

# The hairy-nosed otter *Lutra sumatrana* in Cambodia: distribution and notes on ecology and conservation

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Paper submitted 16 September 2016, revised manuscript accepted 28 October 2016.

## មូលនិយមសង្ខេប

ភេរោមច្រមុះ (*Lutra sumatrana*) មានវត្តមានតែនៅក្នុងតំបន់អាស៊ីអាគ្នេយ៍តែប៉ុណ្ណោះ តែកំណត់ត្រាមានតិចតួច និង ចំណេះដឹងពីប្រភេទនៅមានកម្រិត។ ការសិក្សានេះត្រូវបានធ្វើឡើងក្នុងជម្រកតំបន់ទំនាបដីសើមជាច្រើនទូទាំងប្រទេសកម្ពុជា ពីឆ្នាំ២០០៦ ដល់ ២០១៣។ វិធីសាស្ត្រនៃការសិក្សា គឺសំភាសន៍ជាមួយនិងសហគមន៍មូលដ្ឋាន ការអង្កេតដោយផ្ទាល់ មើលដាន ស្លាកស្នាម និង ការប្រើម៉ាស៊ីនថតស្វ័យប្រវត្តិដើម្បីថតរូបផ្ទាល់តែម្តង។ ភេរោមច្រមុះត្រូវបានគេប្រទះឃើញរស់នៅ៤កន្លែងក្នុងប្រទេសកម្ពុជាគឺ តំបន់ដីសើមបឹងទន្លេសាប តំបន់ជួរភ្នំក្រវាញ តំបន់ឆ្នេរខេត្តកោះកុង និង តំបន់វាលល្បាប់ដីសណ្តទន្លេបាសាក់។ កំណត់ត្រារបស់វា រួមមាន ភេរោមចំនួន៨ ស្បែកចំនួន១៨ និង រូបថតដោយម៉ាស៊ីនថតស្វ័យប្រវត្តិចំនួន៧១ពីតំបន់សិក្សាចំនួន២៦។ ប្រភេទនេះត្រូវបានរកឃើញរស់នៅក្នុងទីជម្រកប្លែកៗគ្នាដូចជា៖ ព្រៃលិចទឹកទំនាបបឹងទន្លេសាប ទន្លេបាសាក់ ព្រៃកោងកាង ព្រៃស្មាច់ តំបន់ទំនាបវាលភក់ និង ស្ទឹងតាមតំបន់ភ្នំដើម។ យោងតាមការសិក្សានេះ រដូវកាលបន្តពូជរបស់វាគឺ ចន្លោះខែវិច្ឆិកាដល់ខែមិនា និង កើតកូនចន្លោះខែមិនាដល់មេសា។ ភេរោមច្រមុះច្រើនមានសកម្មភាពនៅពេលព្រលប់ និង ពេលយប់ ត្រីជាអាហារសំខាន់ និង អាហារបន្ទាប់បន្សំមាន ពស់ទឹក ក្តាម និង សត្វតូចៗផ្សេងទៀតដែលវាអាចចាប់ស៊ីបាន។ យើងសូមផ្តល់អនុសាសន៍អោយមានការសិក្សាបន្ថែមនៅតាមដងទន្លេមេគង្គ រវាងបឹងទន្លេសាប និង តំបន់តាមព្រំដែនវៀតណាម ក៏ដូចជាតាមតំបន់ឆ្នេរនៃឧទ្យានជាតិរាម ដើម្បីយល់ដឹងកាន់តែប្រសើរឡើងពីរបាយភេរោមច្រមុះទូទាំងប្រទេសកម្ពុជា។

## Abstract

The hairy-nosed otter *Lutra sumatrana* is endemic to Southeast Asia, however, records are few, and knowledge of the species is limited. This study was carried out in a range of wetland habitats throughout Cambodia between 2006 and 2013. Field methods included interviews with local communities, direct observations, and track and sign surveys combined with camera trapping. Hairy-nosed otters were confirmed from four regions in Cambodia: Tonle Sap Lake, Cardamom Mountains, Bassac Marsh and coastal areas in Koh Kong province. Records comprised eight live captive individuals, 18 skins, and 71 camera trap photographs from 26 trap locations. The species was recorded from several different habitats including flooded forest, mangrove and *Melaleuca* forest, marsh land and forest streams. Based on our records, we suggest the hairy-nosed otter in Cambodia may breed between November and March and give birth between April and June. We found the species was most active during dusk and at night, and although its diet mainly consists of fish, this is supplemented in Tonle Sap Lake with water snakes, crabs, and other small prey when the oppor-

CITATION: Heng S., Dong T., Hon N. & Olsson, A. (2016) The hairy-nosed otter *Lutra sumatrana* in Cambodia: distribution and notes on ecology and conservation. *Cambodian Journal of Natural History*, 2016, 102–110.

tunity arises. We recommend further surveys along the Mekong River between the Tonle Sap Lake and the Vietnamese border and at coastal sites such as Ream National Park to improve understanding of the distribution of the species in Cambodia.

## Keywords

Cambodia, conservation, distribution, ecology, hairy-nosed otter, *Lutra sumatrana*, Tonle Sap Lake.

## Introduction

The hairy-nosed otter *Lutra sumatrana* is endemic to Southeast Asia, with a historic range throughout the region (Aadreaan *et al.*, 2016). Little is known about the species and until 2008, it was mostly classified as insufficiently known or data deficient by the IUCN/SSC Otter Specialist Group (Hussein *et al.*, 2008). It was also believed by some to be extinct after several years of no field records in the 1990s (Wright *et al.*, 2008). The discovery of hairy-nosed otters in a peat swamp forest in Thailand in 1999 by Kanchanasaka (2000), followed by confirmed records from Vietnam, Peninsular Malaysia and Indonesia (Hussein *et al.*, 2008) indicates that the species still occurs in these countries, although probably at low densities at few and little surveyed sites. Poole (2003) provided the first confirmed record of hairy-nosed otters in Cambodia through records of captive animals in floating houses on the Tonle Sap Lake.

As information has slowly increased on the hairy-nosed otter, the species is now listed as Endangered A2cde on the IUCN Red List (Aadreaan *et al.*, 2015) due to a suspected population decline of at least 50% over the last three generations, extensive habitat destruction and conversion throughout its range, coupled with poaching for its skin and persecution as a pest (Yoxon, 2007). However, confirmed records are still few and far between, and knowledge of the species remains limited, making identification and prioritization of appropriate conservation measures difficult. Apart from a single individual held at the Phnom Tamao Zoological Garden and Rescue Center in Phnom Penh, Cambodia, no other captive individuals or breeding programs currently exist to the authors knowledge.

In this paper we document the presence and distribution of hairy-nosed otter in Cambodia and provide information on its ecology, which can inform efficient protection of the species and its habitats.

## Methods

We carried out surveys in a range of wetland habitats throughout Cambodia between 2006 and 2013. These included Virachey National Park in northeastern

Cambodia, along the Mekong River between the Stung Treng and Kratie provinces, the eastern plains of Cambodia, Tonle Sap Lake, Bassac Marsh, Cardamom Mountains, Ream National Park and coastal areas in Koh Kong Province (Fig. 1, Table 1). Survey areas were chosen based on the habitat requirements of otters, unconfirmed reports of their occurrence and relative ease of access.

### Survey sites

Virachey National Park covers an area of 3,325 km<sup>2</sup> in the Ratanakiri and Stung Treng provinces of northeastern Cambodia and comprises lowland, hill and montane evergreen forest, as well as upland savannah, bamboo and patches of mixed deciduous forest (Hon *et al.*, 2010). Surveys were conducted along Tabok and Ka shep streams in evergreen and bamboo forest.

Survey sites along the Mekong River in the Kratie and Stung Treng provinces were located near the villages of Sambour, O'krieng, O'yeay, Achen and Kompong Chrey, at the islands of Koh Dombong and Kbal O'chom and at sites in Prey Lang Wildlife Sanctuary. The Mekong River has a lot of deep pools, as well as numerous small islands and sandbanks during the dry season, which are important habitats for wildlife (Poulsen *et al.*, 2002). Prey Lang Wildlife Sanctuary is located in the Kratie, Stung Treng and Preah Vihear provinces and mainly comprises lowland evergreen and deciduous forest. Survey sites within the wildlife sanctuary included the O'krack, Ponror, O'long and Kbal Damrey streams, which are connected to the Mekong River (Olsson *et al.*, 2007).

Several sites were surveyed within Keo Siema Wildlife Sanctuary in Mondulakiri province and Sre Pok Wildlife Sanctuary in Ratanakiri Province. In Keo Siema, we surveyed along the Opam, Khlong Khnong, and Pour streams, which are surrounded by evergreen and bamboo forests (Keo & Evans, 2013). Surveys in Sre Pok Wildlife Sanctuary focused on the Sre Pok River, a major tributary of the Mekong River, which is surrounded by dense lowland evergreen forest (Constable, 2015).

The Tonle Sap Lake is the largest wetland in Southeast Asia, with a unique flood-pulse system, high biodiversity, and very productive fisheries (Arias *et al.*, 2013). Located in central Cambodia, the dominant habitat of the

floodplain surrounding the lake is generally described as 'seasonally flooded forest'. This is divided into several vegetation types, and large areas are inundated by up to nine meters of water during the wet season between July and November. Gallery forests with trees between 7 and 15 m tall occur on the inner edge of the lake near open water, rivers, streams, and ponds where the ground rarely dries up. Lower tree cover and scrubland occurs on a larger proportion of the floodplain, with vegetation reaching heights of up to 4 m. Stationary and floating aquatic vegetation and grasslands are also common. These can reach a height of up to 3 m, and floating islands of vegetation occur along the edge of the lake and in canals (McDonald *et al.*, 1997).

The Bassac Marsh is located between the Bassac and Mekong Rivers in Kandal Province, 40 km south of Phnom Penh. It consists of swamp forest and wetlands similar to Tonle Sap, with scattered trees and scrubs such as *Barringtonia acutangula* and most of the associated emergent plants comprising *Sesbania rixburghii*, *Eiahornia crassipes* and *Utricularia aurea* (UNEP, 2008). The marsh is inundated by up to 3 m of water during the wet season between July and November, and forms a wetland surrounding a narrow body of open water during the dry season. Due to its proximity to Phnom Penh and demand for land for rice cultivation, the site faces intense human pressure from agriculture and other development, such that the wetland is being converted to agriculture, landfills and human habituation (Heng, 2010).

The Cardamom Mountains span southwest Cambodia and neighbouring areas of Thailand. The mountains are heavily forested with hill and lowland evergreen forest and contain many rivers and streams which flow southwards into the sea and northwards into Tonle Sap Lake (Campbell *et al.*, 2006). On the northern side of the mountains, the Takong stream flows into the Pursat River and subsequently into Tonle Sap Lake. The stream is rich in fish and surrounded by evergreen forest. Little water is present in the stream during the dry season, especially in April, except in deep pools. A large flooded grassland is located next to the stream, which provides suitable habitat for otters.

The coastal zone of southwest Cambodia is dominated by rivers draining the Cardamom Mountains, estuaries, mangrove and *Melaleuca* forest, with evergreen and bamboo forests occurring further upstream. Peam Krasop Wildlife Sanctuary is located in this area and is dominated by mangrove and *Melaleuca* forests (UNEP, 2008). These are intermixed with agriculture areas and grasslands. The rivers are rich in marine and freshwater fish and provide good habitat for otters. Sand-dredging in the rivers, hunting and land conversion are major threats

to otters and other wildlife at the site (Dong *et al.*, 2010), and interviews indicate that local otter populations are in decline. Ream National Park, located in the coastal area of Sihanoukville Province, comprises similar habitats (Heng, 2010).

### Sampling methods

Survey methods included semi-structured interviews of fishermen, hunters, rangers, and village chiefs whom often have good knowledge of local wildlife. Reference photographs of the otter species that occur in Cambodia were used during the interviews to aid species identification, although confirmed records of otter presence were not based on interview data alone. Interview results guided site selection for track and sign surveys and camera trapping.

As Hussain & Choudhury (1997) found otter signs were located within 12.5 m of water bodies, track and sign surveys were conducted within 20 m of water edges along rivers, streams and dry season ponds. Signs sought for included spraints, food remains, footprints, dens, and resting sites. The wetlands of Tonle Sap and Bassac Marsh are difficult to navigate through due to dense vegetation, which in some cases diverted survey effort. During the rainy season, boats were used to move around these areas. Although tracks of hairy-nosed otter and Eurasian otter *Lutra lutra* are very similar and difficult to distinguish (Kanchanasaka, 2001), the team learned to recognise spraints produced by different otter species from the IUCN Otter Specialist Group Chair Nicole Duplaix and so could confidently identify those produced by hairy-nosed otters. Despite this, records of otters were not regarded as confirmed unless substantiated by a camera trap photograph, skin or direct observation.

Camera traps were set at a total of 228 locations across the areas surveyed (Table 1). Different camera traps were used during the survey (Reconyx, Bushnell, and Woodland Outdoor Sport) and were deployed at all sites where signs of otters were found. These were attached to trees approximately 50 cm above the ground, on branches over the water, or on floating logs and vegetation. Camera traps were typically left in place for 3–4 weeks, and at some locations were used several times during the year. Habitats at the survey sites were described and recorded.

## Results

Our surveys confirm the presence of the hairy-nosed otter in four areas of Cambodia: Tonle Sap Lake, Cardamom Mountains, coastal areas in Koh Kong province, and Bassac Marsh. No evidence of the species was found at

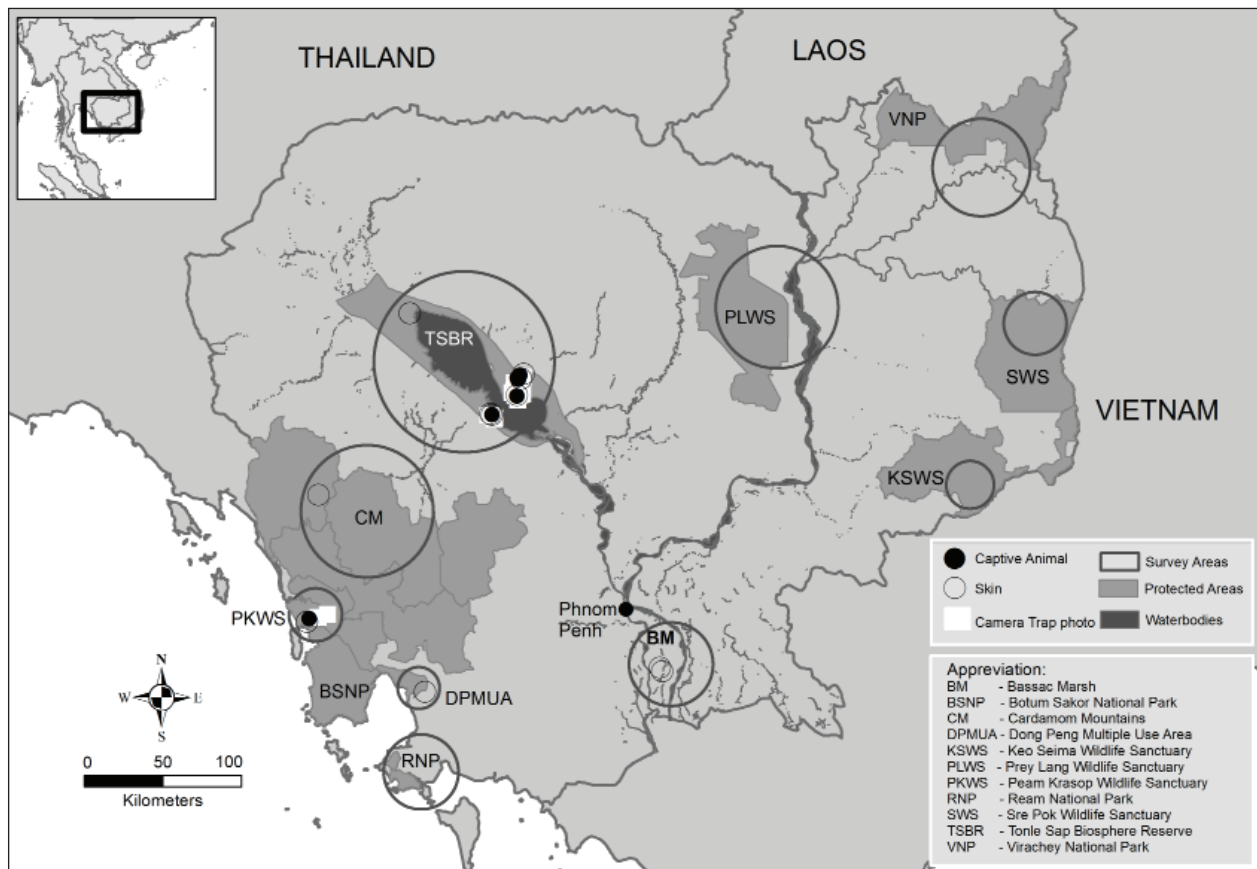


Fig. 1 Survey areas and confirmed records for hairy-nosed otter *Lutra sumatrana* in Cambodia.

Table 1 Survey effort and confirmed records for the hairy-nosed otter and other otter species in Cambodia. LS = hairy-nosed otter *Lutra sumatrana*; LP = smooth-coated otter *Lutrogale perspicillata*; AC = Asian small-clawed otter *Aonyx cinereus*.

Survey Area	Survey Year	No of Sites Surveyed	Habitat Types	No of Camera Locations	No of Camera Trap Photos			No of Skins			No of Live Individuals		
					LS	LP	AC	LS	LP	AC	LS	LP	AC
Northeast Cambodia	2006–2010	6	Hill & lowland evergreen forest	18		19	3		1	10			
Bassac Marsh	2008	1	Wetlands and flooded forest	0				2					
Mekong River	2007–2008	2	Lowland evergreen forest	7		10			1				
Cardamom Mountains	2006–2009	10	Hill & lowland evergreen forest	46		1		1					
Tonle Sap Lake	2006–2013	5	Wetlands and flooded forest	118	66	169		10	6		7		
Coastal Region	2006–2012	6	Mangrove & <i>Melaleuca</i> forest	39	5	322		5	3		1		

other survey sites, which included the lowland evergreen and swamp forests of Prey Long Wildlife Sanctuary and riparian sites along the Mekong River in the Kratie and Stung Treng provinces, and riparian forest along the Sre Pok River and tributaries in northeast Cambodia in the Ratanakiri and Mondulakiri provinces.

Records of hairy-nosed otter comprised eight live captive individuals and 18 skins found in local houses and 71 camera trap photographs (Table 1). Of the 228 locations surveyed with camera traps, hairy-nosed otter was confirmed at 26 (Fig. 1). Smooth-coated otter *Lutrogale perspicillata* was also recorded at all sites where hairy-nosed otters were confirmed and these two species evidently live sympatrically in parts of their ranges. Smooth-coated otter was also recorded from the Sre Pok River and Asian small-clawed otter *Aonyx cinereus* at sites within and nearby Virachey National Park.

Most records of hairy-nosed otter were from Tonle Sap Lake, where ten skins, 66 camera trap photographs, and seven live individuals were registered (Table 1). Results from the camera trap and sign surveys suggest that the species here is mostly associated with gallery forest habitat with wide canopies during the wet season. Spraints were found mostly on the following tree species: *Xanthophyllum glaucum*, *Terminalia cambodiana*, *Coccoceras anisopodum*, *Barringtonia acutangula* and *Combretum trifoliatum*, and individuals were caught on camera moving about the branches of these trees (Fig. 2). In the dry season when waters subside, hairy-nosed otters were predominantly recorded along streams and ponds in areas of the floodplain that still contained water.

Most of the records (camera trap photos, scat, skins and live animals) from Tonle Sap Lake were from Boeng Tonle Chmmar, a Ramsar site and one of three core zones of the Tonle Sap UNESCO Man and Biosphere Reserve. This area contains some of the best remaining habitat for the species at Tonle Sap, with intact and dense high-canopy flooded forests and scrub. Interviewees reported that fish diversity and abundance is high, and the area also supports seasonal colonies of water birds that use the site for feeding and nesting.

Two hairy-nosed otter skins were recorded during interviews at local houses in Bassac Marsh, both of which came from animals that had been by-catch in fishing gear. One of the interviewees previously acted as a middleman, buying otter skins from villagers and selling these onwards to traders. This individual and other interviewees reported that local otter populations were declining due to development and hunting. Otters are sometimes seen in the swamp forest by local residents and are occasionally caught in fishing gear. A single

hairy-nosed otter skin was also found in a household near the Takong stream in the Veal Veng district of the Cardamom Mountains. This animal had been caught by dogs near the stream between 700–800 m asl (above sea level) during the dry season when the stream contained little water. Packs of three to six dogs are regularly used by villagers to hunt mammals and reptiles such as otters, turtles, and lizards.

Hairy-nosed and smooth-coated otters were both recorded in the coastal region, with most records being of the latter. Records of hairy-nosed otters comprised five camera trap photographs, five skins, and one live individual kept as a pet, whereas smooth-coated otter records comprised 322 camera trap photographs and three skins (Table 1).

## Discussion

### Distribution and habitat use

Our data suggests hairy-nosed otters inhabit several habitats in Cambodia, namely flooded forest and scrub around the Tonle Sap Lake, marshland and coastal mangrove and *Melaleuca* forest. This matches the findings of Kanchanasaka *et al.* (1998, 2003) who found the species in peat swamp and *Melaleuca* forest in Thailand, as well as Nguyen *et al.* (2001) and Nguyen (2005) who found it in the low-lying peat swamp forests of U Minh Thuong Nature Reserve near the Cambodian border in Vietnam. Hairy-nosed otter also occurs in coastal areas in Indonesia, especially in mangrove forest (Hussain *et al.*, 2008). Sivasothi & Burhanuddin (1994) suggest the species may inhabit streams >300 m asl in Malaysia, although most records in the Cardamom Mountains appear to be from lakes and wetlands at lower elevations. Our findings also match those of Heng (2010), who found the species inhabits flooded forest and scrub around the Tonle Sap Lake, using ponds and drainage canals in the dry season.

Our results indicate that hairy-nosed otters and smooth-coated otters share the same habitats in the Tonle Sap Lake. However, smooth-coated otters were more often found in open habitats such as floating logs and bare river/lake banks, whereas hairy-nosed otters appeared to prefer areas sheltered by trees and vegetation such as gallery forest and scrublands (Heng, 2010). Heng (2010) also recorded both species at the same sites in Tonle Sap Lake, as did Kanchanasaka *et al.* (1998) in peat swamp forest in Thailand.



**Fig. 2** Hairy-nosed otter in flooded scrub at Tonle Sap Lake on 23 September 2008 (© Conservation International).



**Fig. 3** Pregnant female hairy-nosed otter at Tonle Sap Lake on 18 March 2012 (© Conservation International).



**Fig. 4** Hairy-nosed otter with cubs at Tonle Sap Lake on 20 April 2013 (© Conservation International).

#### Previous records from Cambodia

The first record of hairy-nosed otter was of two captive otters photographed in 1998 by Frederic Goes at Prek Toal village in the floodplain of Tonle Sap Lake (Poole, 2003). A mounted specimen was found at Phnom Tamao Zoo (now Phnom Tamao Zoological Park and Wildlife Rescue Center, PTWRC) in 1999, which may have originated from Mondulhiri province (although this remains unconfirmed). In 2000, a live hairy-nosed otter was photographed at Sre Khlong village, Kompong Speu Province, which reportedly originated from the area (unconfirmed). Poole (2003) also reported secondary records of the species from *Melaleuca* swamp forests north and west of Sre Ambel in Koh Kong province. In addition, unconfirmed records of the species at Tonle Sap Lake are included in several reports (Bonheur, 1997; Goes, 2005; Davidson, 2006). Holden & Thy (2009) reported a skin of hairy-nosed otter found at a hunter's house in Chhe Teal Chrum village, Pursat Province. This was reportedly caught in 2006 from the Ang Krang River at the foot of Phnom Samkos in the Cardamom Mountains. The Ang Krang is a small stream which flows through hilly primary and secondary forest at approximately 400 m asl. Holden & Thy (2009) also reported camera trap photos of hairy-nosed otters from Veal Veng marsh at 560 m asl in the Cardamom Mountains between 2007 and 2008.

Most of the above records fall within the same regions where we recorded the species. We suspect the reason for the relative paucity of hairy-nosed otter records in Cambodia is due to a combination of the species being naturally shy and secretive (compared to smooth-coated otter for instance), its natural occurrence at low densities and probably solitary nature, coupled with confusion with other otter species and the fact that areas where the species is now confirmed have been little surveyed until recently, due to their poor accessibility and years of civil conflict.

#### Breeding

Most of our camera trap photographs were of a single individual, which suggests that the hairy-nosed otter is mainly solitary, similar to the Eurasian otter *Lutra lutra* (Yoxon & Yoxon, 2014). Only eight of our photographs were of two adults, whereas one set of photographs showed two adults with two cubs and three sets were of a female with cubs. As the latter were taken within weeks of each other in the same area, these may represent a family group comprising one female and three cubs.

The breeding season of the hairy-nosed otter in Cambodia is unclear. Wright *et al.* (2008) concluded that the gestation period for hairy-nosed otters (and other

otter species) is approximately two months. Our camera traps recorded hairy-nosed otters in pairs between November and March, which could indicate mating activity. A heavily pregnant female was captured on camera at Tonle Sap Lake in March (Fig. 3) and a dead female with four unborn fetuses was photographed in a cylinder fish trap by our team at Tonle Sap Lake in June. Camera trap photographs of hairy-nosed otters with cubs occurred in April (Fig. 4), and cubs were reportedly caught by fishermen in July. One fisherman caught a juvenile hairy-nosed otter in coastal *Melaleuca* forest in November, although interviewees also reported seeing unknown otter species with cubs throughout the year. These records collectively suggest that the hairy-nosed otter may give birth towards the end of and just after the dry season between April and June. During this period, water levels are low and prey fish are concentrated in smaller, restricted water bodies such as dry season ponds, oxbow lakes, and deep river pools, and may therefore be easier to catch. This period may also provide better access to land where dens can be established, particularly at Tonle Sap Lake. Despite extensive survey effort, holts and resting areas used by hairy-nosed otters have yet to be found in Cambodia however, so the kind of den used by the species in the country remains unknown.

#### Activity patterns

Although camera traps recorded hairy-nosed otters at all times of day and night, most photographs were taken between 17:00 and 01:00 hrs, suggesting the species is most active during this time. In contrast, smooth-coated otters were equally active during the day and night at our survey sites.

#### Conservation threats and recommendations

Hairy-nosed otters have been confiscated from or donated by hunters and fishermen on several occasions in Cambodia. Some of these individuals have been released, but when injured or deemed unhealthy, others have been transferred to the PTWRC.

In November 2008, one hairy-nosed otter was caught and kept as a pet by a fisherman near Koh Kong Khnong village in Kong Kong Province, but later confiscated and brought to PTWRC. In June 2009, one animal caught by a fisherman near a dry season pond in the Boeng Tonle Chmmar area of Tonle Sap Lake was confiscated and brought to PTWRC. Four adult individuals were also caught at Boeng Tonle Chmmar in 2010 and 2011, and subsequently released. In July 2010, two sub-adult animals left by their mother along a stream were caught

by a fisherman from Anlong Rieng village near Kompong Prak Fish Sanctuary, Pursat Province and also released.

All otter species in Cambodia are threatened by illegal wildlife trade, destruction of habitats, loss of food sources, and persecution as pests. Otter fur is popular for use in fashion and traditional clothing, particularly in China, and because pelts fetch high prices on the illegal market (Bennetto, 2009), this demand threatens otters throughout Asia. In Cambodia, a good quality pelt can sell for up to US\$200 and this creates a strong incentive for fishermen and hunters to target otters (Heng, 2010).

Degradation and conversion of wetlands and wet forests into rice fields, shrimp farms, and other land uses is steadily reducing habitat for otters, while over-fishing is depleting their food sources. Otters are often targeted and killed by fishermen who view them as pests that compete for fish and damage fishing gear. Additionally, disturbance of wetlands has escalated as human populations increase in neighbouring areas, which raises a concern for shy and secretive species such as the hairy-nosed otter. More broadly, as climate change and infrastructure development on the Mekong River, its tributaries, and in the delta are altering water flows and ecological processes, this will impact otters and other wildlife that depend on these ecosystems (MRC, 2010). If action is not taken to preserve the habitats used by hairy-nosed otter and to combat illegal wildlife trade, extinction of this species, as previously feared in 1998, will likely become a reality. In clarifying the current range of hairy-nosed otter in Cambodia, our study should aid development of conservation and management plans for the species nationally.

Tonle Sap Lake is linked to the Bassac Marsh by the Mekong River which in turn connects to the U Minh Thuong wetlands in Vietnam. Our finding that the hairy-nosed otter occurs at all of these sites is to be expected given the presumed historical range of the species. Existing records from the northern side of the Cardamom Mountains are from streams and wetlands drained by the Pursat River, which originates in the mountains and flows into the Tonle Sap Lake. As rivers on the southern side of the Cardamom Mountains in Koh Kong province belong to a different catchment, populations of hairy-nosed otter inhabiting these waterways are unlikely to be connected to the population at Tonle Sap Lake. Historically however, the species likely occurred all along the east coast of Thailand through Cambodia and Vietnam (Wright *et al.*, 2008). We recommend further surveys in suitable habitats along the Mekong River between the Tonle Sap Lake and the Vietnamese border and at coastal sites such as Ream National Park to improve under-

standing of the distribution and status of hairy-nosed otter in Cambodia.

## Acknowledgements

The authors would like to thank the reviewers for comments which improved this manuscript. Thanks are also extended to the local researchers who work with Conservation International at Tonle Sap Lake and greatly contributed to data collection. Funding for this study was provided by Conservation International, Disney Wildlife Conservation Fund, International Otter Survival Fund and the Critical Ecosystem Partnership Fund.

## References

- Aadrean, A., Kanchanasaka, B., Heng S., Reza Lubis, I., de Silva, P. & Olsson, A. (2015) *Lutra sumatrana*. *The IUCN Red List of Threatened Species*. <http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T12421A21936999.en> [accessed 29 October 2016].
- Arias, M.E., Cochrane, T., Norton, D., Killeen, T.J. & Khon P. (2013) The flood pulse as the underlying driver of vegetation in the largest wetland and fishery of the Mekong Basin. *AMBIO*, **42**, 864–876.
- Bennetto, C. (2009) International training workshop on Asian otter research and conservation. *IUCN Otter Specialist Group Bulletin*, **26**, 65–131.
- Bonheur, N. (1997) *An action plan for natural resource and environmental management in the Mekong river basin of Cambodia including Tonle Sap system*. Ministry of Environment, Phnom Penh, Cambodia.
- Campbell, I.C., Poole, C., Giesen W. & Valbo-Jorgensen, J. (2006) Species diversity and ecology of Tonle Sap Great Lake, Cambodia. *Aquatic Sciences*, **68**, 355–373.
- Constable, D. (2015) *The Sesan and Sre Pok River Basins*. IUCN Asia Regional Office, Bangkok, Thailand.
- Davidson, J.A. (2006) *The biodiversity of the Tonle Sap Biosphere Reserve, 2005 status review*. Unpublished report to Wildlife Conservation Society, Phnom Penh, Cambodia.
- Dong T., Tep M., Lim S., Soun S. & Chrin T. (2010) Distribution of otters in the Tropeang Rong, Koh Kong Province, Cambodia. *IUCN Otter Specialist Group Bulletin*, **27**, 63–77.
- Goes, F. (2005) *Four years of waterbird conservation activities in Prek Toal Core Area, Tonle Sap Biosphere Reserve (2001-2004)*. Unpublished report to Wildlife Conservation Society, Phnom Penh, Cambodia.
- Heng S. (2010) Factors affecting site selection and feeding habits of hairy-nosed otter *Lutra sumatrana* and smooth-coated otter *Lutrogale perspicillata* at Tonle Sap Great Lake, Cambodia. *Cambodian Journal of Natural History*, **2010**, 63–65.
- Holden, J. & Thy N. (2009) Small carnivore records from the Cardamom Mountains, southwestern Cambodia. *Small Carnivore Conservation*, **40**, 16–21.
- Hon N., Neak P., Khov V. & Cheat V. (2010) Food and habitat of Asian small-clawed otter in northeastern Cambodia. *IUCN Otter Specialist Group Bulletin*, **27**, 12–23.
- Hussain, S.A. & Choudhury, B.C. (1997) Distribution and status of the smooth-coated otter *Lutrogale perspicillata* in National Chambal Sanctuary, India. *Biological Conservation*, **80**, 199–206.
- Hussain, S.A., Kanchanasaka, B., de Silva, P.K., & Olsson, A. (2008) *Lutra sumatrana*. *The IUCN Red List of Threatened Species*. <http://www.iucnredlist.org/> [accessed 14 October 2014].
- Kanchanasaka, B. (2000) The status of otters in Thailand and a note on the discovery of three hairy-nosed otter (*Lutra sumatrana*) cubs. In *Proceedings of the Workshop on Conservation and Public Awareness of Otters* (eds C. Santiapillai & Sasaki H.), pp 110–113. Otter Research Group, Fukuoka, Japan.
- Kanchanasaka, B. & Duplaix, N. (2013) Food habits of the hairy-nosed otter (*Lutra sumatrana*) and the small-clawed otter (*Aonyx cinereus*) in Pru Toa Daeng Peat Swamp Forest, southern Thailand. *IUCN Otter Specialist Group Bulletin*, **28A**, 139–161.
- Kanchanasaka, B., Simcharoen, S. & Than, U.T. (1998) *Carnivores of Mainland South East Asia*. WWF-Thailand, Bangkok, Thailand.
- Kanchanasaka, B., Arsal, D. & Thumchimplee, C. (2003) *Status and distribution of the hairy-nosed otter (Lutra sumatrana) in Thailand*. Unpublished report to Wildlife Research Division, National Parks, Wildlife and Plant Conservation Department, Royal Forest Department, Bangkok, Thailand.
- Kanchanasaka, B. (2001) Tracks and other signs of the hairy-nosed Otter (*Lutra sumatrana*). *IUCN Otter Specialist Group Bulletin*, **18**, 57–63.
- Keo O. & Evans, T. (2013) *Reduced emissions from deforestation and degradation in Seima Protection Forest*. Unpublished report to Wildlife Conservation Society and the Forestry Administration, Phnom Penh, Cambodia.
- McDonald, J.A., Bunnat P., Virak P. & Bunton, L. (1997) *Plant communities of the Tonle Sap floodplain*. Unpublished report to UNESCO, IUCN and Wetlands International, Phnom Penh, Cambodia.
- MRC (2010) *State of the Basin Report 2010*. Mekong River Commission, Vientiane, Laos.
- Nguyen X.D., Pham T.A. & Le H.T. (2001) New information about the hairy-nosed otter (*Lutra sumatrana*) in Vietnam. *IUCN Otter Specialist Group Bulletin*, **18**, 64–75.
- Nguyen X.D. (2005) Current status of otters (Mammalia: Lutrinae) in Viet Nam with conservation implications. *Tiger-paper*, **33**, 8–14.
- Olsson, A. (2009) International training workshop on Asian otter research and conservation, February 24 to March 3, 2009 in Cambodia. Unpublished report to Conservation International, Phnom Penh, Cambodia.
- Olsson, A. & Emmett, D. (2007) *A floral and faunal biodiversity assessment of Prey Long*. Unpublished report to Conservation International, Phnom Penh, Cambodia.



- Poole, C.M. (2003) The first records of hairy-nosed otter *Lutra sumatrana* from Cambodia with notes on the national status of three other otter species. *Natural History Bulletin of the Siam Society*, **51**, 273–280.
- Poulsen, A., Ouch P., Sintavong, V., Ubolratana, S. & Nguyen T. (2002) *Deep pools as dry season fish habitats in the Mekong Basin*. MRC Technical Paper No. 4, Mekong River Commission, Phnom Penh, Cambodia.
- Sivasothi, N. & Burhanuddin, H.M.N. (1994) A review of otters (Carnivora: Mustelidae: Lutrinae) in Malaysia and Singapore. *Hydrobiologia*, **285**, 151–170.
- UNEP (2008) *National reports on wetlands in the South China Sea*. UNEP/GEF/SCS Technical Publication No. 13, United Nations Environment Programme, Bangkok, Thailand.
- Wright, L., Olsson, A. & Kanchanasaka, B. (2008) A working review of the Hairy-nosed otter (*Lutra sumatrana*). *IUCN Otter Specialist Group Bulletin*, **25**, 38–59.
- Yoxon, P. & Yoxon, G.M. (2014) *Otters of the World*. Whittles Publishing, Scotland, UK.
- Yoxon, P. & Yoxon, G. (2007) *Otters – the forgotten victims of wild-life crime*. International Otter Survival Fund, Scotland, UK.