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Records of the Malayan porcupine, *Hystrix brachyura* (Mammalia: Rodentia: Hystricidae) in Singapore

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Abstract. The Malayan porcupine (*Hystrix brachyura*) is known to be native to Singapore, but the lack of sightings from 1970–2000 suggested that the species was either locally rare or extinct. With the widespread use of camera traps in wildlife monitoring projects since 2005, there have been a substantial number of records involving porcupines which are compiled here. The conservation status of *Hystrix brachyura* in Singapore is briefly discussed.

Key words. camera trap; conservation; distribution; Malayan porcupine; wildlife survey; Singapore

INTRODUCTION

The Malayan porcupine, *Hystrix brachyura* Linnaeus, 1758, is one of three species in the family Hystricidae found in mainland Southeast Asia (Harrison, 1974; Medway, 1983; Francis, 2008). It ranges from eastern Nepal through Indochina to the Malay Peninsula, with southern Gansu and southern Shaanxi in China as the northern limit (Corbet & Hill, 1992; Lunde et al., 2008a). *Hystrix brachyura* is also found on islands such as Hainan, Sumatra, Borneo, as well as Singapore (Lekagul & McNeely, 1988).

The Malayan porcupine is generally black. Long white spines or quills with a black band in the middle are found on the lower back, whereas shorter spines on the front parts of the body are mostly blackish or dark brown (Payne & Francis, 1985; Lekagul & McNeely, 1988). The tail has hollow, goblet-shaped quills which rattle when shaken (Payne & Francis, 1985; Lekagul & McNeely, 1988; Corbet & Hill, 1992). This species has a head-body length of 59–72 cm, a tail length of 6–11 cm, and a hindfoot length of 8–9.5 cm (Francis, 2008). When annoyed, it will raise and rattle its tail, erect its quills, and charge backwards. There is no evidence that the porcupine can discharge the quills, but these are easily detached and remain in the body of the foe.

Hystrix brachyura was classified as 'Least Concern' worldwide by the IUCN Red List (Lunde et al., 2008b), albeit with a reported decline in total population size of at least 20% in the 1990s due to hunting (Nowak, 1999). Throughout its distribution, *Hystrix brachyura* is protected under legislation. In Singapore and Peninsular Malaysia, the species is protected under the Wild Animal and Bird Act (Singapore, 1965) and Wildlife Conservation Act (Malaysia, 2010), respectively. Overhunting of *Hystrix brachyura* for its meat and its bezoars (used in traditional medicine) seems to be the greatest threat to the population (Banks, 1949; Borschberg, 2006). Habitat loss, fragmentation, and modification, also contribute to the decline in *Hystrix brachyura* numbers (Corlett, 1992; Brook et al., 2003).

There are two specimens of *Hystrix brachyura* collected from Singapore in the Zoological Reference Collection (ZRC) of the Lee Kong Chian Natural History Museum (LKCNHM) at the National University of Singapore (NUS). The first specimen (ZRC 4.1601) comprises the skin and skull of a sub-adult male *Hystrix brachyura* collected from Bukit Timah in August 1923. Subsequently, a skull of an adult male (ZRC 4.1637) was obtained in December 1923.

In the past, *Hystrix brachyura* was reported to be common in plantation and forested area in Singapore (e.g., Ridley, 1895; Chasen, 1925; Harrison, 1966). However, owing to lack of sightings since the 1970s, some authors (e.g., Yang et al., 1990) were uncertain of the status for *Hystrix brachyura*, and they believed that it was either 'rare' or 'extinct' in Singapore (Chuang, 1973: 3; Medway, 1983: 83).

RECENT RECORDS AND REDISCOVERY

Hystrix brachyura was first rediscovered in Singapore on 16 December 2005 on Pulau Tekong by NT-LL. One example was sighted, and then photographed on two occasions by camera trap deployed with bait at the site where the animal

Fig. 1. Camera trap image of the first rediscovery of *Hystrix brachyura* in December 2005 on Pulau Tekong. (Photograph by: Norman Lim).

was seen (Fig. 1). On 17 April 2012, another photographic record of *Hystrix brachyura* was obtained by Marcus Chua with a camera trap set approximately 500 m away from the first record.

On Singapore Island, a list of recent records of *Hystrix brachyura* was compiled from a review of additional camera-trapping exercises by students from the NUS and the National Parks Board (NParks), as well as interviews with NParks staff members (Table 1).

The first recent record of *Hystrix brachyura* on Singapore Island was made in 2011 during grid camera trapping at the Bukit Timah Nature Reserve (BTNR) for the pre-construction survey of the Eco-Link@BKE, a planted bridge over the Bukit Timah Expressway that links the forest of the Central Catchment Nature Reserve with the forest of the BTNR. A total of 107 camera traps (Reconyx HyperFire HC600, Wisconsin, U.S.A.) were deployed at the BTNR from March 2011 to May 2011 over an accumulated total of 3,945 trap nights. An individual *Hystrix brachyura* was recorded in one of the camera traps with seven continuous photographs on 8 April 2011 (Fig. 2). Subsequently, the survey protocol was repeated thrice in the exact same locations on October 2011, March 2012, and February 2015 (about 3,000 trap nights for each survey), and *Hystrix brachyura* was only recorded from the latest survey in 2015.

At Upper Peirce in the Central Catchment Nature Reserve, and during a separate camera trapping survey by Ong Say Lin, one *Hystrix brachyura* was recorded on 8 March 2012. Six months after that, another camera trap, which was deployed by Delia Quek and Norman Lim, approximately 600 m away within the same forest patch detected one *Hystrix brachyura*.

On Pulau Ubin, a female *Hystrix brachyura* of 60–70 cm head-and-body length, was found caged in a resident's home by NParks staff during a regular forest patrol on 30 March 2012 (Fig. 3). The individual was reported to have entered the resident's compound in late January 2012 and was cornered by the resident dogs. This porcupine was released in the forest on Pulau Ubin by the staff of NParks on 2 April 2012.

On Singapore Island, *Hystrix brachyura* has also been recorded in the Western Catchment Area (Chua, 2015) and Lower Peirce. There is also an unconfirmed record of a roadkill carcass from Sembawang (see Table 1).

Table 1. Summary of recent records of *Hystrix brachyura* in Singapore. BTNR refers to Bukit Timah Nature Reserve.

Date	Location	Sighting Method	Recorded By
16 and 18 December 2005	Pulau Tekong	Spotlighting and camera trapping	Norman Lim (Chang, 2006)
8 April 2011	BTNR	Camera trapping	Chua Yen Kheng & Mishak Shunari
8 March 2012	Upper Peirce	Camera trapping	Ong Say Lin
30 March 2012	Pulau Ubin	Forest petrol	Robert Teo
17 April 2012	Pulau Tekong	Camera trapping	Marcus Chua
20 July 2012	Western Catchment Area	Camera trapping	Marcus Chua (Chua, 2015)
16 September 2012	Upper Peirce	Camera trapping	Delia Quek & Norman Lim
Undated 2013	Sembawang	Roadkill carcass	Tony O'Dempsey
15 January 2015	Lower Peirce	Forest patrol	Ngon Soon Kong
10 February 2015	BTNR	Camera trapping	Chung Yi Fei

DISCUSSION

Based on recent local records, *Hystrix brachyura* is relatively widely distributed within Singapore Island and larger adjacent islands (i.e., Pulau Tekong and Pulau Ubin). Additionally, it occupies a gradient of forest habitats ranging from native species-dominated, tropical lowland rainforests (such as that in Upper Peirce Reservoir and the BTNR; see Corlett, 1988) to non-native species-dominated, abandoned plantation and young secondary forest (such as that in Pulau Ubin; see Sha, 2002) (Table 1). Although the number of recent records seems to suggest that secondary forest is preferred, there might be a bias in the encounter rate of *Hystrix brachyura* in primary rainforest owing to insufficient survey effort and low detection probability within the dense forest. In fact, the species is believed to be adaptable and can readily be found in all types of forest, forest edges, and plantations (Bank, 1949; Medway, 1983; Payne & Francis, 1985).

An inquiry into possible porcupine escapees from the Singapore Zoo revealed that only one *Hystrix brachyura* of unknown gender and age escaped from the Night Safari in September 1994. Additionally, two *Trichys fasciculata* individuals were recorded to have escaped in 1995 and 2004, respectively. However there has been no report of *Trichys fasciculata* in the wild in Singapore. The possibility of mistaking *Trichys fasciculata* with *Hystrix brachyura* is minimal as there are distinct morphological and size differences between the two species (the former resembling a large rat). As recent *Hystrix brachyura* records on Singapore Island were from multiple locations that appear to be isolated from one another, it is highly probable that these records are of the native population that has gone undetected for the past few decades.

Fig. 2. An infrared camera trap image of a *Hystrix brachyura* at the Bukit Timah Nature Reserve on 08 April 2012. (Photograph by: National Parks Board).

Fig. 3. A female *Hystrix brachyura* caged by a resident on Pulau Ubin in March 2012; fruits such as apples were offered to the captive by the resident. (Photograph by Robert Teo).

Market demand for the body parts (specifically, bezoars) of *Hystrix brachyura* can be one of the main causes leading to overhunting, which would have contributed to a decline in the species' population. According to Borschberg (2006), porcupine bezoars cost more than USD 7,000 per gram in Singapore in 2005, which is 16 times the price of gold within the same year. Currently, the trade of porcupine body parts within Southeast Asia is not regulated. This supports the notion that *Hystrix brachyura* can be a vulnerable animal that requires protection under legislation throughout its geographic distribution. However, there has been no record of *Hystrix brachyura* being hunted in Singapore, and there is no supporting records to show that the porcupine is sold in the country either as pets or for food. It would appear that hunting and trapping are not likely to be a threat to the wild porcupine population in Singapore.

In highly urbanised Singapore, natural greenery such as those in the nature reserves or regenerating abandoned plantation and waste ground sites are possible habitats for generalists like *Hystrix brachyura*. Even though the species is deemed to be adaptable (Bank, 1949; Medway, 1983; Payne & Francis, 1985), it cannot survive in urbanised landscapes. Thus, these vegetated patches can play an important role in the conservation of the Malayan porcupine and other endangered species, in addition to supporting high urban biodiversity in the vicinity (Chong et al., 2014). It is currently unknown if roads pose a barrier to dispersal for *Hystrix brachyura* as there is only one roadkill on record. Since forest patches are fragmented in Singapore (e.g., between the BTNR and the Central Catchment Nature Reserve), ecological corridors, such as the Eco-Link@BKE, may help to restore the fragmented landscape by enhancing connectivity between patches of forest (see Chung et al., 2014; Chew & Pazos, 2015).

In Singapore, the rediscovery of the *Hystrix brachyura* has been made possible with the widespread and intensive use of camera traps in recent years (e.g., Lim & Yeo, 2012; Lim & Ou Yang, 2012; Chua, 2013). In Malaysia, Azlan (2006) reported 13 camera-trapping records of *Hystrix brachyura* with 5,972 trap-nights at the Jerangau Forest Reserve in Terengganu, and Azlan & Lading (2006) documented two camera records with 1,127 trap-nights at Lambir Hills National Park in Sarawak. In contrast, porcupine records obtained in Singapore by camera trapping has been relatively low despite the high number of accumulated trap-nights (e.g., two records with more than 9,000 trap-nights of Eco-Link@BKE surveys). This suggests that *Hystrix brachyura* is an elusive animal or that it occurs at low population densities. Consequently, very little is known about the porcupine population in Singapore. Evidently, more studies should be carried out to find out more about this mammal that is regarded as Critically Endangered (Lim et al., 2008) in the country.

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