Hong Kong Biodiversity
Agriculture, Fisheries and Conservation Department Newsletter

Issue No. 6 March 2004

Feature Article

Migration and overwintering aggregation of Danaid butterflies in Hong Kong

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Butterfly Working Group

漁農自然護理署於 2002 年年底，在香港斑蝶越冬的主要停留地點進行了「重複捕取」實驗，以了解越冬斑蝶的遷移路線及小冷水越冬群落的族群動態。本文闡述實驗的主要結果並附討論。

Introduction

Danaids (Family Danaidae 斑蝶科) are the only group of butterflies that may aggregate in large numbers to survive over the cold winter at their adult stage. This peculiar behaviour of butterflies is usually referred as overwintering aggregation and has attracted the interest of the public and naturalists particularly in the US, Canada, Australia, India and Taiwan. The Monarch (*Danaus plexippus* 君主斑蝶) in the US and Mexico is the most well studied example of overwintering butterflies (Knight *et al*. 1999). In Taiwan, more than ten active overwintering sites have been documented whose numbers of butterflies range from hundreds to hundred thousands (Lee and Wang, 1997).

Figure 1:Butterflies aggregating at Siu Lang Shui

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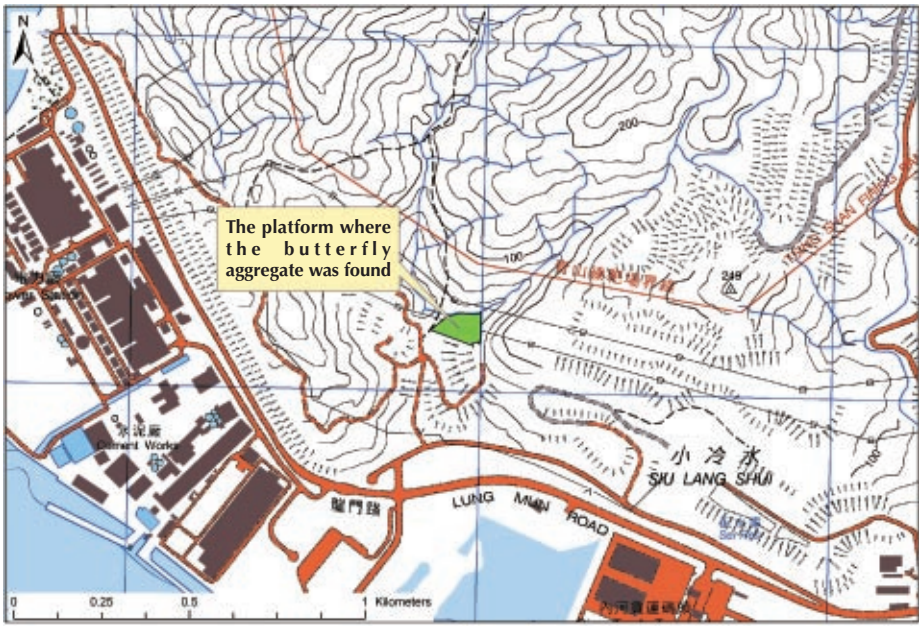

Figure 2: Location of the overwintering butterflies at Siu Lang Shui closed landfill

The record of butterfly overwintering in Hong Kong can be dated back to December 1938 that "thousands of butterflies were swarming on the twigs and branches" in the "Butterfly Valley" near Lai Chi Kok (Chan, 1939). In recent years, small aggregates of Danaids are regularly seen in particular sites in the winter. While these aggregates disappear, a large butterfly aggregate is forming in Siu Lang Shui (SLS), Tuen Mun. Therefore, it is believed that the Danaids may migrate to SLS from other sites.

Siu Lang Shui, located in the Northwest of the New Territories, is a closed and restored landfill, and is currently managed by the Environmental Protection Department (EPD). The site is almost entirely planted with exotic species like Cadaga (毛葉桉 *Eucalyptus torelliana*) and Taiwan Acacia (臺灣相思 *Acacia confusa*) while some young native species including Prickly Ash (簕欓花椒 *Zanthoxylum avicennae*), Hairy Fig (粗葉榕 *Ficus hirta*) and Chinese Privet (山指甲 *Ligustrum sinense*) can also be seen.

Objectives

To better understand the butterfly overwintering in Hong Kong, Agriculture, Fisheries and Conservation Department (AFCD) has undertaken a series of capture-mark-recapture experiments. The objectives are: (i) to trace the migration route of the overwintering Danaids and locate their important transitional stops; (ii) to investigate the population dynamics of the overwintering aggregate in SLS including their species compositions, sex ratios, population sizes and the changes in population sizes over their stay period.

Experiment Design and Data Analysis

Capture-mark-recapture

Capture-mark-recapture is a commonly used technique to follow the migratory route of butterflies and estimate population parameters (Knight *et al.*, 1999; Pradel, 1996; Schappert and Shore, 1998). The captured butterflies would be marked with a site code and an identity number on the underside of the left hindwing with a thin-point permanent marker on the first encounter and released (Mousson *et al.*, 1998). Recapturing the marked individuals in different sites would provide information on the butterflies' mobility and the information of recaptures at the same site could be used to investigate the population dynamics of the butterfly population.

Migration route

The migration of Danaids in Hong Kong usually starts from November and small aggregates of butterflies would be seen in areas such as Nam Fung Road (NFR) Site of Special Scientific Interest (SSSI), Shing Mun Country Park (SMCP), Chuen Lung (CL) and Tai Lam Country Park (TLCP). Yiu (2003) believed that some of

Figure 3: Butterfly with the site code and identity number on its hindwing

Table 1: The numbers of captured and marked butterflies at the four transitional stops

Site	Date	Species					Total
		D. genutia	*E. midamus*	*E. core*	*I. similis*	*T. limniace*	
NFR	05/11/02	0	0	2	1	0	3
SMCP	07/11/02	8	32	28	18	1	87
	14/11/02	1	12	10	4	2	29
CL	12/11/02	0	0	0	2	0	2
TLCP	14/11/02	1	62	3	0	1	68

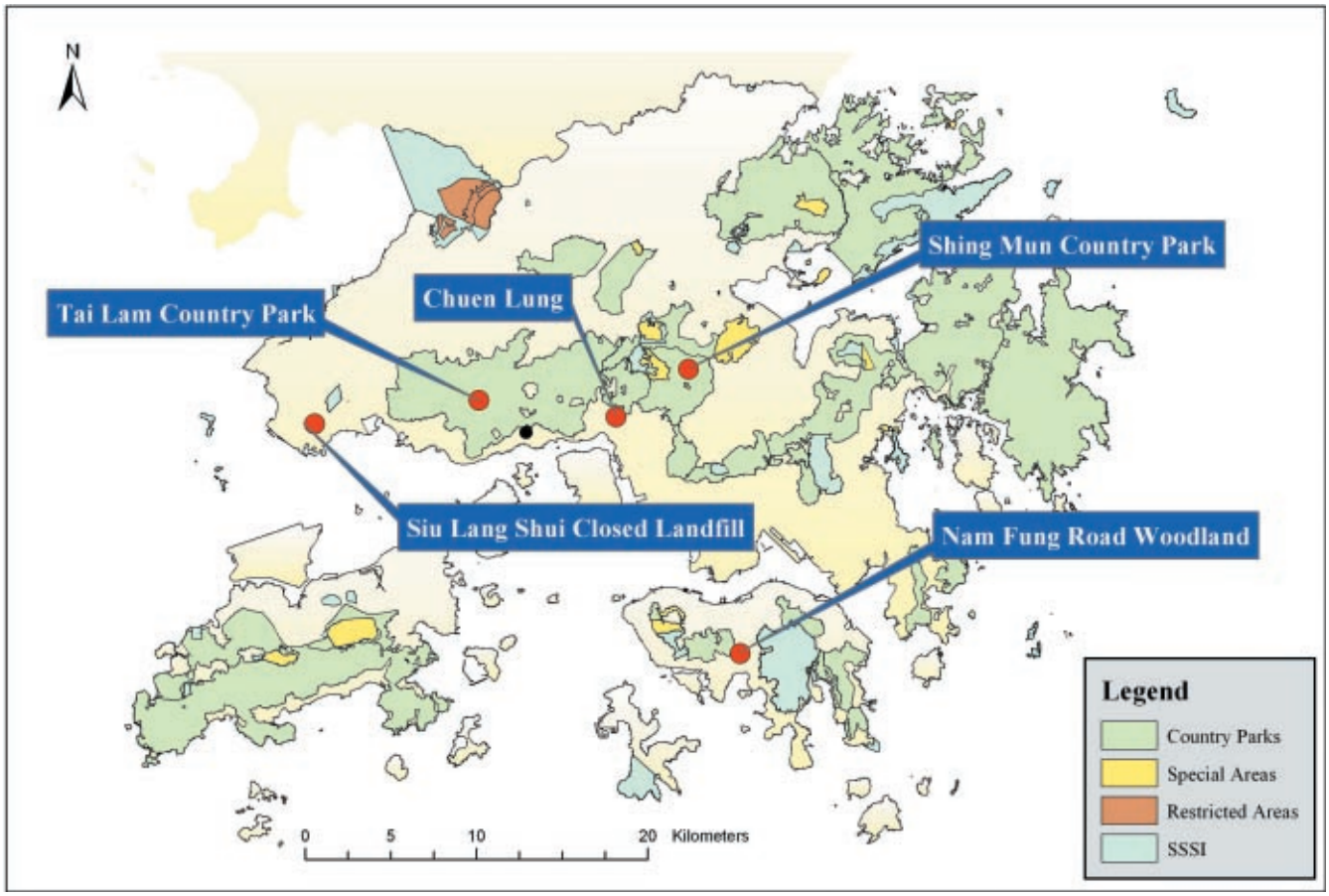

Figure 4: Locations of the selected transitional stops of migrating butterflies

these sites were transitional stops on the migration route of the butterflies, but no evidence had been provided to confirm the status of these sites. Therefore these four sites were visited in November and December 2002 to mark the captured butterflies.

Overwintering population

Early sign of overwintering aggregation in SLS was notified by the staff of SLS site office of EPD. Under the permission of EPD, capture-mark-recapture experiments were conducted in SLS. The captured butterflies were marked and examined for previous marking. The sampling of butterflies is believed to be random as the butterflies would fly to drink water or take nectar on warmer days and mix themselves randomly before landing onto the trees.

Data analysis

The data collected in SLS was analysed with computer software, MARK, which provides parameter estimates for marked and recaptured animals (White and Burnham, 1999). As the butterfly aggregation at SLS was subject to immigration and emigration, the Jolly-Seber Model for open populations was selected for data analysis (Baguette *et al*., 1997; Knight *et al*., 1999).

Results

Migration route

(i) General observation

Seven visits were made to the four sites which are believed to be the transitional stops of migrating butterflies from 5 Nov 02 to 3 Dec 02. Butterfly aggregates greater than 300 individuals could only be observed in SMCP (7 & 14 Nov 02) and TLCP (14 Nov 02) in the morning. The butterflies were found flying over the tree canopy and taking nectar from Ivy Tree (鵝掌柴 *Schefflera heptaphylla*). SMCP and TLCP were revisited on 3 Dec 02 and it was found that the butterfly aggregates had diminished to less than 50 individuals.

(ii) Capture-mark-recapture

Five Danaid species including Common Tiger (*Danaus genutia*, 虎斑蝶), Blue-spotted Crow (*Euploea midamus*, 藍點紫斑蝶), Common Indian Crow (*E. core*, 幻紫斑蝶), Ceylon Blue Glassy Tiger (*Ideopsis similes*, 擬旖斑蝶) and Blue Tiger (*Tirumala limniace*, 青斑蝶) were captured and marked in the four sites (Table 1).

Among the 189 marked individuals, a male *E. midamus* and a male *E. core*, both marked on 7 Nov 02 at SMCP, were recaptured in SLS on 6 and 12 Dec 02 respectively.

Overwintering population

(i) General observation

As notified by the staff of EPD, the butterfly aggregate in SLS appeared on 15 Nov 02 and the estimated number of individuals was about 500. Subsequently, six visits were made to SLS from 21 Nov 02 to 10 Jan 03 between 9:30 am and 12:00 noon. Although it was scheduled that SLS would be visited once every two weeks but the actual dates of visits were adjusted due to inclement weather. It was observed that most

of the butterflies, mainly of *Euploea* species, were roosting on the branches of Cadaga (毛葉桉 *Eucalyptus torelliana*) in clumps. The butterflies were usually motionless on the trees unless being approached closely. However, on sunny days, the butterflies were more active and found flying over tree canopy. The number of butterflies present seemed to decrease after 11:00 am.

(ii) Capture-mark-recapture

Five Danaid butterfly species i.e. *D. genutia, E. midamus, E. core, E. mulciber, I. similis* were captured and *T. limniace* was observed in SLS. The captured butterflies were mainly *E. midamus* (750 individuals; 68%) and *E. core* (294 individuals; 27%) with some *I. similis* (54 individuals; 5%). Other Danaid species contributed less to 1% of the total capture. Over the study period, three individuals of *E. midamus* and 14 individuals of *E. core* were recaptured.

(iii) Sex ratios of *Euploeas*

The sex ratios of the captured *Euploeas* over the study period (except 10 Jan 2003 which only a few individuals were present) were shown in Table 2. The average sex ratio for *E. midamus* is 57.47% female to 43.53% male while that of *E. core* is 43.88% female to 56.12% male. The sex ratios for other species were not estimable because of the low number of capture. The results of two-tailed t-tests suggested that both *E. midamus* ($t=3.39$, $p<0.05$) and *E. core* ($t=3.90$, $p<0.05$) have an equal sex ratio.

Table 2: Sex ratios of *E. midamus* and *E. core*

Date	*E. midamus*		*E. core*	
	Female	Male	Female	Male
21 Nov 02	56.50%	43.50%	47.62%	52.38%
06 Dec 02	56.59%	43.41%	33.33%	66.67%
12 Dec 02	47.41%	52.59%	38.03%	61.97%
23 Dec 02	73.45%	26.55%	45.05%	54.95%
2 Jan 03	57.14%	42.86%	50.00%	50.00%

(iv) Population dynamics

The population sizes of the *Euploeas* in the beginning of the study period and the changes in population sizes are shown in Figure 5. As the numbers of butterflies on 15 Nov 02 and 10 Jan 03 were not estimable, the observed numbers of individuals were plotted directly.

It is noted that the total number of *Euploeas* had increased from about 500 on 15 Nov 02 to 43,000 on 21 Nov 02 and increased slightly to a peak of about 45,000 on 6 Dec 02. Afterwards, the number dropped sharply to 32,500 and levelled around 33,000 until another sharp decline happened after 2 Jan 03. On 10 Jan 03, only a few living individuals and a number of dead butterflies were seen in the site (Figure 6).

Both *Euploea* species have similar trends in their population changes before 12 Dec 02. However, after the first drop in population after 6 Dec 02, *E. core* continued on the rise from 5,100 to the second peak of 6,500 on 23 Dec 02 while the number of *E. midamus* continued to decrease after the peak on 6 Dec 02.

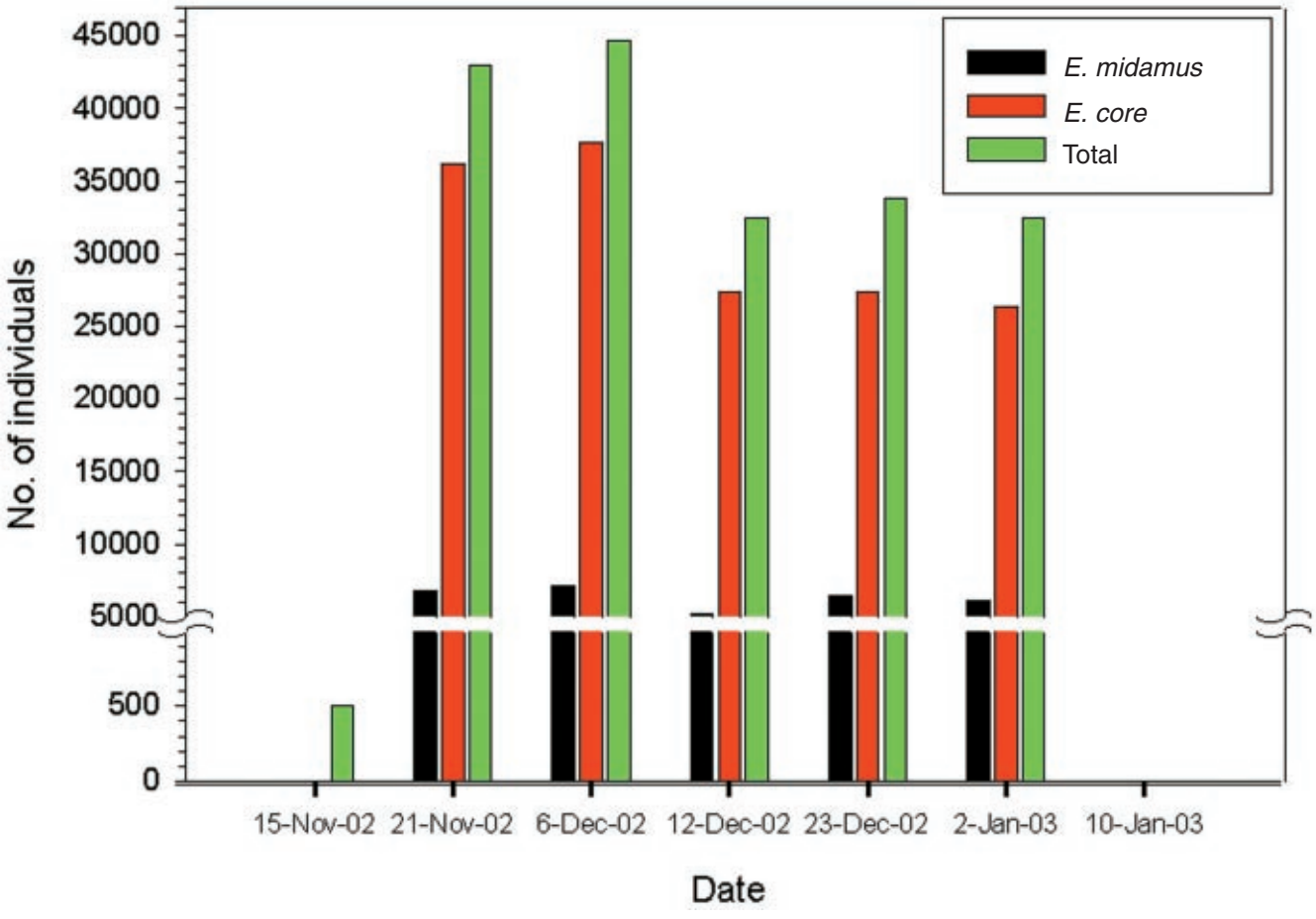

Figure 5: Population changes of the overwintering butterflies

Figure 6: Dead butterflies were found on the floor of the woodland

Discussion

Migration route

The observation in SMCP and TLCP showed that these two Country Parks were being used by Danaids as aggregation sites in early winter. The recaptures of individuals from SMCP in SLS confirmed that SMCP was the transitional stop on the butterfly's migration route towards SLS.

Knight *et al*. (1999) interpreted that short residence of butterflies was the characteristic of transitional stops. Gibo and McCurdy (1993) also suggested that migrating butterflies might actively take nectar to fuel their migration and build up fat reserve to sustain them through the winter. Since the butterflies have only stayed for about two weeks, which was much shorter than the aggregate in SLS (about eight weeks) and spent most of the time in the morning taking nectar from *Schefflera heptaphylla* in TLCP, it was likely that TLCP served as another transitional stop for migrating Danaids.

Apart from the availability of nectar, the level of disturbance was believed to affect the butterflies' choice of transitional stops as human disturbance would cause disorientation of butterflies migration and unusual aggregation (Crolla and Lafontaine, 2003). Within the protected area system, SMCP and TLCP have dense vegetation cover for nectar source in winter and a relatively stable and undisturbed environment, and are therefore favoured by the migrating butterflies.

Overwintering population

(i) Butterfly preference on trees species

Overwintering butterflies have a specific preference of trees on which they roost. In Taiwan, artificial woodland of *Albizia lebbek* has attracted 15,000 - 30,000 Danaids to aggregate in the winter every year (Lee and Wang, 1997) while the butterflies preferred dead Casuarina trees, Paperbarks and Rubber Vines in Australia (ABC Online, 2000). Crolla and Lafontaine (1996) also pointed out that the Monarchs in California of the US had used *Pinus radiata* and *Cupressus macrocarpa* but now preferred Eucalyptus trees which were introduced to California in the 1850s. In Hong Kong, the butterflies' preference on Eucalyptus trees is evident in that they mostly confined themselves to the Eucalyptus woodland and seldom roost in the *A. confusa* woodland in the close proximity.

It is noteworthy that Eucalyptus trees which originate in Australia are considered as exotic species in Hong Kong and the US. Plantation woodlands of exotic species are usually regarded as of low ecological value in the local context. However, in this particular case, the overwintering butterflies augmented the conservation value of the plantation woodland. It is therefore advised that, when the ecological values of artificial woodlands are to be assessed, the associated fauna have to be taken into consideration.

(ii) Species composition

Yiu (2003) recorded seven Danaid species i.e. *E. midamus* (85%), *E. core* (9%), *E. mulciber* (<1%), *D. genutia* (3%), *I. similis* (1%), *T. liminace* (1%) and *T. septentrionis* (<1%) in SLS in 1999. The observed species in 2002/03 were consistent with Yiu's observation except that no *T. septentrionis* was recorded. The proportion of *E. core* and *I. similis* had increased while the others had decreased in 2002/03. Nevertheless, *E. midamus* and *E. core* still accounted for about 95% of the total population.

Although *E. midamus*, *E. core*, *D. genutia* and *I. similis* are regarded as very common and *T. limniace* as common (Young and Yiu, 2002), according to the baseline survey undertaken by AFCD, their relative abundance in Hong Kong are in the order of: *E. midamus* > *E. core* > *I. similis* > *D. genutia* > *T. limniace*. In this connection, the disproportion of species in the overwintering aggregate might be related to the species' abundance in the region. The exceptionally low number of *D. genutia* in SLS may be due to their preference of different overwintering sites (to be discussed in Further Studies).

(iii) Sex ratios of *Euploeas*

The sex ratios of overwintering Danaids are various. Crolla and Lafontaine (1996) observed a 1:1 ratio for *D. plexippus* in Canada while Oberhauser (1997) observed a female-biased sex ratio in Mexico. For *E. core* in Australia the intrinsic sex ratio, there were twice as many males as females (ABC Online, 2000). Nevertheless, in the present study, both *E. midamus* and *E. core* have an equal sex ratio. Although the intrinsic sex ratio, sex-specific behaviour and the difference in mortality (Knight *et al*., 1996) may affect the final sex ratio of the overwintering butterflies, it is believed that sex ratios are specific to species and the migration population. Owing to the lack of information about the sex ratios of local butterflies, further comparisons could not be made. However, the estimated sex ratios for the *Euploeas* in SLS could be valuable information for the reference of other studies on local butterfly populations.

(iv) Population dynamics

Although only the population sizes of *Euploeas* were estimated using MARK, the sum of these figures may be considered as a close approximation of the total number of Danaids in SLS in that the *Euploeas* have accounted for 95% of the captured butterflies. The total number of individuals ranged from 32,500 to 45,000 over the study period and is comparable to that estimated by Young in 2001 (>30,000).

The changes in population over time can also be used to infer the arrival pattern of the butterflies (Knight *et al.* 1999). Base on Figure 5, most *E. midamus* arrived at SLS between 15 to 21 Nov 02 and there was no further increase in number afterwards. It is therefore apparently that this species arrived at the overwintering site in a single wave. In contract, the two peaks in the population size (6 and 23 Dec 02) of *E. core* imply a two-wave arrival pattern of the species.

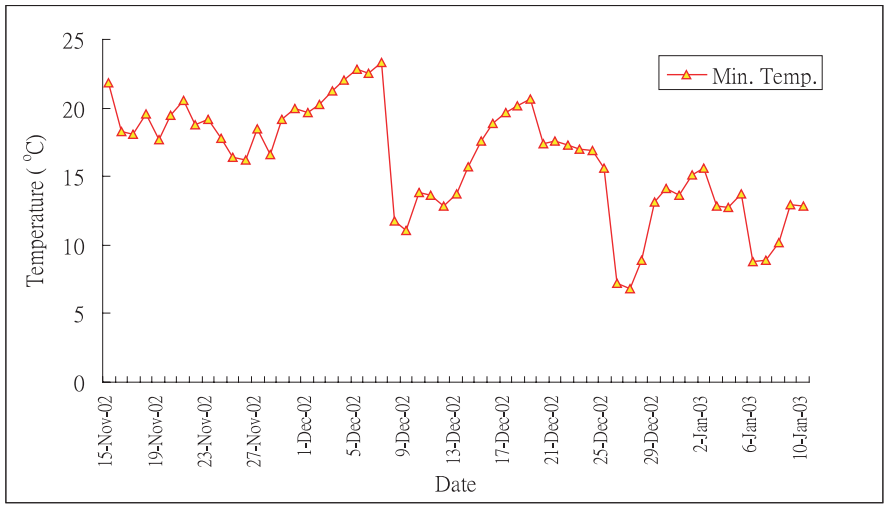

Figure 7: The changes in the minimum air temperature (Source: Hong Kong Observatory)

Air temperature has been considered as an important factor for butterfly overwintering activities (Yiu, 2003) and weather pattern like cold fronts could result in butterfly mortality (Schappert, 1996). Therefore, the population changes were compared against the daily minimum air temperature (Figure 7) over the study period. There were two drastic changes in the minimum air temperature, one from 23.3˚C (7 Dec 02) to 11.8˚C (8 Dec 02) and the other from 15.6˚C (25 Dec 02) to 7.2˚C (26 Dec 02). As the weaker butterflies may be more susceptible to drastic temperature changes, the first cold front may have caused the mortality of the weaker butterflies in the overwintering aggregate and resulted in a sharp drop in the population. The remaining butterflies were stronger ones that could endure fluctuation in air temperature and therefore the second cold front had not caused significant drop in population again.

Conclusion and Recommendations

This study has confirmed SMCP as a transitional stop and TLCP is likely to be another on the migration route of overwintering butterflies. Within the protected area system, these Country Parks do not suffer from development pressure or severe disturbance. To enhance the habitats as the transitional stops for migrating butterflies, it is recommended that more winter-flowering vegetation like Ivy Trees and Paper-bark Trees (白千層*Melaleuca quinquenervia*) should be planted to provide more nectar sources for the migrating butterflies.

SLS is believed to be the largest butterfly overwintering site in Hong Kong and has been used by Danaids since 1999. The estimated number of overwintering individuals was over 40,000 in 2002/03. The site is currently covered by the Tuen Mun Outline Zoning Plan and is zoned as "Green Belt". As there is a general presumption against development in the "Green Belt" zone, development within this zone will be carefully controlled. It is recommended that AFCD should continue to monitor the overwintering butterfly aggregate. If SLS is proved to be a permanent butterfly overwintering site, subject to the advice of other relevant authorities, AFCD should explore the possibility of designating SLS as a SSSI to highlight its scientific significance and render the site suitable protection status. In the mean time, any proposed development in the vicinity of SLS should be kept in view and potential impacts to the viability of the overwintering site should be carefully assessed.

Further Studies

After overwintering, the butterflies usually leave the site within a very short period of time. Although it is believed that the butterflies would mate and lay eggs in other localities, little is known about their pattern of dispersal and the final destinations. Since the success in encountering their larval food plants would greatly affect the population in the coming year, the post-overwintering migration of the butterflies may need to be studied to locate the important breeding sites, if any, of the butterflies.

Fan Lau is another butterfly overwintering site with more than 5,000 individuals (Yiu, 2003). The site was visited on 26 Nov 02 and about 350 *D. genutia*, and small numbers of *E. midamus*, *E. core* and *T. limniace* were observed. *D. genutia* seemed to be the major species (>70%) and its preference of Fan Lau may explain why only small number of *D. genutia* was observed in SLS. Without doubt, conducting capture-mark-recapture experiments in Fan Lau could help understand the overwintering population better and assess the importance of this overwintering site.

Acknowledgements

The authors cordially thank Ms. Camill S. Y. Lok of EPD and her staff for their assistance throughout the study at SLS.

References

Australian Broadcasting Corporation Online, 2000. Butterflies take a winter break. http://www.abc.net.au/science/scribblygum/July2000/

Baguette, M., C. Vansteenwegen, I. Convi and G. Nàove, 1998. Sex-biased density-dependent migration in a metapopulation of the butterfly *Proclossiana eunomia*. *Acta Oecologia*, 19(1): 17-24.

Chan, K., 1939. Butterfly swarming in "Butterfly Valley". *The Hong Kong Naturalist*, 9: 165-166.

Crolla, J.P. and J.D. Lafontaine. 1996. Status report on the monarch butterfly (*Danaus plexippus*) in Canada. Canadian Wildlife Service Website. 24 pp. http://www.monarchwatch.org/read/articles/canmon1.htm

Gibo, D. L. and J. M. McCurdy, 1993. Lipid accumulation of migrating Monarch butterflies (*Danaus plexippus* L.). *Canadian Journal of* Zoology, 71(1): 76-82.

Knight, A., L. P. Brower and E. H. Williams, 1999. Spring remigration of the monarch butterfly, *Danuas plexippus* (Lepidoptera: Nymphalidae) in north-central Florida: estimating population parameters using mark-recapture. *Biological Journal of the Linnean Society*, 68: 531-556.

Lee, J. Y. and H. Y. Wang, 1997. *Migration and overwinter aggregations of nine Danaine buttrefly species in Taiwan*. Taiwan Museum, Taipei.

Mousson, L., G. Nàove and M. Baguette, 1999. Metapopulation structure and conservation of the cranberry fritillary *Boloria aquilonaris* (Lepidoptera, Nymphalidae) in Belgium. *Biological Conservation*, 87: 285-293.

Oberhauser, K., 1997. Mexico Trip Report. http://www.learner.org/jnorth/1997/critters/monarch/KarenOMarch18.html

Pradel, R., 1996. Ultilization of Capture-Mark-Recapture for the Study of Recruitment and Population Growth Rate. *Biometrics*, 52(2): 703-709

Schappert, P. J., 1996. Distribution, Status and Conservation of the Monarch butterfly, *Danaus plexippus* (L.), in Canada. Consultant's Report (NAFTA) submitted to the Commission for Environmental Cooperation, Montràmal, Quàmbec, 20 pp. http://www.esb.utexas.edu/philjs/Monarch/monrep97.html

Schappert, P. J. & J. S. Shore, 1998. Ecology, population biology and mortality of *Euptoieta hegesia* Cramer (Nymphalidae) on Jamaica. *Journal of the Lepidopterists' Society*, 52: 9-39.

White, G.C. and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. *Bird Study*, 46 Supplement: 120-138.

Yiu, V., 2003. *The Winter Butterfly Valley of Hong Kong*. Hong Kong: Hong Kong Lepidopterists' Society. (In Chinese: 香港的冬天蝴蝶谷)

Young, J. J., 2001. Record Euploeas hibernating at Siu Ling Shui, Tuen Mun. http://hkls.org/news/roosting/roosting.htm

Young, J. J., and V. Yiu, 2002. *Butterfly Watching in Hong Kong*. Wan Li Book Co. Ltd. Hong Kong.

Article Review

Endemic Bird Species of China and Their Distribution

Eric Liu, Bird Working Group

本文節錄一篇關於中國特有鳥類的文章。文中列舉了100種中國特有種，其中六種曾在香港有記錄，包括常見的留鳥白頭鶇、畫眉和夏候鳥海南藍仙鶲。

A list of 100 endemic China bird species, belonging to 53 genera and 16 families, was consolidated from various existing lists by Lei (2002). The selected species include those that are restricted within China, or those that breed mainly in China but are occasionally seen in other places, with no sub-species in nearby areas.

Lei (2002) processed distribution data for these endemic birds using Geographic Information System (GIS). This indicated three "centres of endemism" for the birds of China, namely the "Hengduanshan areas" (橫斷山脈), the "mountain areas in north Sichuan Province, Qinling and south Gansu Province" (川北、秦嶺及隴南山地), and "Taiwan Island" (台灣島嶼). Each of these three areas had about 20 endemic bird species. In terms of zoogeographical regions, most of these endemic birds are found in sub-montane, montane and plateau regions, ranging from an altitude of 1800m - 2900m.

Six of the 100 endemic birds of China have been recorded in Hong Kong, and these are listed in Table 3. Of particular interest to Hong Kong is the Hainan Blue Flycatcher which is the only summer visitor with breeding records in Hong Kong. Apart from this species, Chinese Bulbul and Hwamei are common and widespread resident bird species in Hong Kong. The other three endemic birds are irregular and rare visitors. As most of the endemic birds of China are found at altitudes between 1800 - 2900m, the small number of such birds in Hong Kong may be the result of its lower relief compared to the typical habitat requirements of these birds.

References

Carey, G.J., Chalmers, M.L., Diskin, D.A., Kennerley, P.R., Leader, P. J., Leven, M.R. Lewthwaite, R.W., Melville, D.S., Turnbull, M., Young, L., 2001. *The Avifauna of Hong Kong*. Hong Kong Bird Watching Society, Hong Kong.

Lei, F.M., Lu, J.L., Liu, Y., Qu, Y.H.,Yin, Z.H., 2002. Endemic Bird Species to China and Their Distribution. *Acta Zoologica Sinica*, 48(5): 599-610. (In Chinese, with English abstract).

Table 3. Endemic birds of China that have been recorded in Hong Kong

Species Name	Common Name	Chinese Name	Status in HK[1]
Pycnonotus sinensis	Chinese Bulbul	白頭鶇	Abundant resident with increased numbers in winter.
Garrulax canorus	Hwamei	畫眉	Common and widespread breeding resident.
Phylloscopus sichuanensis	Chinese Leaf Warbler	四川柳鶯	A sole record of a trapped bird at KFBG in 1997.
Niltava davidi	Fujian Niltava	棕腹大仙鶲	Rare winter visitor.
Niltava hainana	Hainan Blue Flycatcher	海南藍仙鶲 (海南藍鶲)	Uncommon summer visitor, passage migrant and rare winter visitor.
Parus venustulus	Yellow-bellied Tit	黃腹山雀	Irregular and rare irruptive winter visitor.

[1] Carey *et al.* (2001)

Working Group Column

Kandelia obovata (Rhizophoraceae), a new name for the Kandelia in Hong Kong
秋茄樹(紅樹科)的新學名

Joseph Yip & Patrick Lai, Hong Kong Herbarium

植物分類學家最近根據染色體、份子分支地理區系、生理適應性及葉解剖結構等多方面証據，發現以南中國海為界，秋茄(*Kandelia*)可分為兩個種群系，代表秋茄屬內兩個品種：(1)南中國海以南及以西的種群系，分布北婆羅洲、馬來半島、泰國、緬甸及印度(模式標本產地，因此本種保留原學名*Kandelia candel*)；(2)南中國海以北的種群系，分布於越南北部、海南島、香港、廣東、福建、台灣及日本南部，被定為新種。它具倒卵形的葉片，新學名是*Kandelia obovata*。經過審閱香港植物標本室所藏採於香港的秋茄樹標本及最近野外觀察所得的初步結論，香港秋茄樹種群的特徵均與新發表文獻所描述的*K. obovata*相符。

Figure 8: Leaves of *Kandelia obovata* in Hong Kong.

Kandelia is the most common mangrove plant in Hong Kong. It is widely distributed from western and eastern India, Burma, through the South China Sea region to southern China and southern Japan. The species, first discovered in Malabar, India, was named "Tsjerou-kandel" by van Rheede in 1686. Carl Linnaeus, the father of taxonomy, named it *Rhizophora candel* as its hypocotyl resembles a candle (as the Latin word "candel" suggests). Until recently, it had the name *Kandelia candel* and was recognized as the monotypic species of the genus.

Figure 9: Hypootyls of *Kandelia obovata* in Hong Kong.

Based on the recent studies in molecular phylogeography (Huang & Chen, 2000; Chiang *et al*., 2001), chromosome number, physiological adaptation and leaf anatomy, botanists found that there existed two distinct geographical population groups of *Kandelia* separated by the South China Sea. The population group to the south and west of the South China Sea (i.e. from India, Burma, Thailand, Malay Peninsula to northern Borneo), to which the type specimen belongs, retain the scientific name *Kandelia candel*. The northern group (i.e. from northern Vietnam, Hainan, Hong Kong, Gunagdong, Fukien, Taiwan to southern Japan) was recognized as a distinct species by Sheue *et al*. (2003), who described and named the new species *Kandelia obovata*, apparently for the obovate leaves.

Previous studies demonstrated that chromosome numbers of *Kandelia* differ between populations in Japan (i.e. currently considered as *K. obovata*) and India (*K. candel*), which were reported as 2n=36 (Yoshioka *et al*., 1984) and 2n=38 (Das *et al*., 1995) respectively. In addition, differences in their tolerance to cold have also been reported in *Kandelia* populations from different regions. Maxwell (1995) considered that local natural populations of *Kandelia* species (i.e. currently considered as *K. obovata*) were able to survive cold winter and reproduced well in Hong Kong, while transplants from Brunei and Thailand (*K. candel*) to the same site in Hong Kong had only 33% of survival and no fruit was produced during the same period. Similar tolerance of cold in *Kandelia* populations has also been reported in Japan and China.

Besides the above differences in physiological feature and chromosome number, *Kandelia obovata* can also be distinguished from *Kandelia candel* by several external morphological features. Table 4 summarizes some of the major differences between the two species and the characteristic features of *Kandelia obovata* are illustrated in Figures 8 to 10.

Our preliminary examinations on the specimens kept in the Hong Kong Herbarium and recent observations in the field revealed that the populations of *Kandelia* occurring in Hong Kong matched the key characters of *Kandelia obovata* as described by Sheue *et al.* (2003). In this connection, the proper taxonomic citation for the *Kandelia* in Hong Kong should be "*Kandelia obovata* Sheue, Liu and Yong (*Kandelia candel* auct. non (L.) Druce)". Perhaps next time when you are out in the field, you may look for such key characters of *Kandelia* and see if you come to the same conclusion. If you find two distinct *Kandelia* species in Hong Kong, please collect a specimen for the herbarium. Another issue to be followed up is providing the corresponding Chinese names for the two species. At present there is only one *Kandelia* species in Chinese speaking regions. Perhaps, we could still apply the same Chinese name (秋茄樹，亦稱水筆仔) for *Kandelia obovata* for the time being.

Figure 10: Lateral veins of *Kandelia obovata* in Hong Kong.

References

Chiang, T. Y., Chiang, Y. C., Chen, Y. J., Chou, C. H., Havanond, S., Hong T. N. and Huang, S., 2001. Phylogeography of *Kandelia candel* in East Asiatic mangroves based on nucleotide variation of chloroplast and mitochondrial DNAs. *Molecular Ecology* 10: 2697-2710.

Das, A. B., Basak, U. C. and Das, P., 1995. Karyotype diversity and genomic variability in some Indian tree mangroves. *Caryologia* 48: 319-328.

Huang, S. and Chen, Y.-C., 2000. Patterns of genetic variation of *Kandelia candel* among populations around South China Sea. In: Chiang, T. Y. & Hsu, T. W. (eds.), *Wetland Biodiversity, Proceedings of Symposium of Biodiversity in Wetlands*, pp. 59-64. Taiwan Endemic Species Research Institute, Nantou.

Maxwell, G. S., 1995. Ecogeographic variation in *Kandelia candel* from Brunei, Hong Kong and Thailand. *Hydrobiologia* 295: 59-65.

Sheue, C.-R., Liu, H.-Y. and Young, J.W.H., 2003. *Kandelia obovata* (Rhizophoraceae), a new mangrove species from Eastern Asia. *Taxon* 52: 287-294.

Yoshioka, H. Kondo, K., Segawa, M., Nehira, K. and Meada, S., 1984. Karyomorphological studies in five species of mangrove genera in the Rhizophoraceae. *Kromosomo* 35-36: 1111-1116.

表四、 兩種秋茄屬植物部份特徵的比較 (取材自 Sheue *et al.* [2003])
Table. 4. Comparison of key characters between *Kandelia candel* and *K. obovata* (extracted from Sheue *et al.* [2003])

Species 種名	*K. candel*	*K. obovata*
Leaf 葉	Elliptic-oblong to oblong-lacneolate, 6-16 cm x 3-6 cm 橢圓狀長圓形至長圓狀披針形，長 6 至 16 厘米，闊 3 至 6 厘米	Obovate to obovate-elliptic, very rarely obovate-oblong, 6-12 cm x 2.5-5 cm 倒卵形至倒卵狀橢圓形，稀為倒卵狀長圓形，長 6 至 12 厘米，闊 2.5 至 5 厘米
Lateral veins 側脈	Mostly 8-11 (or 13) pairs 多為 8 至 11(或 13)對	Mostly 5-8 pairs 多為 5 至 8 對
Sepal 萼片	Light green (abaxial side) when blooming, 1.4-1.6 cm x 1.9-2.1 mm 花開時下面淺綠色，長 1.4 至 1.6 厘米，闊 1.9 至 2.1 毫米	White (abaxial side) when blooming, 1.5-1.9 cm x 2.5-3.0 mm 花開時下面白色，長 1.5 至 1.9 厘米，闊 2.5 至 3.0 毫米
Hypocotyl 下胚軸	20-40 cm long, 0.7-0.9 cm at the broadest part: apex attenuate 長 20 至 40 厘米，最闊處為 0.7 至 0.9 厘米：先端鈍	15-20 (-23) cm long, 0.9-1.4 cm at the broadest part; apex acuminate 長 15 至 20(或 23)厘米，最闊處 0.9 至 1.4 厘米：先端漸尖
Tree height 樹高	Up to 7 m tall 高達 7 米	Up to 3 m tall 高達 3 米

Summer Breeding and Winter Night Roosting Sites of Egrets in Hong Kong 2003

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Introduction

In Hong Kong, there are five colonial breeding Ardeid species, including Little Egret (LE, *Egretta garzetta*), Great Egret (GE, *Egretta alba*), Cattle Egret (CE, *Bubulcus ibis*), Black-crowned Night Heron (NH, *Nycticorax nycticorax*) and Chinese Pond Heron (CPH, *Ardeola bacchus*). The number of breeding pairs/active nests in the colonies of the Hong Kong Ardeids have been monitored from the early 1950's (Young and Cha, 1995). In 1998, a systematic and territory-wide monitoring programme of egret breeding sites (egretries) was begun, and since then it has been conducted by the Hong Kong Bird Watching Society (1998-) and later also the Agriculture, Fisheries and Conservation Department (2002-).

This paper presents the number of active nests and/or breeding pairs of Ardeids in all known and newly identified egretries in Hong Kong, surveyed in the summer 2003. The paper also presents the preliminary Ardeid counts in their night roosting sites in winter 2002/03.

Results and Discussion

Summer Breeding Sites of Ardeids

In total 1,008 nests or breeding pairs of the five Ardeid species were found at 25 active egretries, in a survey made from 6 May to 24 June 2003, and with the Shuen Wan egretry separately surveyed on 4 August 2003 (Table 5). The number of nests/breeding pairs remains high, this being the third survey with records of over 1,000 Ardeid nests in the last 10 years (Young and Cha, 1995; Tsim, 2002). Four sites including Tuen Mun Nullah, Tai Tong, Ha Che (site C) and Pat Heung Road/Tsing Long Highway Junction were newly recorded and listed as new breeding sites in 2003. The Shuen Wan egretry was found to be re-used this year, after having been abandoned for several years. However, Shing Uk Tsuen egretry, which had been established in the 2001 summer (Wong and Kwok, 2002) was now abandoned.

Table 5 shows the number of nests of Ardeids species recorded at individual egretries. Compared to the total count of active nests in the 2002 summer (Tsim, 2002), there is a 10% decrease in nests/pairs for 2003. The

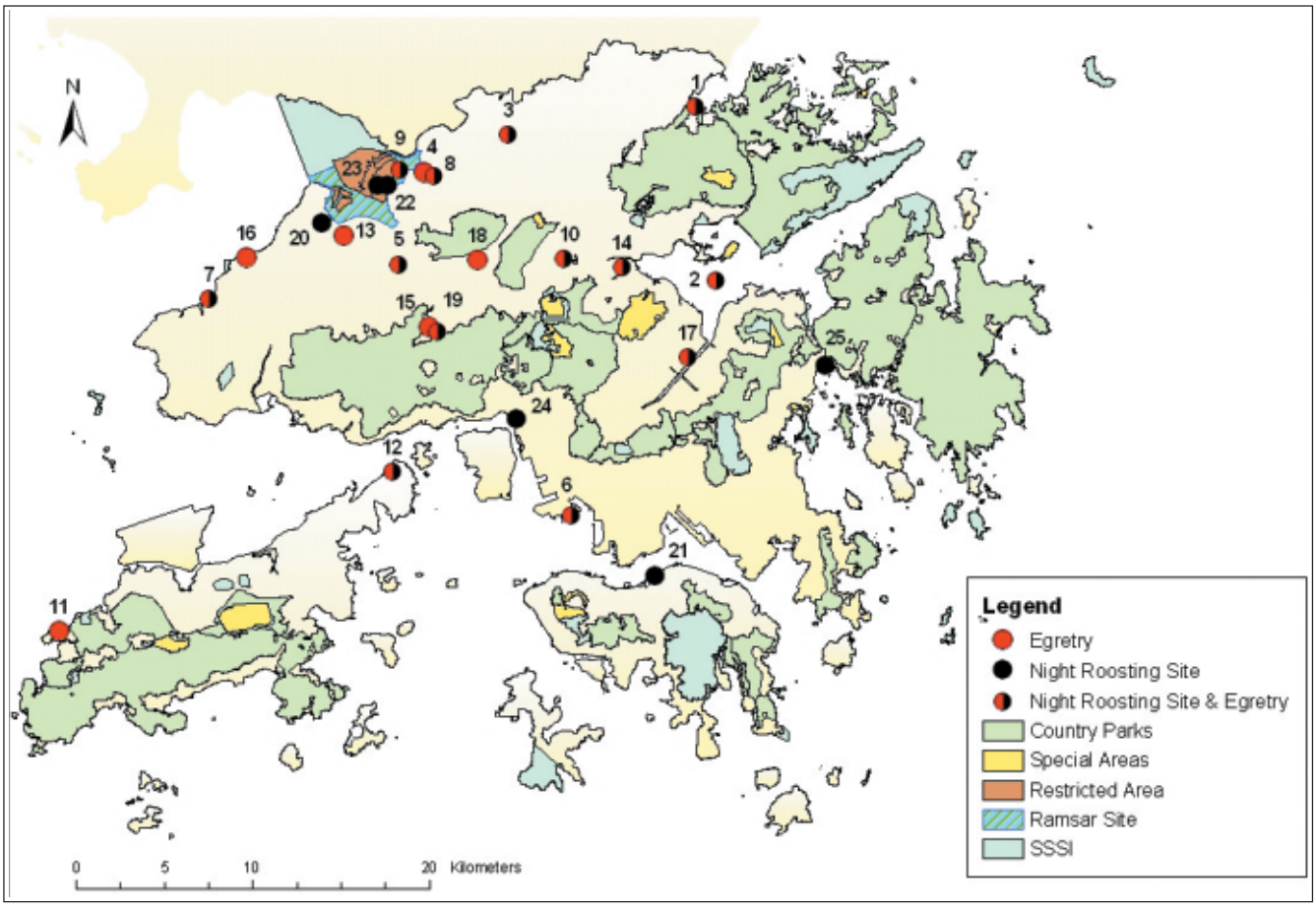

Figure 11: Locations of the egretries and night roosting sites. Key: 1. A Chau; 2. Centre Island; 3. Ho Sheung Heung; 4. Mai Po Tsuen; 5. Tung Shing Lei; 6. Stonecutters Island; 7. Ha Pak Nai; 8. Mai Po Lung Tsuen; 9. Tam Kon Chau; 10. Lam Tsuen San Tsuen; 11. Tai O; 12. To Kau Wan; 13. Shing Uk Tsuen; 14. Tai Po Market; 15. Ma On Kong; 16. Ngau Hom Shek; 17. Penfold Park; 18. Ha Che; 19. Ho Pui; 20. Fung Lok Wai; 21. Causeway Bay; 22. Waterfowl Collection Pond, MPNR; 23. Gei Wai 13, MPNR; 24. Tsuen Wan; 25. Sha Ha

Table 5. Number of Ardeids active nests or breeding pairs, at surveyed breeding sites in Hong Kong in summer 2003 (ranked by total number of active nests or breeding pairs).

Location (Date of survey)	Number of active nests or breeding (% of nest/breeding pair)						Counts in 2002
	LE	GE	CE	NH	CPH	Total	
A Chau (13 May 2003)	21 (7.3%)	28 (40%)	48 (55.2%)	199 (83.6%)	0 (0%)	296 (29.5%)	400 (35.8%)
Ho Sheung Heung (9 May 2003)	21 (7.3%)	0 (0%)	8 (9.2%)	0 (0%)	85 (26%)	114 (11.4%)	92 (8.2%)
Tam Kon Chau (6 May 2003)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	85 (26%)	85 (8.5%)	42 (3.8%)
Centre Island (14 May 2003)	24 (8.4%)	27 (38.6%)	4 (4.6%)	22 (9.2%)	0 (0%)	77 (7.7%)	97 (8.7%)
Tung Shing Lei (6 May 2003)	41 (14.3%)	0 (0%)	0 (0%)	0 (0%)	18 (5.5%)	59 (5.9%)	52 (4.7%)
Mai Po Village (6 May 2003)	44 (15.4%)	2 (2.9%)	6 (6.9%)	0 (0%)	0 (0%)	52 (5.2%)	91 (8.1%)
Ha Pak Nai (9 May 2003)	37 (12.9%)	4 (5.9%)	0 (0%)	0 (0%)	1 (0.3%)	42 (4.2%)	44 (3.9%)
Mai Po Lung Tsuen (6 May 2003)	9 (3.1%)	0 (0%)	0 (0%)	0 (0%)	27 (8.3%)	36 (3.6%)	44 (3.9%)
Penfold Park (14 May 2003)	17 (5.9%)	7 (10%)	2 (2.3%)	5 (2.1%)	2 (0.6%)	33 (3.3%)	11 (1.0%)
Tuen Mun Nullah (21 May 2003)	27 (9.4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	27 (2.7%)	0 (0%)
Tai Tong (19 May 2003)	1 (0.3%)	0 (0%)	3 (3.4%)	0 (0%)	21 (6.4%)	25 (2.5%)	0 (0%)
Ha Che - site B (28 May 2003)	0 (0%)	0 (0%)	1 (1.1%)	0 (0%)	20 (6.1%)	21 (2.1%)	30 (2.7%)
Ha Che - site C (24 June 2003)	1 (0.3%)	0 (0%)	0 (0%)	0 (0%)	19 (5.8%)	20 (2.0%)	0 (0%)
Lam Tsuen Sun Tsuen (12 May 2003)	2 (0.7%)	0 (0%)	0 (0%)	0 (0%)	15 (4.6%)	17 (1.7%)	40 (3.6%)
Ha Che - site A (12 May 2003)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	17 (5.2%)	17 (1.7%)	9 (0.8%)
Tai O (15 May 2003)	12 (4.2%)	0 (0%)	0 (0%)	3 (1.3%)	0 (0%)	15 (1.5%)	23 (1.4%)
Ngau Hom Shek (9 May 2003)	8 (2.8%)	0 (0%)	0 (0%)	0 (0%)	6 (1.8%)	14 (1.4%)	15 (1.3%)
Ho Pui (12 May 2003)	0 (0%)	0 (0%)	14 (16.1%)	0 (0%)	0 (0%)	14 (1.4%)	6 (0.5%)
Stonecutters Island (by HKBWS)	10 (3.5%)	0 (0%)	0 (0%)	3 (1.3%)	0 (0%)	13 (1.3%)	24 (2.1%)
To Kau Wan (13 May 2003)	8 (2.8%)	1 (1.4%)	1 (1.1%)	0 (0%)	0 (0%)	10 (1.0%)	39 (3.5%)
Tai Po Market (14 May 2003)	2 (0.7%)	1 (1.4%)	0 (0%)	6 (2.5%)	0 (0%)	9 (0.9%)	19 (1.7%)
Shuen Wan (4 August 2003)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (1.8%)	6 (0%)	0 (0%)
Pat Heung Rd/Tsing Long Highway Junction (12 May 2003)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (1.2%)	4 (0.4%)	0 (0%)
Ma On Kong (12 May 2003)	1 (0.3%)	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)	2 (0.2%)	17 (1.5%)
Shing Uk Tsuen (9 May 2003)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	22 (2.0%)
Total in 2003 =	286 (100%)	70 (100%)	87 (100%)	238 (100%)	327 (100%)	1008 (100%)	
Total in 2002 =	411	102	82	270	252		1117 (100%)
% variation compared with the counts in 2002	- 30.4%	- 31.4%	+ 6.1%	- 11.9%	+29.8%	- 9.8%	

total number of nests of CPH increased while that of LE, GE and NH decreased. The number of nests of CE remained stable.

The largest egretries, supporting 60% or more of all the nests of the five Ardeid species and individual Ardeid species in summer 2003, also supported similar percentages of total nests in summer 2002 (Table 5). This indicated that the distribution of each breeding Ardeid species and the conditions of the major egretries remained stable. Table 5 shows that A Chau remained the most important egretry, supporting about 30% of total nests surveyed in Hong Kong. Moreover, A Chau also supported the highest number of nests of GE, CE and NH. On the other hand, the Mai Po Village egretry and Ho Sheung Heung egretry/Tam Kon Chau egretry supported the highest numbers of LE and CPH nests, respectively.

Preliminary Survey on Winter Night Roosting Sites of Ardeids

Monitoring of Ardeids in their winter night roosting sites indicates the estimated number of Ardeids inhabiting in Hong Kong during winter months. In winter 2002/03, 5,344 of five species of Ardeids were counted in 15 night roosting sites from 14 December 2002 to 20 February 2003 (Table 6). The three largest night roosting sites, in descending order of total counts, were Tam Kon Chau, Penfold Park and A Chau, which together accounted for 64% of Ardeids in winter (Table 6). LE and GE, each with more than 2,000 birds, contributed to over 90% of the Hong Kong resident Ardeids during winter months (Table 6). The number of CE, NH and CPH might, however, have been underestimated as they were less conspicuous in the evening.

It is noteworthy that Tam Kon Chau, Penfold Park, A Chau, To Kau Wan, Ha Pak Nai, Stonecutters Island and Ho Pui/Ma On Kong served as both winter night roosting and summer breeding sites. However, some breeding sites such as Centre Island, Lam Tsuen Sun Tsuen, Mai Po Lung Tsuen and Tung Shing Lei did not serve as night roosting sites - while some winter night roosting sites, like Fung Lok Wai, Causeway Bay, Waterfowl Collection Pond (Mai Po Nature Reserve), gei wai 13 (Mai Po Nature Reserve), Tsuen Wan and Sha Ha did not serve as breeding sites. The factor(s) affecting the selection of winter night roosting, and also summer breeding sites, by Ardeids in Hong Kong deserves further investigation.

Acknowledgements

The authors would like to thank Mr. L. C. Wong of Hong Kong Bird Watching Society to provide the counts of Stonecutters Island egretry and other valuable communications.

References

Tsim, S. T., 2002. Egretry Survey in Hong Kong 2002. *Hong Kong Biodiversity No. 3.* Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region.

Wong, L. C. and Kwok, H. K., 2002. *Egretry Counts in Hong Kong, with particular reference to the Mai Po Inner Deep Bay Ramsar Site: Summer 2001 report.* Hong Kong Bird Watching Society, Hong Kong.

Young, L. and Cha, M. W., 1995. The History and Status of Egretries in Hong Kong with Notes on those in the Pearl River Delta, Guangdong, China. *Hong Kong Bird Report 1994.* The Hong Kong Bird Watching Society, Hong Kong.

Table 6. Ardeid counts in the surveyed night roosting sites in winter 2002/03. The counting was conducted from 5:30 pm - 7:00 pm by two surveyors.

Location of Night Roosts (Date of survey)	LE	GE	CE	NH	CPH	Total
Tam Kon Chau* (7 Feb 2003)	876	1095	0	0	27	**1998**
Penfold Park* (17 Dec 2002)	324	429	0	5	1	**759**
A Chau* (28 Jan 2003)	309	402	0	0	0	**711**
Fung Lok Wai (21 Dec 2002)	100	290	0	0	0	**390**
To Kau Wan* (26 Dec 2002)	240	60	0	0	0	**300**
Ha Pak Nai* (20 Feb 2003)	225	57	0	0	14	**296**
Tai Po Market (28 Dec 2002)	230	0	0	0	0	**230**
Ho Sheung Heung (18 Feb 2003)	34	0	47	0	16	**97**
Causeway Bay (14 Jan 2003)	83	3	0	9	0	**95**
Waterfowl Collection Pond, MPNR (14 Dec 2002)	0	0	0	94	0	**94**
Stonecutters Island* (10 Feb 2003)	82	9	0	0	0	**91**
Gei wai 13, MPNR (14 Dec 2002)	0	0	0	0	74	**74**
Tsuen Wan (19 Dec 2002)	63	0	0	0	0	**63**
Sha Ha (Sai Kung) (16 Feb 2003)	40	10	0	0	0	**50**
Ho Pui/Ma On Kong* (19 Feb 2003)	2	0	14	0	12	**28**
Centre Island* (11 Feb 2003)	0	0	0	0	0	**0**
Lam Tsuen Sun Tsuen* (14 Feb 2003)	0	0	0	0	0	**0**
Mai Po Lung Tsuen* (17 Feb 2003)	0	0	0	0	0	**0**
Tung Shing Lei* (13 Feb 2003)	0	0	0	0	0	**0**
Total =	**2608**	**2355**	**61**	**108**	**144**	**5276**

*** The exact location of the winter night roost is also known as the breeding site of egrets in summer 2003.**

Preliminary Results of Trial Contraceptive Treatment with SpayVac™ on Wild Monkeys in Hong Kong

By CL WONG and Gary CHOW, Mammal Working Group

本署在 1999 年開始進行對野生猴子避孕處理的試驗，作為長遠控制本港猴子數目的方法。第一階段的試驗於新界北動物管理中心進行，為5隻雄性猴子以藥物注射方法阻塞輸精管使精子不能排出，其後於2001年再為7隻雌性猴子注射避孕疫苗。在 2002 年初，第一階段的試驗得到了初步的成效，於是署方再計劃把這項試驗推廣到野外作實地試驗，並先後取得了「郊野公園及海岸公園委員會」與「保護稀有動植物諮詢委員會」的同意，進行第二階段的野外試驗，而這項對野生猴子避孕處理的野外實地試驗也是全球首次在香港進行。

第二階段的野外試驗包括在金山郊野公園捕捉20隻雌性猴子進行避孕處理，雄性猴子則不限數目。當擒獲猴子後，會替牠們注射小量麻醉藥使牠們麻醉，然後進行避孕疫苗注射，又在耳朵打孔作記號及植入微型晶片以資識別，再注射預防狂犬病疫苗及杜蟲藥，最後抽取猴子的血液樣本作紀錄。待猴子的麻醉藥藥力消散蘇醒後，原地放回到所屬猴群。

第二階段的野外試驗在困難重重的情況下最後於 2002 年 10 月完成，在時間上比原定的計劃多用了 4 個月。而最困難的環節是在遊客眾多的金山郊野公園內捕捉活力強而具威嚇性的聰明野生猴子。

Background

The majority of the macaques in Hong Kong are rhesus macaques (*Macaca mulatta*). At present, a minority group of longtailed macaques (*Macaca fascicularis*) are still present in Kam Shan Country Park. Hybrid macaques are also commonly seen. In 1994, the species composition of the macaques in Kowloon Hills was: *M. mulatta*, 65.3%; *M. fascicularis*, 2.2%; hybrid 32.3% with a mean variance of 3.1. (Wong and Ni, 2000)

The first formal study of Hong Kong's macaques was completed by Charles and Karen Southwick in July and August, 1980 and 1981. Their main findings were: (1) The macaque population was 113 in 1981. (2) Three social groups were observed. (3) Three species and some hybrids were identified and they were *M. mulatta* (rhesus) 57.5%; *M. fascicularis* (longtailed) 25.7%; *M. fuscata* (Japanese macaques) 4.4%; and hybrids of possible mating 12.4%. Charles Southwick returned to Hong Kong in 1987, when he counted only 72 individuals, instead of the 113 in 1981, in the Kowloon Hills area. He suggested that urbanization, modernization and increased picnicking in the area had caused the decrease. (Southwick and Southwick, 1983; Southwick and Manry, 1987)

Figure 12: A cage trap with bait, surrounded by macaques. The alpha male macaque (on the fence) stopped the other macaques from going inside the cage.

Figure 13: A net-gun.

John Fellowes, sponsored by the World Wide Fund for Nature Hong Kong, found about 600 macaques in the Kowloon Hills area in 1991 and the macaque population was increasing at about 10% per year. The study suggested that intensive feeding by humans, and low mortality, were the main reasons for the rapid population increase. He recommended that the best way to control the long-term population growth, and to curb the risk of aggression towards visitors, was to prohibit or reduce macaque feeding by humans - and to increase the availability of natural food sources for the macaques. (Fellowes, 1992)

In later studies on Hong Kong's macaques, made in 1994, Wong and Ni (2000) estimated that there were 690 wild macaques - and that the population was increasing at 5.5 to 7.8% per annum. This increase in the macaque population, certainly unnatural, was mainly due to the continued feeding of macaques by humans in the Country Parks. To curb the unnatural and rapid growth of the

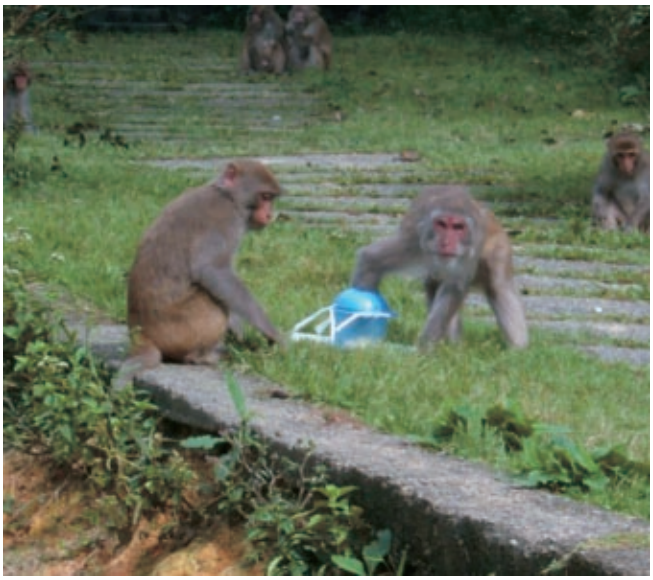

Figure 14: A food trap - note the narrow opening of the trap. When a monkey puts its hand into the trap and grasps the food inside, the hand will be too large to pull out.

Figure 15: Anaesthetics put into food - used under strict supervision of a Veterinary Officer

macaque population, a ban on feeding wild monkeys (and other wild animals) was implemented in July 1999.

In view of the continuous increase in the macaque population in Hong Kong - estimated by AFCD to be 1,450 in 2003, and expected to reach 2,000 by 2007 - AFCD has proposed in 1999 *A Plan for Managing Wild Monkeys in Hong Kong*, that in the long term a contraceptive programme for the wild macaques should be implemented.

The first trial of the contraceptive programme for the wild monkeys was initiated in AFCD's Animal Management Centre in 1999, when five male macaques were vasectomized by injecting the chemical at the epididymis, resulting in blockage of the vas deferens - thus making sperm absent from ejaculated semen.

A further trial was conducted in 2001, when seven female macaques were injected with a contraceptive vaccine named SpayVac™ (supplied by ImmunoVaccine Technologies Inc., Canada - web site: http://www.immunovaccine.com). SpayVac™ acts on the mammalian egg (oocyte). It stimulates the immune system of the female to produce antibodies that change the biochemical process on the outer layer of the egg, between zona pellucida and sperm, resulting in stopping sperm from penetrating into the egg (©ImmunoVaccine Technologies Inc., http://www.immunovaccine.com). As a result, male and females may have normal mating activities but without any egg being fertilized. Over the years, SpayVac™ has been applied to over 10 mammalian wildlife species including fallow deer, white-tailed deer, wolves, horses and seals - with a 90 - 100% effectiveness rate. (©ImmunoVaccine Technologies Inc., http://www.immunovaccine.com). Hong Kong is the first city to test SpayVac™ on macaques, and the first place in the world to conduct field trials of applying contraceptive vaccines to wild macaques.

The Field Trial

Hong Kong's first field trial on the contraceptive programme for wild macaques ran from March to October 2002. The aim of the trial was to capture 20 female macaques in Kam Shan and Lion Rock Country Park, and treat them with SpayVac™. Male macaques captured in the field were to be vasectomized by injection. Following the field operations, the behaviour, sociobiology and mating activities of the treated monkeys were monitored for two following mating seasons[1] - to check the effectiveness of the contraceptive vaccine, and to establish if there might be any side-effects on the macaques' social behaviour.

Capturing the monkeys was the most difficult and time-consuming part of the field trial. Precautionary measures had to be taken, such as to cordon off an area inside a Country Park for public safety, to protect staff from attacks by aggressive high-ranking males/females of macaque groups when an individual of the group was

Figure 16: A macaque caught by a snare.

[1] The mating season of wild macaques in Hong Kong starts in Mid-October and ends in March (peaking in December). The birth season starts in April and ends in early September (peaking in June).

Figure 17: Vets taking a blood sample from a sedated macaque.

trapped, to control traffic while the trapping was proceeding, and to control the Country park visitors watching the trapping operation.

Various methods were tried to capture macaques. These included cage traps, net-gun, putting anaesthetics in food, live decoys, dart-gun, food trap and snares. Most were unsuccessful or ineffective. The use of snares had the highest success rate, but even so only one macaque was trapped each time - and this might result in attacks by aggressive members in the group. Macaques in the Country Parks also learnt fast to avoid the traps. It would be very difficult to use the same method for a second time after a group of macaques had seen a previous member being trapped. After several capture operations, macaques could even recognize AFCD staff and vehicles. When they saw AFCD vehicles or staff, they would jump away quickly, hiding themselves in the nearby woods. As a result, more time was required for capturing macaques and the field trial was eventually completed in October 2002, 4 months later than planned.

Results

1. Trial in the Animal Management Centre

Antibody levels were checked for every female macaque treated with SpayVacTM. Six out of the seven treated animals were found with sufficient level of induced antibodies, which was believed to be able to stop fertilization of the ovum. The antibody level of the last treated female was only one-third of the previously treated females.

Semen of the vasectomized male macaques was checked and found to be sperm free. During the mating season of 2002, when fertile male macaques were allowed to stay with the treated female macaques normal mating activities were observed but no pregnancy resulted.

No baby macaque was born in the birth season of 2003 in the Animal Management Centre.

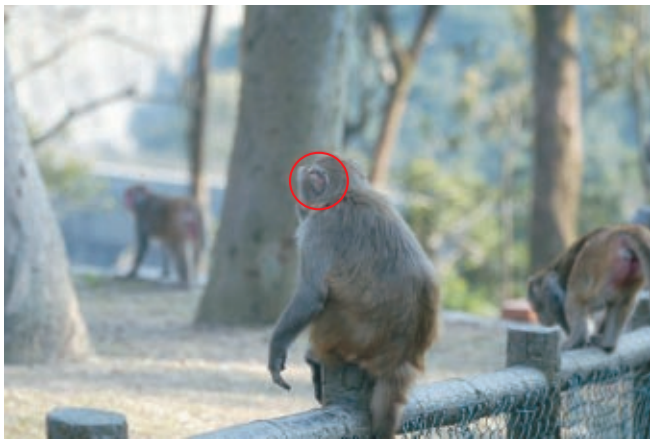

Figure 18: Treated macaque ID007 (female) seen in the field (the ear-mark is clearly seen and no baby is found.)

2. Field Trial at Kam Shan and Lion Rock Country Parks

Eleven treated female macaques and four treated males were seen again in the wild during a field monitoring programme. In the treated macaques normal sexual characteristics (e.g. swelling and reddening of the genitalia in mating season) were observed, but none of the treated female macaques were seen to be pregnant in the birth season. In addition, no newborn baby macaques were observed being held by treated female macaques.

Mating activities for both the treated male and females were observed to be normal, compared to other macaques. No apparent change of social status of the treated male macaques in its group was detected. Treated macaques interacted normally with other macaques in their group and group splitting/dropouts of treated macaques was not observed.

Extended Field Trial

As the initial results of the field trial of the contraceptive programme for wild macaques at Kam Shan and Lion Rock Country Parks were encouraging, and the contraceptive vaccine seemed effective, AFCD proposed in September 2003 to extend the field trial of contraceptive treatment to three other groups of macaques with a total of about 330 individuals. The aim of this extended field trial is to treat about 30 to 55% of the fertile females in the target groups, so that sufficient data on the population dynamics of the macaque groups can be obtained - to assist in developing a long-term plan on population control of wild macaques in Hong Kong.

To increase efficiency in capturing macaques, in early 2003 AFCD commissioned a joint project with the Hong Kong Productivity Council - to develop a large monkey cage trap, equipped with remote control. This large cage trap is equal in size to a 20 feet container (extendable to 28 feet) with gates open at both ends. Tree branches and camouflage leaves were placed inside, so that it looks reasonably like natural place. Fruits are placed in the middle of the cage; when monkeys come inside to get food, the gates are closed by remote control. This trap was found effective to capture as many as 19 macaques at one time.

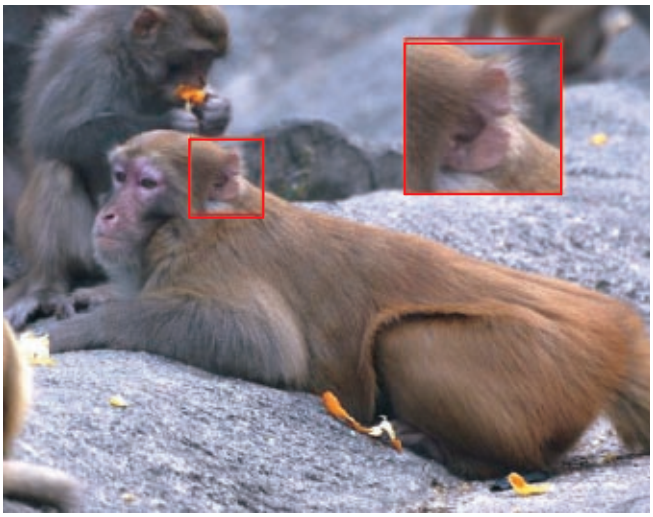

Figure 18: Treated macaque ID019 (male). Its status in the Ah Tsat group remains a high ranking male, even after the chemical vasectomy.

Figure 19: Monkeys enjoying a meal inside the big monkey cage trap produced by Hong Kong Productivity Council

With the help of this specially designed device, capturing macaques will be less time-consuming. Nevertheless, one has to wait for the macaques to enter the trap.

Acknowledgements

We wish to express our thanks to AFCD's Senior Veterinary Officer, Dr. David J. G. Burrows and Veterinary Officers Dr. Eric H. F. Tai and Dr. Kenny C. H. Ho. The project could not have been successful without their assistance. Dr. David J. G. Burrows initiated the project, and liaised with groups overseas. Dr. Eric H. F. Tai participated in capturing monkeys in the field, applying SpayVac™ to female macaques and conducting the chemical vasectomy to male macaques. Dr. Kenny C. H. Ho was responsible for applying SpayVac™ to female macaques kept in the Animal Management Centre, as well as checking the macaque blood serum and antibodies. We are also in debt to Dr. Brian C. W. Li who provided help in the initial stages. Finally, we wish to thank Mr. Edward Stokes for his assistance with technical editing, and officers from Country Parks and our Nature Wardens for their continuing supports in the project.

References

Fellowes, J. R. 1992. *Hong Kong Macaques: final report to the WWF Hong Kong projects committee*. Hong Kong, WWF.

Southwick, C.H., Manry, D. 1987. Habitat and population changes for the Kowloon macaques. *Primate Conservation* 8:48-49.

Southwick, C.H., Southwick, K.L.. 1983. Polyspecific group of macaques on the Kowloon Peninsula, New Territories, Hong Kong. *American Journal of Primatology* 5:17-24.

Wong, C.L., Ni, I-H. 2000. Population dynamics of the feral macaques in the Kowloon Hills of Hong Kong. *American Jounal of Primatology* 50:53-66.

Table 7: Summary of Observations for Treated Female Macaques, October 2002 - September 2003

ID	Species	Group	Estimated age	Weight (kg)	No. of times seen in the field	Sexual characteristics in mating season	Mating activities observed
004	Rhesus	鴨咀李	9	8.5	2	Y	Y
007	Rhesus	高腳七	12	7	3	Y	N
015	Rhesus	超人	3	2.5	2	-	-
017	Rhesus	高腳七	10	6.6	1	Y	Y
018	Rhesus	高腳七	10	7.5	1	Y	Y
020	Rhesus	超人	3	2.5	3	-	-
024	Rhesus	孖指	13	8.2	5	Y	Y
025	Rhesus	孖指	8	6.7	1	Y	Y
026	Rhesus	孖指	12	7.9	2	Y	Y
033	Rhesus	大舊	11	8.5	2	Y	N
034	Rhesus	孖指	8	6	2	Y	Y

Table 8: Summary of Observations for Treated Male Macaques, October 2002 - September 2003

ID	Species	Group	Estimated age	Weight (kg)	No. of times seen in the field	Sexual characteristics in mating season	Mating activities observed
003	Rhesus	鴨咀李	7	8.8	1	Y	Y
014	Rhesus	超人	3	2.4	1	-	-
019	Rhesus	高腳七	11	12	3	Y	Y
036	Rhesus	孖指	3	3	1	-	-

Remarks: Y = Yes; N = No; - = Not applicable (observation not in the mating season)