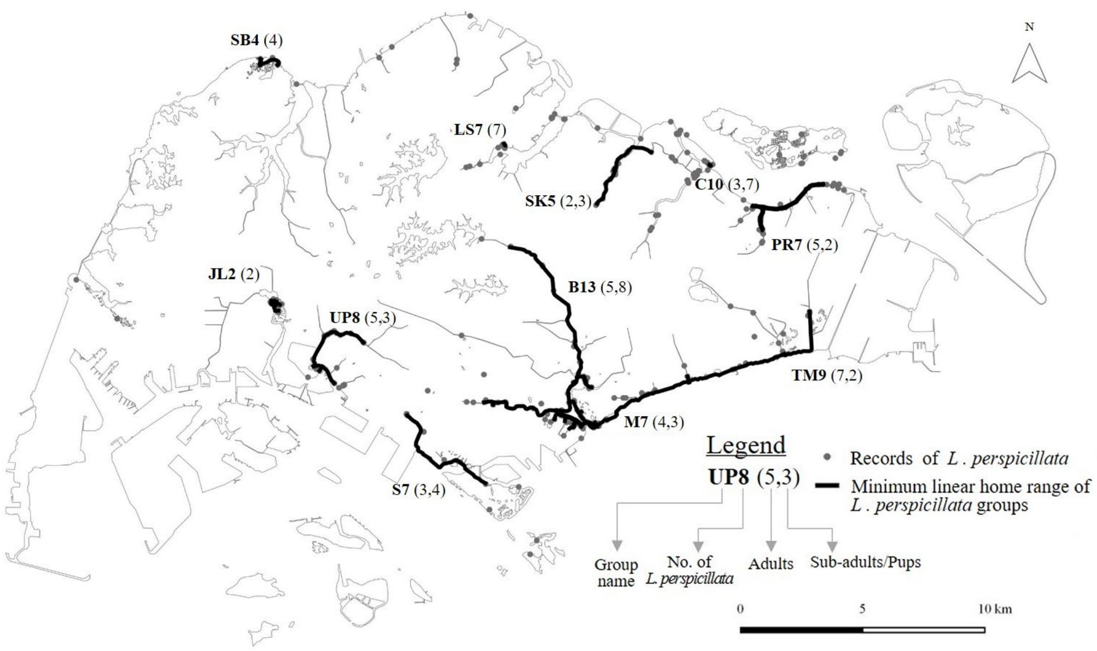


Figure 3. The population structure and distribution of *L. perspicillata* in Singapore (August 2016 to January 2017) based 9h 690 records.

The presence of 11 groups and at least 79 *L. perspicillata* is a positive comeback for the species in Singapore, considering that the species is listed as "Critically endangered" in the Singapore Red Data Book (Lim et al., 2008) and were absent from Singapore 20 years ago. This is also positive for the species, as they are listed as "Vulnerable" in the IUCN Red List of Threatened Species due to threats from habitat loss and persecution in other parts of its range (de Silva et al., 2015).

It is important to note that this six-month study only presents a snapshot of the true population of *L. perspicillata* in Singapore. This species is likely to be present in areas where data collection was not possible, based on past records of their presence (e.g. Western water catchment and western side of Pulau Ubin) (Theng and Sivasothi, 2016). The population count is likely to be an underestimate, as records in certain areas that were few and had inconsistency in group numbers (Woodlands, Sembawang, North-eastern side of Pulau Ubin) were not counted, to prevent overestimation. Also, the methodology used prevented the counting of lone *L. perspicillata* individuals as there was no methodology to differentiate lone otters from other groups.

Based on the current population number and structure, it is likely that the population will continue to increase but at a decreasing rate. The population will possibly increase because most *L. perspicillata* groups can still accommodate additional litters based on the known maximum recorded group size assuming prey is not a limiting factor. Also, increased sampling in restricted sites not covered by this study will likely document additional *L. perspicillata* groups. The rate of population increase will likely decline as most of the reservoirs and major waterways are already occupied, and mortality will likely increase due to intraspecific aggression between groups and roadkills when *L. perspicillata* explore more areas to find suitable territories in a saturated landscape.

Distribution

L. perspicillata are territorial carnivores that do not tolerate the presence of another *L. perspicillata* group (Estes, 1989; Kruuk, 2006). While multiple groups of *L. perspicillata* have reportedly used the same stretch of river in Malaysia and India (Shariff, 1984; Nawab and Hussain, 2012), it is unclear if these groups did have overlapping territories. During this study, six accounts of intraspecific aggression between two *L. perspicillata* groups were recorded within overlapping territories. One of the aggression accounts resulted in the mortality of a five-month old pup. There have been limited accounts of intraspecific aggression between most species of otters apart from *P. brasiliensis* (Duplaix et al., 2015), and these were the first documented records for *L. perspicillata*.

Habitat use

The range of aquatic habitat types for *L. perspicillata* in Singapore, including mangroves, rivers, coasts, and reservoirs, is coherent with their habitat use in other countries (Hussain and Choudhury, 1995; Anoop and Hussain, 2004; Qamar et al., 2010; Omer et al., 2013; Abdul-Patah, 2014). However, this species was not observed in Singapore's freshwater swamp forests and forested inland reservoirs, although they do occur in similar habitats overseas (Abdul-Patah, 2014). For freshwater swamp forest, the absence of *L. perspicillata* is likely because there is only one remaining patch in Singapore ($5km^2$), of which the streams are relatively narrow and shallow compared to a typical river *L. perspicillata* uses. As for within forested inland reservoirs, this species was subsequently recorded in one locality after this study. Reasons for their absence initially are unclear, but could include lower prey availability or lower prey catch rate in these areas as compared to other habitats (Nawab and Hussain, 2012).

L. perspicillata are generally not known to be able to persist in urban environments (Kamjing et al., 2017), but this was found to be contrary in this study. In fact, this study have shown that this species have adapted to urban environments. This is evident based on four examples of spraint site characteristics, resting sites and holt characteristics, and habitat use. Firstly, they have adapted to use other substrates such as concrete and grass instead of the preferred choice of sand near spraint sites (Anoop and Hussain, 2004) for grooming, as sand is not common in urban environments. Next, the presence of many spraint sites, resting sites, and holts in areas with high human accessibility indicate urban adaptation, as *L. perspicillata* are generally known to prefer sites that are protected and secluded (Macdonald and Mason; 1983; Melquist and Hornocker, 1983; Anoop and Hussain, 2004; Prakash et al., 2012). Holts were recorded to be mostly in small gaps and crevices that are likely difficult for humans and other predators to enter. This supports the idea that having secure and undisturbed holts for resting is a key factor for *L. perspicillata* to establish in an area (Anoop and Hussain, 2004), and suggests that the location of the holt may not be as crucial to their survival as the protection that the holt provides. The third example of urban adaptation would be types of resting sites and holts recorded. Resting sites were known to be on open clay banks, while holts were known to be in natural rock crevices, among boulders, dug under or between roots of trees, or inside vegetation (Shariff, 1984; Hussain and Chodhury, 1995, Anoop and Hussain, 2004; Theng and Sivasothi, 2012; Sutaria and Balaji, 2013). In contrast, most resting sites and holts in this study were found in man-made structures like the gaps under bridges, under metal beams and under roads. Such holts have never been recorded for *L. perspicillata*, although other species of otters such *P. brasiliensis*, *Lontra canadensis* and *Lutra lutra* were recorded using similar structures as holts (under bridges, in canals, in buildings, in piers etc.) (Chanin, 2003; Sleeman and Moore, 2005; N. Duplaix, personal communication). The last example of urban adaptation is the use of stairs and ladders to access dry land in concrete canals with steep sloping walls, a habitat that *L. perspicillata* are not usually associated with. While the use of stairs had been documented for *L. lutra* in a similar highly urbanised environment, in the urban centre of Cork, Ireland (K. Loxton and P. Sleeman, personal communication), the use of ladders recorded in this study is likely the first for *L. perspicillata*. As such, the ability of *L. perspicillata* to adapt, survive and reproduce in such highly urban environments means that they can be classified as urban adapters, which are defined as species that can "adapt to urban habitats but also utilize natural resources" (McKinney, 2006).

MANAGEMENT AND CONSERVATION

With the increased *L. perspicillata* population over the years, coupled with the decrease in their proximity to humans due to their presence in urban environments, human-otter interactions are inevitable. Two types of human-otter interactions with the potential to escalate into serious conflicts have already occurred. They include the raiding of private fish ponds by *L. perspicillata* and *L. perspicillata* road kills. Such interactions are major causes of persecution and decline of otter populations in many countries (Coffin, 2007; Jancke and Giere, 2011; Nawab and Hussain, 2012; Bohm et al., 2013; Poledníkov et al., 2013). Hence, there is a need to examine and consider mitigation measures so as to prevent the escalation of interaction to conflict. In response to this, the Otter Working Group, consisting of multiple parties including government agencies, educational institutions, members of public and non-government agencies, was formed in 2016 with the aim of working towards the management and conservation of otters in Singapore using a multi-stakeholder, multi-disciplinary approach. It is also fortunate that *L. perspicillata* is largely well-liked by Singaporeans, evident by the fact that the most famous *L. perspicillata* in Singapore that lives in the city centre was crowned Singapore's fifty-first icon via online polling (Lee, 2016).

Based on this study, it is evident that urbanization and presence of otters in the city is not necessarily a zero-sum game. With the proper conditions, *L. perspicillata* can thrive even in a highly urbanized city like Singapore. With this, Singapore can be used as a model biophilic city to guide otter-friendly urban design in emerging cities around the region that want to plan for otters in their urban areas, and for developed cities currently devoid of otters to see how they can improve current habitats to attract otters back.

CONCLUSION

This study showed that *L. perspicillata* are urban adapters, and the population in Singapore consist of at least 11 groups with 79 individuals. Group sizes of *L. perspicillata* here are within the reported range of group sizes in other countries. Overall, the population of *L. perspicillata* will likely increase but at a decreasing rate. Moving forward, further population studies should be conducted to monitor and better understand the population trends of *L. perspicillata*, ideally covering restricted areas that were not accessed during this study, or using genetic methods.

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RÉSUMÉ

STRUCTURE DE LA POPULATION, DISTRIBUTION ET UTILISATION DE L'HABITAT DE LA LOUTRE À PELAGE LISSE, *Lutrogale perspicillata*, À SINGAPOUR

La population et la distribution de la loutre à pelage lisse (*Lutrogale perspicillata*) à Singapour a augmenté depuis son retour en 1998, mais sa structure de population, sa distribution et l'utilisation de l'habitat n'ont pas été quantifiées. Une vaste étude de terrain au niveau national (relevés sur terre et en bateau, utilisation de pièges photos) comportant 15 sites, couplée à la récolte d'informations auprès du public sur *L. perspicillata*, a été menée durant 6 mois (de août 2016 à janvier 2017). L'étude actuelle révèle la présence d'au moins 79 individus comprenant 11 groupes à Singapour.

La population de loutre à pelage lisse de Singapour a cru depuis que le premier couple a été réintroduit en 1998. Elle comporte actuellement 58,2 % d'adultes et 41,8 % de subadultes ou loutrons. La taille moyenne d'un groupe est de 7,2 individus avec des groupes allant de 2 à 14 individus. *L. perspicillata* occupe une grande variété d'habitats aquatiques incluant des mangroves, des côtes, des réservoirs, des rivières et des canaux. Elles se sont adaptées à des structures urbaines, ont survécu et se sont reproduites dans un environnement urbain, ce qui démontre qu'elles peuvent s'intégrer au milieu urbain.

RESUMEN

ESTRUCTURA POBLACIONAL, DISTRIBUCIÓN Y USO DE HÁBITAT DE NUTRIAS LISAS *Lutrogale perspicillata* EN SINGAPUR

La población y la distribución de las nutrias lisas (*Lutrogale perspicillata*) en Singapur han aumentado desde su retorno en 1998, pero su estructura poblacional, distribución y uso del hábitat no han sido cuantificados. Condujimos un estudio de campo a lo largo de todo el país (relevamientos terrestres, en bote, y con cámaras-trampa) en 15 sitios, además de colectar registros de L. perspicillata a partir del público; dudrante seis meses (Agosto 2016 a Enero 2017). Este estudio revela al menos 76 individuos en Singapur, de 11 grupos. La población en Singapur está creciendo, y consiste en 58.2 % adultos y 41.8 % sub-adutos o crías. El tamaño promedio de grupo es 7.2, con grupos que van desde 2 hasta 14 individuos. L. perspicillata ocupa una amplia variedad de hábitats acuáticos, incluyendo manglares, costas marinas, lagos artificiales, ríos, y canales. Se han adaptado a usar estructuras urbanas, y han sobrevivido y se han reproducido en ambientes urbanos.

NEW BOOK

DER FISCHOTTER
EIN HEIMLICHER JÄGER KEHRT ZURÜCK
Irene Weinberger, Hansjakob Baumgartner

This book gives an excellent overview over the Eurasian otter (*Lutra lutra*). However, in the first chapter recent findings from Palaeozoology on the origin of the current otter species are discussed. The next chapter covers in short the other living otter species. In the following chapter general biology, diet and breeding are explained. A chapter covers the wide range extension of the Eurasian otter but also aspects such as „city otters". The solitary character and the interaction with other otters are specifically explained and there are very good pictures of the different forms of spraints. Life history and threats ranging from hundting to traffic and pollution are discussed as causes for the partial dissapearence from their former habitat as well as the recent recovery are well explained. There is a specific chapter on human-otter conflicts that covers. The book is written in German and for the general public but in addition to present a good overview of the Eurasian otter in easy understandable terms there is a large number of excellent fotos, which by themself make the book a valuable addition to every library.

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OSG MEMBER NEWS

Since the last issue, we have welcomed 6 new members to the OSG: you can read more about them on the Members-Only pages.

Ricardo Correa, Chile: I have studied Marine Otters (*Lontra felina*) along the coast of Chile for many years and work to persuade the authorities to take their protection seriously. I am currently working with them to develop a mitigation protocol for significant anthropogenic pressures on the coastal region affecting otters.

Sagar Dahal, Nepal: I am a conservationist in Nepal, currently surveying rangers in the Protected Area about the presence (or absence) and threats to otters in their working areas. I am preparing outreach material about all 13 species for use in Nepal. I am President of the Small Mammals Conservation and Research Foundation.

Sugandhi Gadadhur and Raghuneth Belur, India: We are a husband and wife team of certified naturalists and documentary filmmakers. For the last two years, we have been following Smooth-coated otters in India's only Otter Conservation Reserve along the River Tungabhadra, traveling across the river trying to understand the challenges that otters face. We regularly interact with the local fishermen and forest officials on how Otters survive here and what is needed to help conserve them. Over the next few years, we plan to document the Smooth-coated Otters in the Tungabhadra and hope to make a film about these otters, their behaviour and the challenges they face, like poaching, dynamite fishing, sand mining and hostile fishermen.

Taylor Gowin, USA: I am a student studying biology, and I hope to join a research team and study otters as my primary focus with other aquatic mammals as a secondary focus. Otters are my passion and I hope to be able to gain experience with them as soon as I can.

Alexandra Kahler, USA and India: Currently resident in Washington State, USA, I have done field research on African clawless otters in Malawi with Katrina Fernandez, and now intend to study smooth coated otters in Goa using environmental DNA. I also developed and moderate the Global Otter Community facebook page along with Carol Bennetto, Katrina Fernandez and Nicole Duplaix.