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Feature Article

Breeding Ecology of White-bellied Sea Eagle (*Haliaeetus leucogaster,* 白腹海鵰) in Hong Kong – A Review and Update

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Bird Working Group

漁農自然護理署鳥類工作小組自2002年開始對全港的白腹海鵰作繁殖調查，調查共記錄得十七個白腹海鵰繁殖點，平均每年有九對成鳥築巢繁殖，而成功率則受多種因素所影響，如天氣及生境的質素等。本文就多年來所收集的繁殖數據作出分析，並描述各鳥巢的分布及特徵。分析結果顯示，在本港的白腹海鵰正健康繁衍，種群數目有上升的趨勢。

Introduction

Among the 27 species of raptors recorded in Hong Kong, White-bellied Sea Eagle (*Haliaeetus leucogaster*, 白腹海鵰) is one of the few that breed here. White-bellied Sea Eagle is a monotypic species, with a world distribution stretching from India and Sri Lanka through Southeast Asia and the Philippines to Australia and Tasmania (Mayr and Cottrell, 1979; del Hoyo *et al.*, 1994).

The major habitats favoured by White-bellied Sea Eagles include inshore seas, islands, coasts, estuaries and terrestrial wetlands (Robson, 2000). In Hong Kong, they are mostly seen along coastlines, around offshore islands, and sometimes in the vicinity of reservoirs (Carey *et al.*, 2001). Adults are generally sedentary, while juveniles and immatures are more prone to dispersing. White-bellied Sea Eagles are mostly seen singly or in pairs; the largest group reported overseas was 14, most of which were immatures (Ferguson-Lee and Sargatal, 2001), while in Hong Kong, groups of up to five individuals have been reported (Lee, pers. comm.).

White-bellied Sea Eagles form pairs and mate for life, though there have been reports in Hong Kong of individuals intruding on breeding pairs (Tsim *et al.*, 2003). If one member of a pair dies, the remaining eagle will quickly pair up with another individual. Nests are built of sticks, and are 120-170 cm wide and 50-180 cm deep. They are used year after year (del Hoyo *et al.*, 1994). Nests are built near water, on

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trees, cliffs or – in the absence of predators – on the ground. Only rarely are nests built on artificial structures (Cluine, 1994).

The current global population of White-bellied Sea Eagles, including adults, non-breeders and immatures, is estimated to be over 10,000 (Ferguson-Lee and Sargatal, 2001). However, numbers have declined in places like Thailand, mainland Southeast Asia and southern Australia (Ferguson-Lee and Sargatal, 2001; BirdLife International, 2009). In China, White-bellied Sea Eagle is an uncommon resident that can be found along the southeast and south coast, in Fujian, Guangdong, Hainan, Xisha and Nansha Islands (Zheng and Wang, 1998; MacKinnon and Phillipps, 2000). It is categorised in National Protection Class II.

Fig 1. White-bellied Sea Eagle fledgling on nest at Round Island (April 2009).

Objectives

Breeding surveys of White-bellied Sea Eagles have been conducted by AFCD since 2002, in order to:

1. Record distribution of the breeding sites;
2. Characterize the nests and nesting environment;
3. Monitor the active breeding population; and
4. Estimate the species' breeding success in Hong Kong.

This paper presents the key survey findings from 2002/03 to 2008/09, and discusses the breeding ecology of White-bellied Sea Eagles in Hong Kong.

Methods

To record the breeding activity of White-bellied Sea Eagles in Hong Kong, boat surveys, together with land-based surveys when necessary, have been carried out each year during the core period of the breeding season (from December to May of the year that follows). They covered the main coastline of Hong Kong, as well as outlying islands. Information was collected on the numbers of occupied territories, nesting locations, breeding attempts, breeding success, and numbers of fledglings raised. Each suspected nesting location discovered at the beginning of a breeding season was visited at least three times during the season, to obtain the information required.

Given the limitation that nests are sometimes highly concealed and hard to observe, the following analysis is based on the assumption that all nests and fledglings are found and counted. Each pair is assumed to have used the same nest site throughout the 7-year study period, as White-bellied Sea Eagles tend to repeatedly use the same nest (Ferguson-Lees and Christie, 2001). Nesting on artificial structures is not included in this paper.

For the following discussion, "a pair with occupied territory", "an active breeding pair" and "a successful breeding pair" are defined as:

> A pair with occupied territory – a pair of White-bellied Sea Eagles defending a territory during the breeding season, in the vicinity of an observable nest or a probable hidden nest (with or without courtship behaviour or copulation observed) (modified from Postupalsky, 1974).
>
> An active breeding pair – a pair of White-bellied Sea Eagles seen to exhibit courtship or incubation behaviour, or with chick(s) found (Postupalsky, 1974).
>
> A successful breeding pair – a pair of White-bellied Sea Eagles that successfully produces viable fledgling(s) towards the end of the breeding season (Postupalsky, 1974).

Each breeding season is identified by the years in which it commenced and ended – for example, "the 2008/09 breeding season".

Results and Discussion

Population size in 2009

A total of 30 adults (14 pairs with territories in natural habitats plus one pair nesting on a cable tower at Tin Wan, Aberdeen) was recorded in 2008/09. The number of immatures and juveniles was estimated by adding the number of fledglings produced in the previous five years, since White-bellied Sea Eagles attain adult plumage in the fifth year (Parks and Wildlife Service Tasmania, 2008). Using this method, there should have been 26 immatures and juveniles (Table 1) in Hong Kong after the 2008/09 breeding season. Another, first-year fledgling was often observed near Chek Keng after the 2007/08 breeding season, though the location of the nest it was reared in was uncertain. Hence, it is estimated that the total population of White-bellied Sea Eagles is currently as high as 57.

The actual population is probably lower, as the mortality of juveniles after leaving the nest is considered high (Parks and Wildlife Service Tasmania, 2008), and immatures are

dispersive and several might have moved out of Hong Kong. Overseas studies have shown that White-bellied Sea Eagles can forage within a range of 150 km^2, and non-breeding birds may move even further (such as from inland areas to coasts), especially when influenced by climate (Shephard *et al.*, 2005; Parks and Wildlife Service Tasmania, 2008). Nevertheless, when comparing the numbers of adults in 2003 (23 individuals) (Tsim *et al.*, 2003) and 2009, there is a 30% increase in six years. More information on the population of immatures and juveniles is needed, to determine the eagle's actual population size and trend. Nonetheless, the population of White-bellied Sea Eagles in Hong Kong seems healthy.

Table 1. Summary of White-bellied Sea Eagles breeding from 2002/03 to 2008/09.

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08#	2008/09*
No. of active breeding pairs	8	6	11	9	12	7	8
No. of successful breeding pairs	3	3	2	3	6	1	7
No. of fledglings produced	4	5	3	4	10	1	8
% of successful breeding pairs	37.5	50.0	18.2	33.3	50	14.3	87.5
% of successful pairs producing 1 fledgling	66.7	33.3	50.0	66.7	33.3	100.0	85.7
% of successful pairs producing 2 fledglings	33.3	66.7	50.0	33.3	66.7	0.0	14.3

 # One fledgling (first year) was often observed after the 2007/08 breeding season at Chek Keng, but was not included in the breeding analysis as the location of the nest it was reared in could not be identified.

** Only pairs that bred in the natural environment were included in this analysis.*

Of the 30 adults recorded in 2008/09, 28 formed pairs with occupied territories in the natural environment. The distances between these 14 territories (Fig. 2) ranged from 3.4 to 18.7 km, which is similar to the findings in 2003 (3.4 to 14.4 km) (Tsim *et al.*, 2003). This indicated that the territory sizes of White-bellied Sea Eagles in Hong Kong remain relatively stable. When compared to the distance measured in Victoria, Australia (4 to 65 km) (Cluine, 1994), the pairs in Hong Kong are relatively densely distributed.

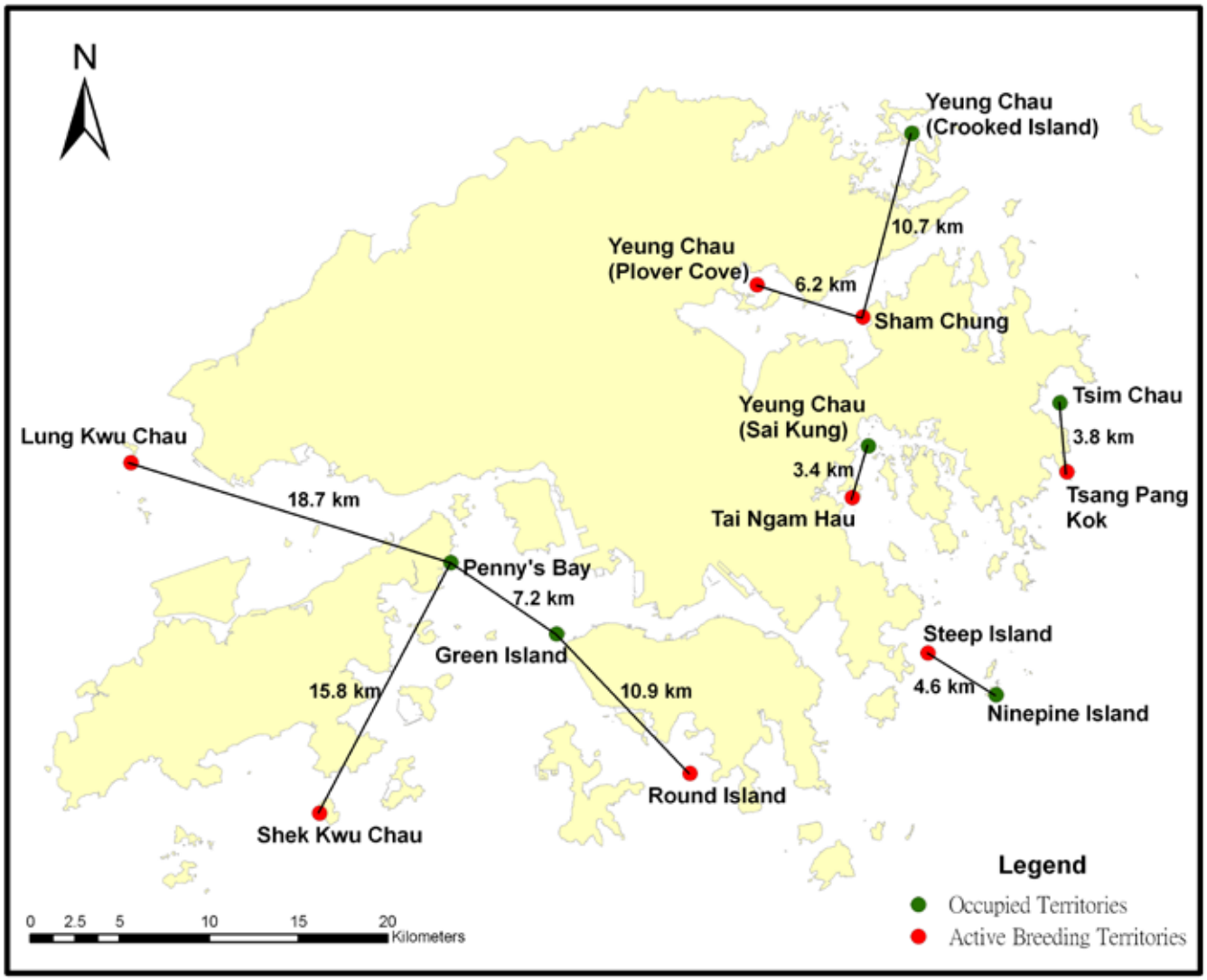

Fig 2. Nesting locations of White-bellied Sea Eagles in 2008/09, showing the shortest distances to other nests.

Number of breeding pairs

In the seven breeding seasons surveyed, the numbers of active breeding pairs ranged from six to twelve; the average was nine pairs per season (Table 1). The breeding population of White-bellied Sea Eagles increased from three pairs in the 1930s and 1960s to ten pairs in the 1980s and 1990s (Carey *et al.*, 2001), and remained at an average of nine pairs, with some degree of fluctuation, in the 2000s. In 2008/09, eight of the 14 (57.1%) pairs of White-bellied Sea Eagles with occupied territories bred actively. This percentage is similar to percentages of active breeding pairs reported in Australia (Bilney and Emison, 1983; Dennis *et al.*, 2005).

Breeding success

The breeding success of White-bellied Sea Eagles fluctuated over the years, with the numbers of successful breeding pairs ranging from 14.3% in 2007/08 to 87.5% in 2008/09 (Table 1). This may be related to the weather during the breeding seasons. The prolonged period of low temperature in February 2008 [average temperature: 13.3°C – 3°C lower than the 30-year average (Hong Kong Observatory 2009)] might have been the major reason for the poor breeding success in 2007/08. Low breeding success was also seen in egrets (Anon., 2008) and House Crow (*Corvus splendens*, 家鴉) (AFCD, unpublished data) in that year. A prolonged cold spell may adversely affect breeding success through reducing fitness of adults, survival rates of chicks/ fledglings, and availability of food.

The numbers of fledglings raised successfully ranged from one in 2007/08 to ten in 2006/07; an average of five fledglings per year was raised in Hong Kong. These figures are related to the above-noted numbers of active breeding pairs and their breeding success rates. On average, 37.8% of the successful breeding pairs produced two fledglings, and 62.2% produced one. These percentages were similar to results from South Australia (i.e. 34% and 66%, respectively) (del Hoyo *et al.*, 1994).

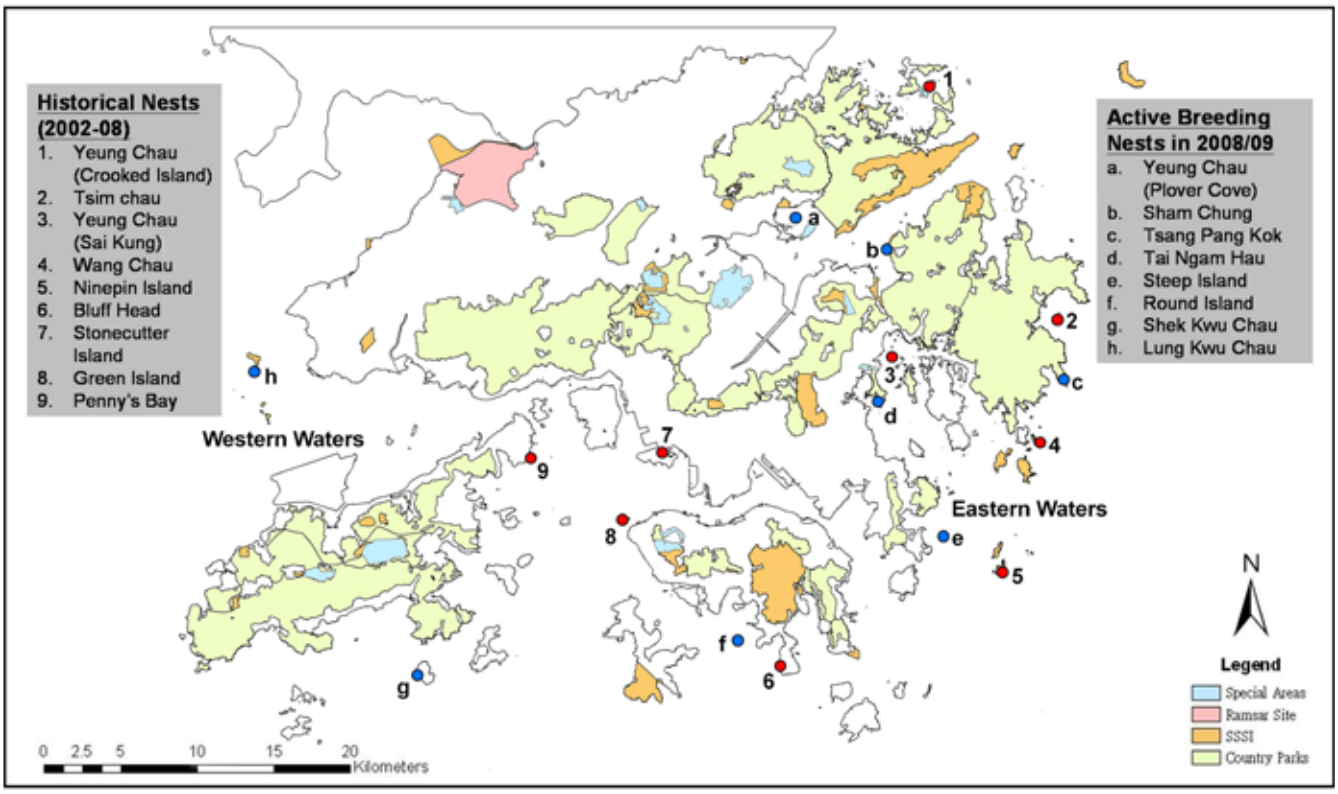

Fig 3. Breeding locations of White-bellied Sea Eagles in Hong Kong (2002-2009).

Nesting locations

In all, 17 nest sites have been found during the surveys. Of these, ten were in eastern Hong Kong, and the remainder were around Hong Kong Island and Lantau Island (Fig. 3). The higher population in the east probably reflects the longer coastline and the presence of more outlying islands, which are favoured by nesting White-bellied Sea Eagles. No nests were found along the west coast of the New Territories, which might be accounted for by a lack of suitable nesting sites on this coast.

In Spain, the reproductive success of Bonelli's Eagle (*Hieraaetus fasciatus*, 白腹隼鵰) was found to be lower if a nest is exposed to prevailing wind (Gil-Sánchez *et al.*, 2004). Northeast winds prevail during winter in Hong Kong, which may account for 13 of the 17 nest sites facing more or less westward (Annex 1). Most of the remaining nests were located in relatively sheltered areas, which are less exposed to wind. Hence, chicks are protected from strong winds.

Fig 4. Nests of White-bellied Sea Eagles: (a) on ledge at Tsang Pang Kok; and (b) on trees at Yeung Chau (Crooked Island).

Of the 17 nesting sites recorded, nine were found within protected areas, i.e. Country Parks, Marine Parks, Special Areas and Sites of Special Scientific Interest (Annex 1). Most of the remaining eight nests were located in remote areas. Therefore, most nests are free from development pressure. The nest at Tsang Pang Kok, located inside Sai Kung East Country Park, was built directly on columnar-jointed rock (Fig. 4a). It was the only nest found that was built on a ledge. On the other hand, Wang Chau was the only site with a nest built on the ground. Other nests found during the surveys were all on trees, either living or dead (Fig. 4b) (Annex 1).

Breeding success of individual pairs

Assuming all pairs of White-bellied Sea Eagles used the same nest site throughout the study period, 17 pairs of White-bellied Sea Eagles were surveyed. Among these pairs, the Tai Ngam Hau pair attempted to breed every year within the survey period, while no breeding attempts were recorded for the newly discovered pair at Yeung Chau (Crooked Island) in 2008/09. Six pairs attempted to breed in five years, four pairs in four years, one pair in three years, one pair in two years and three pairs in one year (Fig. 5).

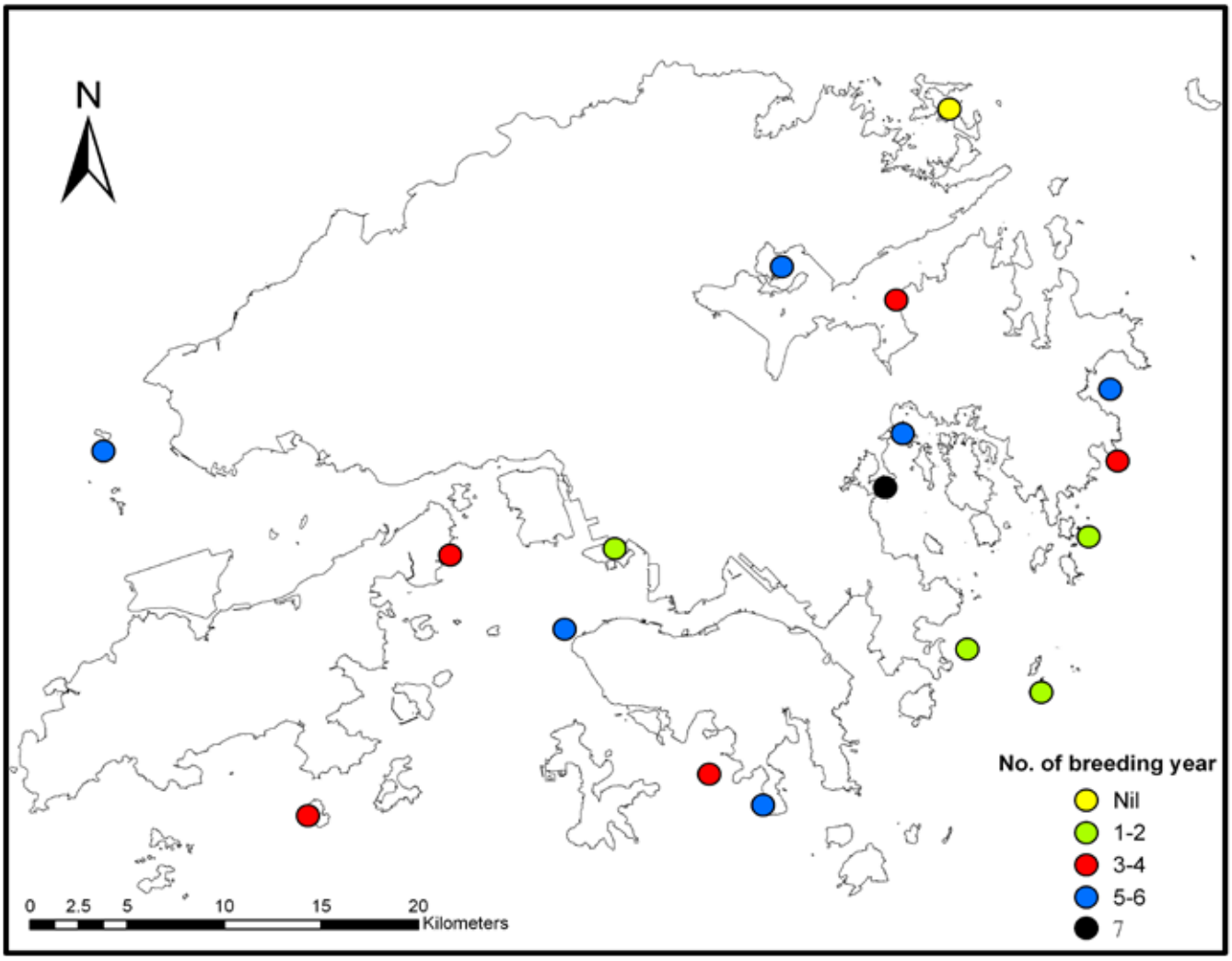

Fig 5. Number of active breeding years of different White-bellied Sea Eagle pairs in Hong Kong during 2002-2009.

The most productive pair was the Tai Ngam Hau pair, which succeeded in producing fledglings in six of the seven breeding years (85.7%). This was followed by the pairs at Lung Kwu Chau (80% in five active breeding years), and Sham Chung (75% in four years). In the harsh 2007/08 breeding season, the Lung Kwu Chau pair was the only one of the seven active breeding pairs that succeeded in raising a fledgling. The least productive pairs were those from Bluff Head, Green Island and Yeung Chau (Sai Kung). All these three pairs attempted to breed in five seasons, but failed to produce any chicks.

Besides being successful in producing viable fledglings in most breeding attempts, the Tai Ngam Hau and Lung Kwu Chau pairs raised two fledglings within a breeding season in more than two years, with the Tai Ngam Hau pair doing so in four out of the seven active breeding years, and the Lung Kwu Chau pair in two out of the five active breeding years. Only four other pairs produced two fledglings within a single breeding season during the survey period, i.e. pairs at Penny's Bay, Shek Kwu Chau, Steep Island and Wang Chau.

Factors affecting breeding success of White-bellied Sea Eagle in Hong Kong

Human Influences

A possible reason for the difference in reproductive success of different pairs might be the degree and type of disturbance experienced. White-bellied Sea Eagles are known to be sensitive to human disturbance during the breeding season, and may even desert a nest if disturbed (Cluine, 1994). On the other hand, they are attracted to man-made sites such as reservoirs and other artificial water bodies, which are usually stocked with fishes (Shephard *et al.*, 2005). Several nests found in this study were located close to human settlements, fish culture zones, typhoon shelters or piers. Some of these pairs are successful breeders, while some rarely produce any offspring. The two pairs found closest to human interference are at Yeung Chau (Sai Kung) and Tai Ngam Hau.

The pair at Yeung Chau (Sai Kung) has been reported to inhabit the site since 2002/03 and still resides there. Breeding attempts were recorded in the first five years (2002/03 to 2006/07), but no viable fledglings were raised. No breeding behaviour was observed in the past two years. This pair's nest site was subject to considerable human interference. Located about 700 m from the Sai Kung pier and town, and just 10-15 m above sea level, the nest was in an area with heavy sea traffic, especially during holidays. The heavy traffic may render the surrounding area less suitable for the White-bellied Sea Eagles to forage, thus decreasing their breeding success.

The pair at Tai Ngam Hau has also been recorded since 2002/03. They bred every year during the study period, and produced fledglings in six of the seven years. The exception was in 2007/08, when the breeding success of White-bellied Sea Eagles was typically low due to a prolonged cold spell. This pair's nest was about 500 m from a small pier at Ma Lam Wat, and about 900 m from Trio Beach. Nevertheless, the nest was on a hillside about 80 m above sea level. The levels of human activity and waterway traffic were less intense than experienced by the Yeung Chau (Sai Kung) pair. Fish culturing at Ma Lam Wat may have boosted nutrient levels in the surrounding area, thus enhancing the foraging ground. Dead fishes from the fish rafts might also act as a food source for these eagles.

Reproductive success of raptors such as White-bellied Sea Eagle and Osprey (*Pandion haliaetus,* 鶚) have been found to be higher for pairs free from human activities (Bischoff, 2001; Dennis *et al.,* 2005). However, as stated above, White-bellied Sea Eagle pairs influenced by human activities might still perform well, e.g. the Tai Ngam Hau pair. There were also cases in which pairs nesting in remote areas failed to produce any chicks or even abandoned the nests, e.g. the pairs at Green Island and Bluff Head. The Sham Chung pair inhabiting Sai Kung West Country Park, where disturbance is minimal, ceased using the nest site for three years during 2005-2008, yet produced fledglings before and after this period.

Climate

Climate definitely affects the breeding success of White-bellied Sea Eagles. As mentioned above, a cold spell in the 2007/08 breeding season apparently caused breeding failures in nearly all White-bellied Sea Eagle pairs that attempted to breed, and also in other species nesting in Hong Kong. A study in Idaho, USA, found the severity of winter was an important factor affecting the percentage of Golden Eagle (*Aquila chrysaetos,* 金鵰) pairs that lay eggs, and more hot days in spring was related to lower reproductive success and smaller brood size (Steenhof *et al.,* 1997). Similarly, cold winters reduced the numbers of occupied territories of breeding Northern Goshawk (*Accipiter gentilis,* 蒼鷹) in Northern Nevada, USA, while breeding success was higher in warmer springs (Fairhurst and Bechard, 2005).

Habitat quality

Habitat quality, including vegetation and water body, might also affect the breeding success of White-bellied Sea Eagles. Results of past studies showed that pairs nesting in wooded habitats generally produced more young than those in more open habitats (Cluine, 1994; Dennis *et al.,* 2005). All the more successful breeding pairs in the survey had territories with dense shrubs and trees inside protected areas, or on outlying islands where the vegetation is less disturbed.

Age of breeding birds

Age of the breeding birds might also affect fecundity, as observed in other raptors elsewhere, e.g. Bonelli's Eagle and Golden Eagle (Sanchez-zapata *et al.,* 2000; Penteriani *et al.,* 2003). The effect of age on the breeding success of White-bellied Sea Eagles may require further study.

Conclusions

This study found that the population of White-bellied Sea Eagles in Hong Kong seems healthy, with the estimated population increasing from 39 individuals in 2003 to 57 individuals in 2009. The number of breeding pairs fluctuated around an average of nine in the last seven seasons. The density of White-bellied Sea Eagle territories was relatively high, particularly in eastern Hong Kong, where there are more favourable habitats.

A total of 17 nesting sites were recorded during 2002-2009. Most are on west facing locations, affording shelter against the prevailing northeasterly winds during the breeding season. Most nests were within protected areas or on remote islands free from human disturbance. These pairs also achieved higher reproductive success - producing more fledglings per nest, and successfully raising fledglings in most years.

Breeding success of White-bellied Sea Eagles varied from year to year, ranging from 14.3% to 87.5% of active breeding pairs during the study period. The intensity and kind of human activities around the nests, climate and habitat quality all affected the breeding outcome.

The White-bellied Sea Eagle's decline elsewhere is mainly due to threats such as human disturbance, habitat destruction, shooting and poisoning (Ferguson-Lees and Christie, 2001). In Hong Kong, thefts of eggs from nests and disturbance such as grass cutting have caused breeding failures of White-bellied Sea Eagles in the past (Taylor, 1933). With the enforcement of the Wild Animals Protection Ordinance (Cap. 170), direct human disturbance of the birds is now prohibited. Besides, as most of the nests are located in protected or remote areas, their nesting sites are relatively free from development pressures.

The results of this study help with understanding the distribution and breeding ecology of White-bellied Sea Eagles in Hong Kong. The White-bellied Sea Eagle breeding surveys will be continued, in order to keep monitoring the population, and provide the most up-to-date information on the breeding ecology, to help conservation of this species.

Acknowledgements

The authors would like to thank Mr. Tang Moon Yiu, a keen observer of White-bellied Sea Eagle, and Mr. Gary Chow for providing some of the information on breeding White-bellied Sea Eagles. Thanks must also be given to Mr. Yu Yat Tung for his views regarding the Wang Chau nest. Assistance from AFCD's staff in the Nature Conservation Division, Wetland and Fauna Conservation Division and the Biodiversity Conservation Division, as well as others involved in data collection, is very much appreciated.

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Annex 1. Summary of nesting conditions of White-bellied Sea Eagles in natural habitats in Hong Kong from 2002/03 to 2008/09.

Nest Site	Orientation	Nesting Substratum	Protected Areas	Remarks
Bluff Head	W	Tree		
Green Island	N to NW	Tree		
Lung Kwu Chau	W	Tree	Sha Chau and Lung Kwu Chau Marine Park	
Ninepin Island	S to SW	Tree	Sites of Special Scientific Interest	Nest could not be directly observed but was probably located on tree based on the pair's behaviour.
Penny's Bay	SW	Tree		
Round Island	S	Tree		Nest hidden in a big tree with tall vegetation on the eastern side which protects them from the wind.
Sham Chung	SW	Tree	Sai Kung West Country Park	Nest located at the inner bay of Sham Chung.
Shek Kwu Chau	W to SW	Tree		
Steep Island	SW	Tree	Clear Water Bay Country Park	
Stonecutter Island	W	Tree		
Tai Ngam Hau	W	Tree	Ma On Shan Country Park	
Tsang Pang Kok	SE	Columnar-jointed rock	Sai Kung East Country Park	Nest located on a sheltered ledge.
Tsim Chau	N to NW	Tree		Nest being sheltered from strong wind by Tai Chau.
Wang Chau	NE	Ground		
Yeung Chau (Crooked Island)	W	Tree	Plover Cove (Extension) Country Park	
Yeung Chau (Plover Cove)	N/A	Tree	Ma Shi Chau Special Area	Nest located on tree on a hill top in the inner bay of Tolo Channel. It is sheltered from strong wind by nearby islands.
Yeung Chau (Sai Kung)	W	Tree		

Division Column

Breeding Record of Black-winged Stilt (*Himantopus himantopus*, 黑翅長腳鷸) in Hong Kong Wetland Park

Hong Kong Wetland Park Reserve Section

本文報告在2009年4月至8月期間，黑翅長腳鷸在香港濕地公園濕地保護區的泥灘築巢育幼的觀察結果，當中包括牠們的巢數、繁殖、育幼及覓食行爲。報告有助了解牠們在香港的繁殖狀況，及檢討公園內的生態環境是否切合其需要。

Introduction

On 25 April 2009, a Hong Kong Wetland Park volunteer (Mr. Y.T. Ip) observed a pair of Black-winged Stilts (*Himantopus himantopus,* 黑翅長腳鷸) nesting on the Mudflat, near the Mudflat bird hide in the reserve area of Hong Kong Wetland Park. More mating pairs and nests were sighted in the following months. This paper presents an account of Black-winged Stilts breeding in Hong Kong Wetland Park.

Black-winged Stilt

Black-winged Stilts are both passage migrants and winter visitors in Hong Kong (Carey *et al.,* 2001). They can be easily identified by their slender physique, and long pinkish legs. Black-winged Stilts amongst small waders are eye-catching, as they are taller than the rest. Downy Black-winged Stilt chicks have pale brown upperparts with black lines on the flanks. They have black spots on the back, arranged in parallel lines. Unlike adults, chicks have brownish crowns, which gradually turn white as they grow.

Black-winged Stilts usually forage for small fishes, insects, tadpoles and small invertebrates, in ponds, lakes and rivers (BirdLife International, 2009). Past records showed that Black-winged Stilts were found in the Deep Bay area, and the first breeding record in Hong Kong was in 2003 at Mai Po (Viney *et al.,* 2005). They have been recorded using small mounds of grass to build nests, and lay eggs on the ground close to water (del Hoyo *et al.,* 1996).

In Hong Kong, the autumn passage of Black-winged Stilts usually commences in late August, and peaks between late October and early November. Wintering flocks are established during early December. Although most Black-winged Stilts leave Hong Kong by the end of April, a few remain in summer (Carey *et al.,* 2001). Fig. 6 shows the numbers of Black-winged Stilts recorded in Hong Kong Wetland Park from 2003 to 2009. Black-winged Stilts in Hong Kong Wetland Park are mainly autumn passage migrants. They usually arrive in late summer, with a peak count of 65 individuals in September 2009.

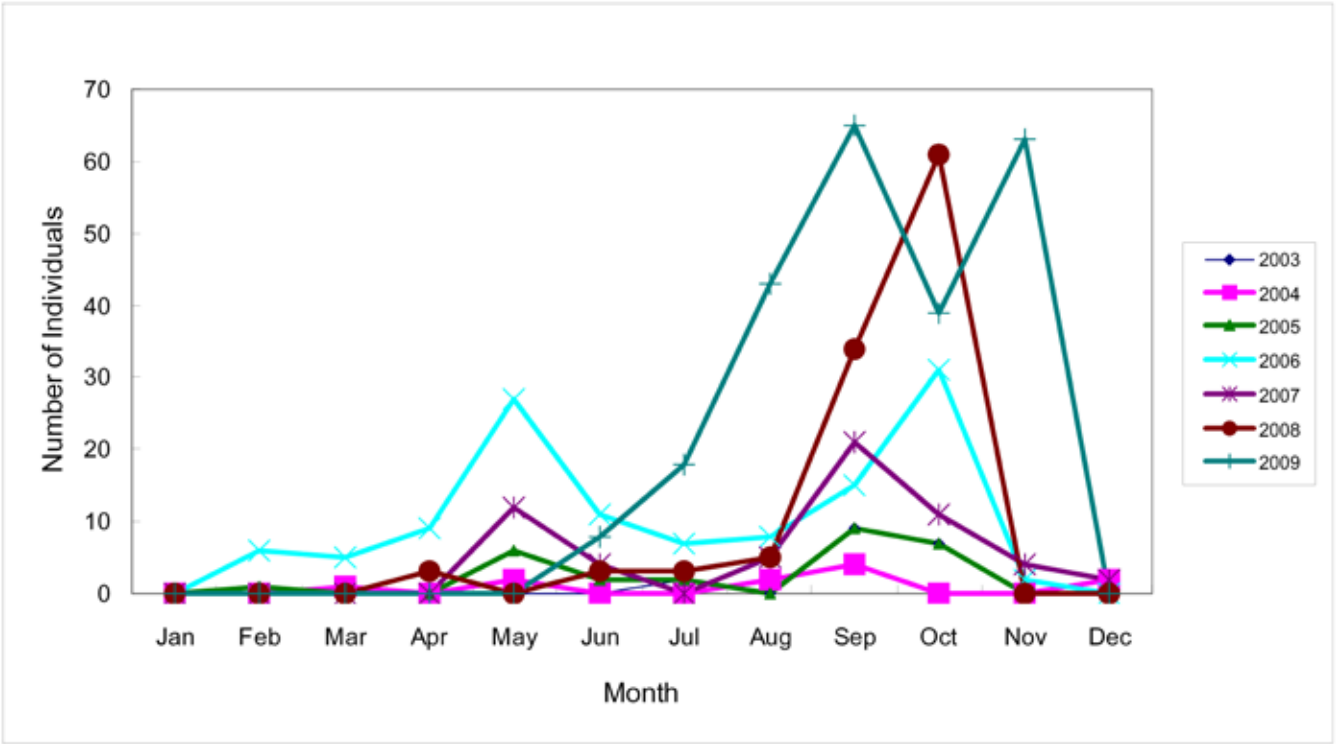

Fig 6. Numbers of Black-winged Stilts recorded in Hong Kong Wetland Park from 2003 to 2009.

Breeding account and findings

The Mudflat is in the south-east of Hong Kong Wetland Park, and has an area of 21,740 m^2 (Fig. 7). The Mudflat is managed to have minimal vegetation, thus affording good visibility. Through use of a weir, the water level is kept low, especially from October to March, to provide foraging grounds for wintering waterbirds, particularly waders. The Mudflat is influenced by the tide from Tsim Bei Tsui, and is therefore mainly brackish.

Fig 7. The mudflat in Hong Kong Wetland Park and its surrounding vegetation.

After the sighting of possible breeding and nesting behaviour on 25 April 2009, the Hong Kong Wetland Park Reserve Team monitored the Black-winged Stilts at the Mudflat twice daily, including carrying out fixed point counts from the Mudflat bird hide, and taking photos and recording video from April to August 2009. The numbers of adults and chicks, their locations, activities, extent of muddy area at the Mudflat and weather conditions were recorded. Precautionary measures were taken to minimise disturbance to the breeding pairs, including close monitoring of the Mudflat water level, postponing the scheduled weeding and related nearby activities, as well as restricting access to the Mudflat.

In all, 8 Black-winged Stilt nests and 14 chicks were recorded during the survey period from 25 April to 17 August 2009 (Fig. 8). Five broods hatched successfully.

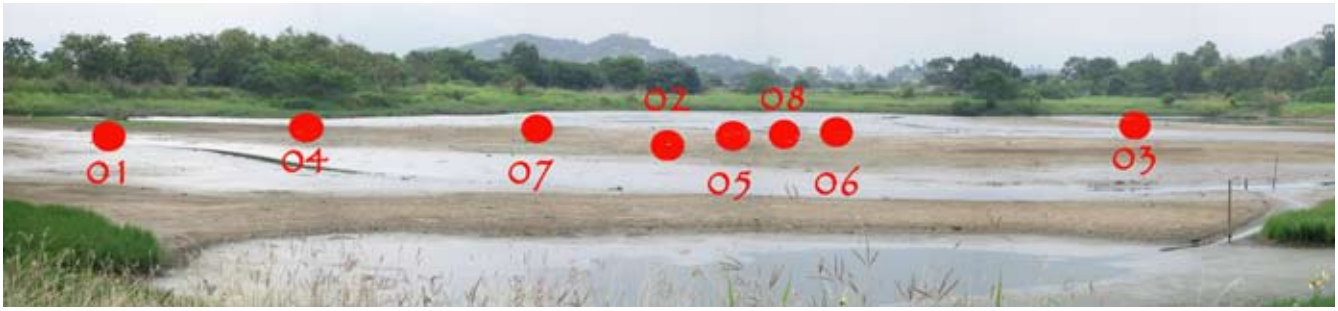

Fig 8. Black-winged Stilt nests at the Hong Kong Wetland Park Mudflat.

Fig 9. Nest built from mud, leaf detritus and grass roots.

Apart from the first nest, which was a mound built from mud, leaf detritus and grass roots (Fig. 9), the other seven nests were in the form of shallow scrapes on mud, covered with some dry grass, around which the stilts built small rings of pebbles (Fig. 10). Also, the first nest was built near grass tufts 15-20 cm tall, while the others were built in rather open areas. The distance between nests ranged from 4 to 30 m.

Fig 10. A nest with four eggs in a shallow scrape.

The eggs are light brown with some black dots. The incubation period was around 20 to 22 days and, on average, there were 3 to 4 chicks per brood. The air temperature ranged from 27˚C to 31˚C during the survey period. Both members of a pair took turns to incubate, forage and defend the nest. The hatchlings started foraging in shallow water on the day they hatched (Fig. 11). Adults took care of the chicks by providing shade and hiding them with spread wings. They also defended the chicks from intruders such as larger waterbirds (Fig. 12). It took about 45 days for the chicks to grow to flying juveniles.

Fig 11. Black-winged Stilt chicks foraging in shallow water.

Fig 12. Black-winged Stilt defending the chicks from an intruding Little Egret (*Egretta garzetta,* 小白鷺).

During the morning of 24 May 2009, the water level in the Mudflat kept rising due to heavy rainfall. To protect the eggs from being drowned, at least 2 pairs of Black-winged Stilt parents built small "platforms" with small branches and stones, and moved their eggs to the platform. Some other Black-winged Stilt parents guided their chicks to the non-flooded areas of the Mudflat.

To prevent the Mudflat from being colonised by grass, weeding was carried out after the last Black-winged Stilt chick left the site in August. The numbers of Black-winged Stilts increased after weeding, to a peak of 65 in September, which was the highest count since recording commenced in 2003. The percentage of exposed mud at the Mudflat and the numbers of Black-winged Stilts counted were recorded (Fig. 13). Based on a preliminary analysis, it appears that more Black-winged Stilts forage in the Mudflat when there is more extensive exposed mud. More data will be collected, to further analyse this relationship. To maximise the utilisation of the Mudflat by waterbirds, the percentage of vegetation cover and exposed mud will be monitored, and adjusted as appropriate.

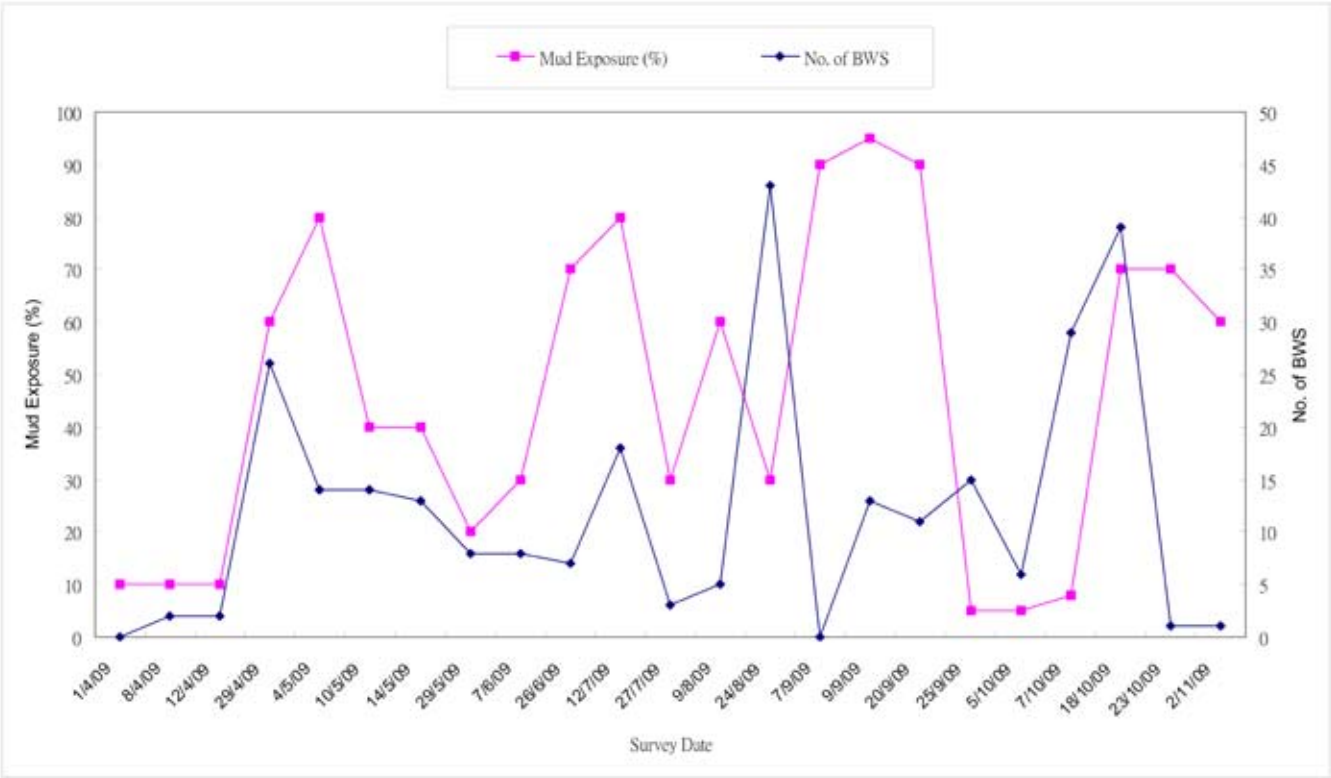

Fig 13. Relationship between the percentage of exposed mud and numbers of Black-winged Stilt (BWS) at the Mudflat from April to October 2009.

All birds occurring in Hong Kong Wetland Park are monitored in an ongoing basis. This provides up-to-date information for formulating appropriate conservation and management measures, to enhance the habitats of the reserve area for birds and other wildlife.

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Working Group Column

The Omnivorous Behaviour of Big-headed Terrapin (*Platysternon megacephalum*, 平胸龜) in Hong Kong

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漁農自然護理署兩棲及爬行動物工作小組自2002年開始對平胸龜於本港的主要種群作出監察，並發現其雜食性行爲。本文將所收集到的平胸龜糞便樣本作出研究及分析，並就其食性作出討論。

Fig 14. Adult Big-headed Terrapin.

Big-headed Terrapin (*Platysternon megacephalum*, 平胸龜, Fig. 14) is one of Hong Kong's native freshwater turtle species, and is mainly restricted to rocky streams at higher altitudes. Since 2002, the Agriculture, Fisheries and Conservation Department (AFCD) has conducted a long-term programme to monitor Big-headed Terrapin's major local populations in Hong Kong. During our regular surveys, we found plant parts in Big-headed Terrapins' droppings, which did not tally with literature reports asserting the species is strictly carnivorous (Ernst and Barbour, 1989; Karsen *et al.*, 1998).

To verify the observations, we examined the droppings of 15 terrapins. Four of them were juveniles, averaging 7.1 cm in straight carapace length (SCL). The other 11 were sub-adults or adults, with an average SCL of 12.9 cm. They were temporarily kept in captivity, so their droppings could be collected. The droppings were then screened through a 2-mm sieve, to separate the indigestible contents.

It took about four days for the terrapins to fully empty their bowels. Ten terrapins – which were all sub-adults or adults – had droppings with distinguishable plant or animal remains (Table 2). Figs. 15-18 show the remains recovered from the droppings.

Table 2. Plant or animal remains found in Big-headed Terrapin droppings.

Number of terrapins	Identifiable remains			
	Stones of *Machilus* (潤楠屬) species*	Stones of *Dendrotrophe varians* (寄生藤)	Fragments of *Cryptotympana mandarina* (黃蚱蟬)	Limbs of *Nanhaipotamon hongkongense* (香港南海溪蟹)
7	+	-	-	-
1	-	+	-	-
1	-	-	+	-
1	+	-	-	+

* Identification to species level was not possible.

Fig 15. Stones of *Machilus* found in Big-headed Terrapin droppings.

Fig 16. Stones of *Dendrotrophe varians* found in Big-headed Terrapin droppings.

Fig 17. Fragments of *Cryptotympana mandarina* (Large Brown Cicada) found in Big-headed Terrapin droppings.

Fig 18. Appendages of freshwater crab *Nanhaipotamon hongkongense* found in Big-headed Terrapin droppings.

Given the abundance of plant remains in the droppings, Big-headed Terrapins are evidently omnivorous. They are probably opportunistic, feeding on items that are readily available and preferable, such as drupes and cicada carcasses, which may be abundant in their stream habitats. The impression that they are strict carnivores was possibly due to their hooked upper jaws, which are specialised for tearing foods, and observations of captive individuals feeding on meat.

It is interesting to note that *Machilus* stones were predominant in the droppings. Field surveys confirmed that *Machilus breviflora* (短序潤楠) and *Dendrotrophe varians* were common in the vicinity of the terrapins' habitats (Fig. 19). In fact, various species of *Machilus* are dominant in uplands from 300-800 m in Hong Kong (Lai and Yip, 2008), which coincides with the distribution range of Big-headed Terrapin. Furthermore, only indigestible and identifiable food items, such as fruit stones, which are seeds protected by endocarps, can be recovered from faecal analysis. These factors may contribute to the predominance of *Machilus* stones in the droppings of Big-headed Terrapins.

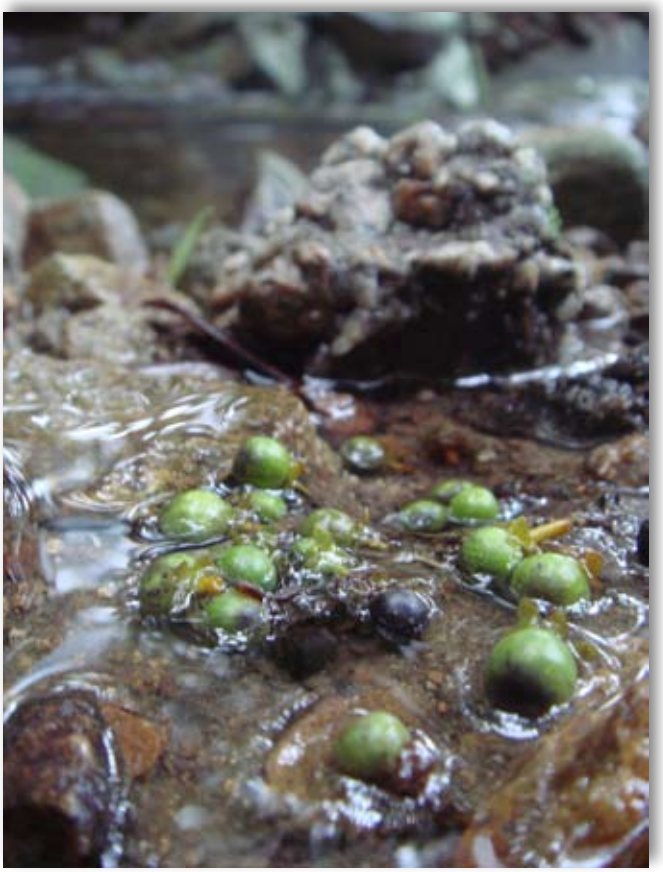

Fig 19. Fallen drupes of *Machilus breviflora* in one of the study sites.

The results show that the foraging behaviour of Big-headed Terrapins is not very well known, and merits more detailed study. It would also be instructive to learn whether Big-headed Terrapins assist in seed dispersal. However, in captivity at least, freshwater turtles tend to defecate under water. It is uncertain whether the seeds in the droppings could germinate underwater, even if they survive after digestion. Tests on germinating seeds recovered from the droppings in both laboratory setting and the field, along with radio-tracking studies on the terrapins' movements and habitat preferences, would shed light on this issue. Also, it would be interesting to discover whether the terrapins deliberately ingest plants to aid digestion and defecation.

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The First Record of Chinese Broad-headed Pond Turtle (*Chinemys megalocephala*, 大頭烏龜) in Hong Kong

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本文報告本港首個大頭烏龜的記錄，並就大頭烏龜的分布、物種真確性及鑒別特徵等方面作出簡短的介紹。

Introduction

On 1 June 2009, a Chinese Broad-headed Pond Turtle (*Chinemys megalocephala*, 大頭烏龜) (Fig. 20) was found in a muddy pond near an abandoned field at Wu Kau Tang. The turtle was found actively foraging in the pond where tadpoles of Brown Tree Frogs (*Polypedates megacephalus,* 棕樹蛙) and aquatic vegetation were present. This turtle is the first record of the species in Hong Kong.

Fig 20. Chinese Broad-headed Pond Turtle

Distribution and Species Validity

Three *Chinemys* species (Family Bataguridae) are recorded in China, namely Reeves' Turtle (*C. reevesii* Gray, 1831, 烏龜), Chinese Black-necked Pond Turtle (*C. nigricans* Gray, 1834, 黑頸烏龜) and Chinese Broad-headed Pond Turtle (*C. megalocephala* Fang, 1834). Among the three *Chinemys* species, the Chinese Broad-headed Turtle and the Chinese Black-necked Pond Turtle were said to be endemic to China. However, until recently, they have been recorded in other places, such as Korea, Japan, Taiwan and Vietnam. Chinese Broad-headed Pond Turtle is distributed in Auhui, Jiangsu, Hubei, Guangxi and Hainan of China, Korea as well as Japan.

Interestingly, the species validity of Chinese Broad-headed Pond Turtle is controversial: Guo *et al*. (1997) reported a subspecies difference between *C. reevesii* and *C. megalocephala* by karyotype differentiation; whereas Barth *et al*. (2003) suggested that both *C. reveesii* and *C. megalocephala* may be an identical species and *C. megalocephala* is probably a diet-induced variant of *C. reveesii*. On the whole, the validity of *C. megalocephala* still needs further verification.

Biological Features

Chinese Broad-headed Pond Turtle is a large *Chinemys* of carapace length ranging from 182 to 265 mm and carapace width from 113 to 190 mm. The carapace of the female turtle from Wu Kau Tang is 188 mm long and 184 mm wide. This individual weighs 997 g. Chinese Broad-headed Pond Turtle has a brown to dark brown carapace, which is oval, moderately doomed and unserrated in the posterior end. Three distinct keels are present on the carapace. Both the plastron and bridges are dark brown to black with yellow to green seams on the outer rim.

Its English common name symbolizes a prominent feature of the turtle having a comparatively large head. The head's width is one-third to half of that of the carapace. There are several small yellowish markings on the lateral sides of the head, along with two postorbital stripes running to the neck. This species has a barely projecting snout with thick beak. It bears a pair of round and conspicuous tympanums. Skin of the soft parts is grayish olive. Its forelimbs are cylindrical and each bears five claws; while its hindlimbs are more flattened and each bears four claws. All of the limbs are fully webbed.

Courtship and nesting take place from May to September. Females lay a clutch of two to nine eggs. The eggs are elongated, white, and about 40 x 26 mm in size. In mid-October, the female turtle from Wu Kau Tang laid a clutch of seven eggs of about 32 x 22 mm (Fig. 21).

Chinese Broad-headed Pond Turtle, and the other two *Chinemys* species in China, can produce nasty carrion-like odours when confronted. Therefore, they are collectively called "Nasty-smelling Turtles" by the Chinese.

Ecology

Little is known about the ecology of Chinese Broad-headed Pond Turtle. However, like Reeves' Turtle, Chinese Broad-headed Pond Turtle is usually found in ponds and slow-flowing streams near hillsides. This species is omnivorous, foraging on larvae, snails and other invertebrates, as well as plants, including algae and aquatic plants.

Fig 21. Eggs of the Chinese Broad-headed Pond Turtle from Wu Kau Tang

Conservation Status

Chinese Broad-headed Pond Turtle is listed as an endangered species in the IUCN Red List of Threatened Species and in Appendix III in CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) as the population of this species is small and it has been occasionally traded as food and medicine.

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