



Turtle Plastron Study Report 2006-09



**Fauna Conservation Department
Kadoorie Farm & Botanic Garden**

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Summary

A total of 6,951 whole turtle plastrons (the ventral shell), originating from an HKSAR Government confiscation, was measured by KFBG's Fauna Conservation Department between March 2006 and November 2008. The original seizure contained approximately 10,000 whole and broken turtle plastrons and took place on 17 Jan 2006. The shipment came from Java, Indonesia. All but 77 whole plastrons were identified, and comprised 2,253 Black Marsh Turtles (*Siebenrockiella crassicolis*), 4,588 Malaysian Box Turtles (*Cuora amboinensis*) and 33 Malaysian Giant Turtles (*Orlitia borneensis*).

For *S. crassicolis*, the median class range was 141 to 150 mm, both overall and for males and females; the largest specimens were females, up to 200 mm in length. For *C. amboinensis* the median class range was 161 to 170 mm, both overall and for males and females; the largest specimens were females, up to 220 mm in length. For *O. borneensis*, the median class range was 361 to 370 mm overall and for females, but for males the median class range was 421 to 430 mm and the largest plastron was of a male, just under 500 mm in length.

These observations indicate that the largest proportion of turtles being trapped at this time (probably late 2005) were relatively young adults, with juveniles, mature and old adults forming only a small part of the trapped population. The distribution patterns for both *S. crassicolis* and *C. amboinensis* plastron lengths were skewed normal distributions, with the large adults under-represented. The distribution of *O. borneensis* (from a much smaller sample) specimens indicated there were no large adults in the captured sample.

This single seizure represents just a small fraction of the massive trade in these species and clearly the trade in these wild chelonians is unsustainable.

Background

This project arose from a confiscation on 17th January 2006 by HKSAR Customs officers of 25 cartons (Figure 2) of turtle plastrons containing three CITES II listed species: *Cuora amboinensis* (Southeast Asian Box Turtle); *Siebenrockiella crassicollis* (Black Marsh Turtle) and *Orlitia borneensis* (Malaysian Giant Turtle) (Anon., 2006), which, upon request, the HKSAR Government's Agriculture, Fisheries & Conservation Department [AFCD] made available to Kadoorie Farm & Botanic Garden [KFBG] from March 2006 for scientific research purposes.

Four subspecies of *Cuora amboinensis* are currently recognised (Schoppe, 2009). Based on the point of shipment, it was assumed that the subspecies dealt with in this study is *C. a. couro* from Java and Sumatra.

Objectives

(1) The Fauna Conservation Department [FCD] of KFBG set out to undertake basic morphometric analysis of the three species of turtle from the confiscation in order to gain some idea of the population demographics of each species:

(2) FCD also aimed to provide data that may be used by researchers to establish the provenance of the turtles.

(3) To make the information obtained from this study available to the Chelonian research community.

Project Team

Kadoorie Farm & Botanic Garden:

Gary Ades (Project Co-ordinator), Roger Kendrick (supervisor; data compilation), Michael Lau (specialist advisor)

Collaborators

HKSAR Govt., Dept. of Agriculture, Fisheries & Conservation;
Hong Kong City University

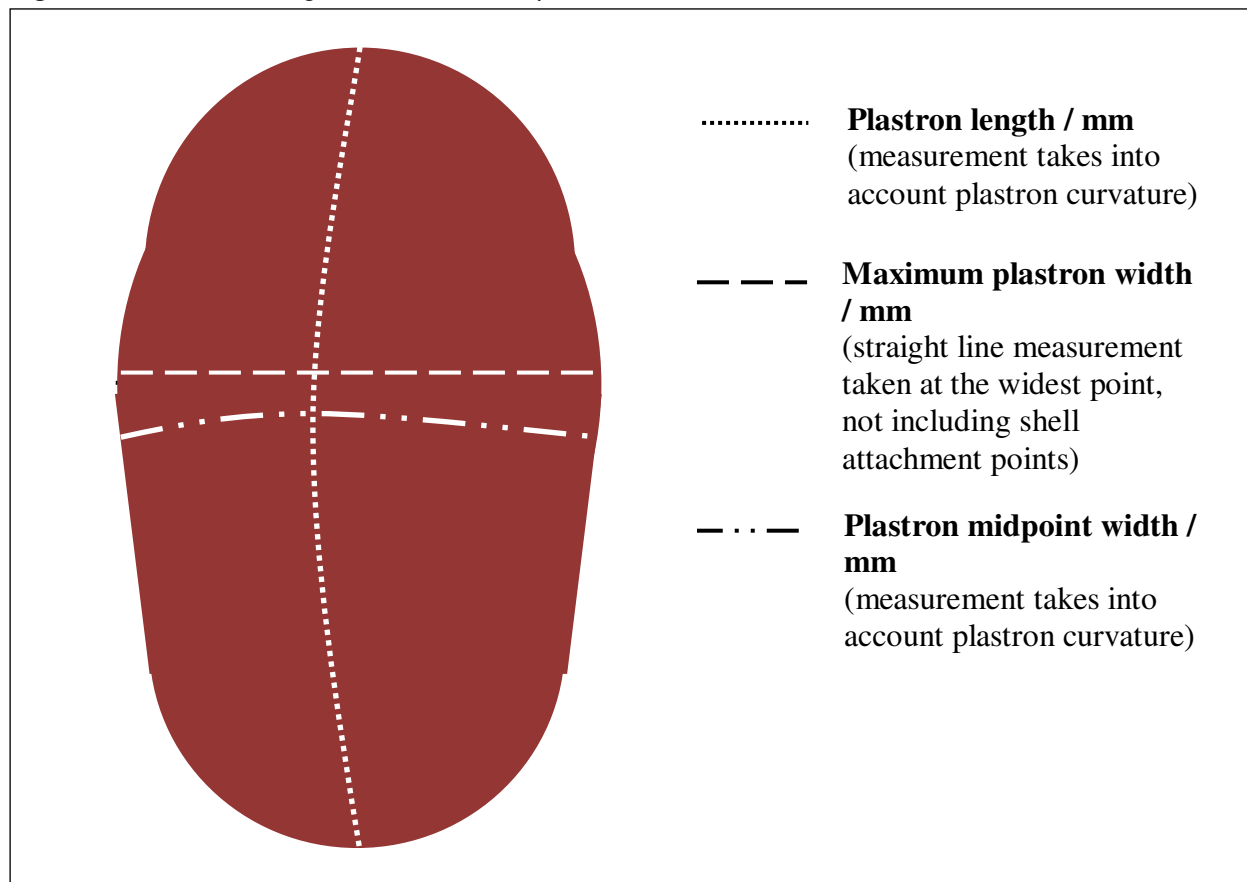
Plastron morphometric data collection methods

For complete plastrons (examples illustrated in Appendix 3), data from three measurements (Figure 1) to the nearest millimetre were collected: (1) the curved plastron length, (i.e. the length measured, taking into account any curvature in the plastron, using a tape measure; not the straight line length that would be measured with callipers), including notch tips for *S. crassicollis* and *O. borneensis*; (2) the curved width of the plastron at mid length using a tape measure, and (3) as an additional width parameter in case the width at midpoint was not the maximum width, the straight line maximum width of the plastron.

Also recorded were the sex of the plastron, i.e. male, or female or undetermined; measured by the degree of concavity / convexion of the plastron, with males being concave) and the relative age of the animal, i.e. juvenile (small, very “fresh” plastrons), sub-adult, or adult; based upon the degree of wear and length of the plastron, with smaller worn plastrons classified as adult, but smaller than median and much less worn plastrons classified as sub-adult). Determination of sex in a few cases was not clear; a small number of plastrons were classified “undetermined” as they did not show sufficiently strong concavity or convexion to be clearly male or female.

The measurements were made by volunteers (listed in Acknowledgements, see also Figure 4) between May 2006 and October 2008, under initial supervision. Each volunteer was given a 30 minute training session explaining and demonstrating what was to be recorded and also including an introductory talk about the project and its purpose. To minimise data collection transcription errors, data were collected on preformatted data sheets (Appendix 1), and the data transferred to a computer spreadsheet later. Each plastron was numbered (format XXX-YYY where XXX was the original packing box number and YYY represents the n^{th} plastron in the box XXX) immediately prior to its measurements being taken. Measured plastrons were repacked in large translucent plastic storage boxes (Figure 3). Morphometric data accuracy was checked by project staff who randomly selected a small sample (usually three or four plastrons) of volunteer gathered data after each data collection session. Data transfer onto computer was undertaken and double checked against the original data sheets.

Figure 1. Schematic diagram to show turtle plastron measurements taken.



For the purpose of this preliminary study, only descriptive analysis (non-statistical) has been undertaken to compare the distribution of sizes and sex ratios of each species.

Results

In total, 6,951 plastrons were measured, although 77 of these were not identified to species. The remaining 6874 comprised 2,253 *Siebenrockiella crassicollis*, 4,588 *Cuora amboinensis* and 33 *Orlitia borneensis*. The breakdown of each species according to age and sex is given in Tables 1 and 2, and depicted in pie chart form in Figure 5. Most plastrons (~75% for *S. crassicollis*, ~89% for *C. amboinensis* and ~94% for *O. borneensis*) appear to have come from adult turtles, though the *O. borneensis* specimens were substantially smaller than the maximum size of 800mm total length given by Ernst *et al.* (1997), thus it may be possible that some the *borneensis* plastrons classified as adult were from sub-adult turtles. There were slightly more females than males for *S. crassicollis* and *C. amboinensis*. Three-quarters of the *O. borneensis* were females.



Figure 2 (left).
Cartons of turtle
plastrons, as delivered
by AFCD: each carton
weighed between 35
and 40kg.



Figure 3 (right)
Measured plastrons
from one carton,
repacked into two
plastic boxes.

Figure 4 (below)
Volunteers recording
the morphometric data
of the turtle plastrons



Table 1. Age composition of plastrons

Age class	Species	<i>Siebenrockiella crassicollis</i>	<i>Cuora amboinensis</i>	<i>Orlitia borneensis</i>
Adult		1672	4094	31
Sub-adult		106	4	0
Juvenile		454	483	2
undetermined		21	7	0
total		2253	4588	33

Table 2. Sex composition of plastrons

sex	Species	<i>Siebenrockiella crassicollis</i>	<i>Cuora amboinensis</i>	<i>Orlitia borneensis</i>
Male		1053	2113	6
Female		1179	2460	26
undetermined		21	15	1
total		2253	4588	33

For each species, overall distribution of plastron lengths (Figures 6a, 7a & 8a) and comparison of male with female plastron lengths (Figures 6b, 7b & 8b) in 10mm class ranges were plotted.

For *S. crassicollis*, the median class range is 141 to 150mm, both overall and for males and females; the largest specimens were females, up to 200mm in length. The overall adult length is in the region of 200mm (Bonin *et al.*, 2006), rarely up to 340mm (Jenkins, 1995), thus the range of *S. crassicollis* plastron lengths observed in this study probably covers class sizes from juvenile to fully mature adult individuals.

For *C. amboinensis* the median class range is 161 to 170mm, both overall and for males and females; the largest specimens were females, up to 220mm in length. Maximum adult length is in the region of 220-250mm (Ernst *et al.*, 1997; Bonin *et al.*, 2006), thus the range of *C. amboinensis* plastron lengths observed in this study probably covers class sizes from juvenile to fully mature adult individuals.

For *O. borneensis*, the median class range is 361 to 370mm overall and for females, but for males the median class range is 421 to 430mm and the largest plastron was of a male, just under 500mm in length. It is noted that for *O. borneensis*, adults grow up to approximately 800mm in total length (Ernst *et al.*, 1997). From this small sample, it is clear that all the specimens were not of fully grown individuals and probably represent young adults.

The morphometric observations indicate that the largest proportion of turtles for all three species being trapped at this time (late 2005) were relatively young adults, with mature and old adults forming only a small part of the trapped population.

Figure 5.

Pie charts illustrating proportions of adults to juveniles and sexes (with actual counts given) from the measured plastrons of (a) *Orlitia borneensis*, (b) *Cuora amboinensis* and (c) *Siebenrockiella crassicollis*.

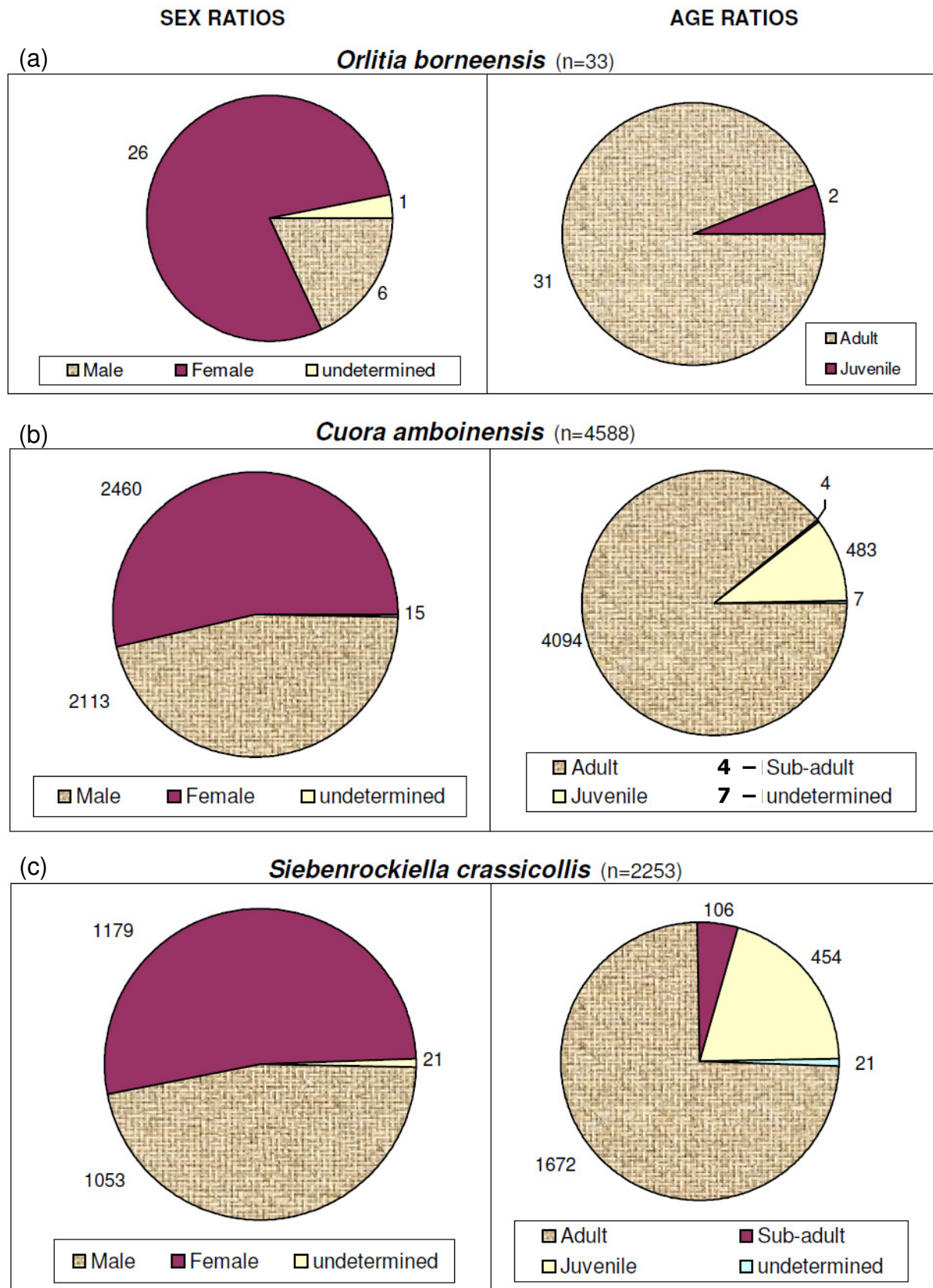


Figure 6. Size distributions of *Siebenrockiella crassicollis* turtle plastrons: (a) overall and (b) classed by sex.

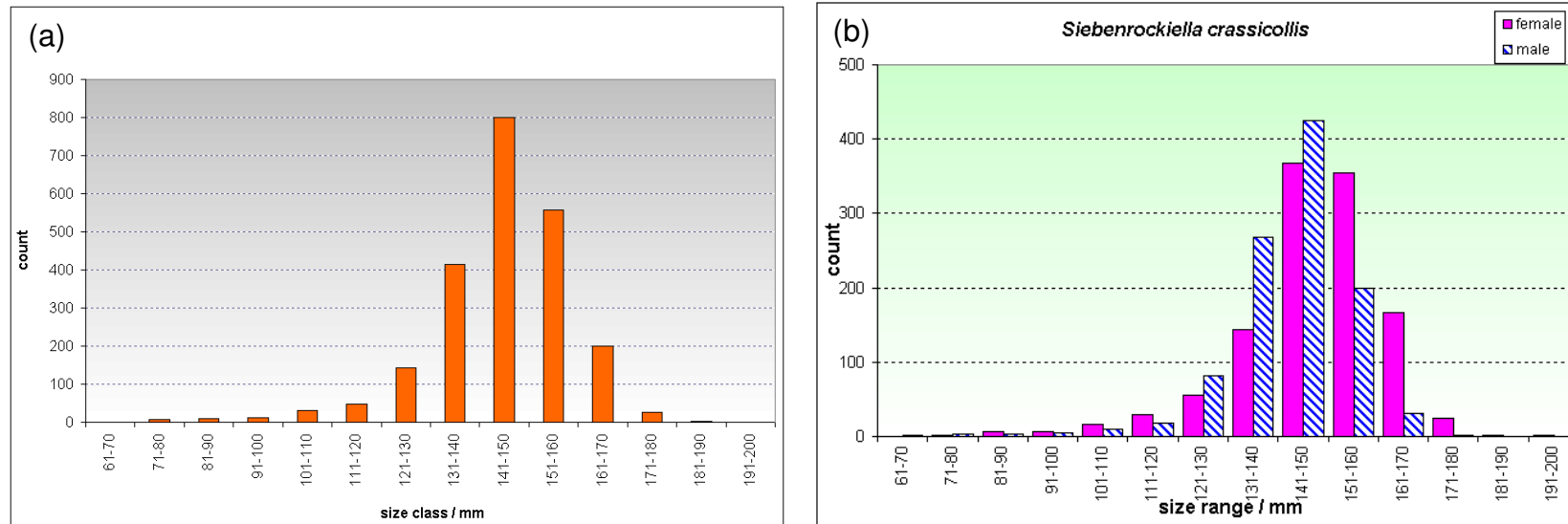


Figure 7. Size distributions of *Cuora amboinensis* turtle plastrons: (a) overall and (b) classed by sex.

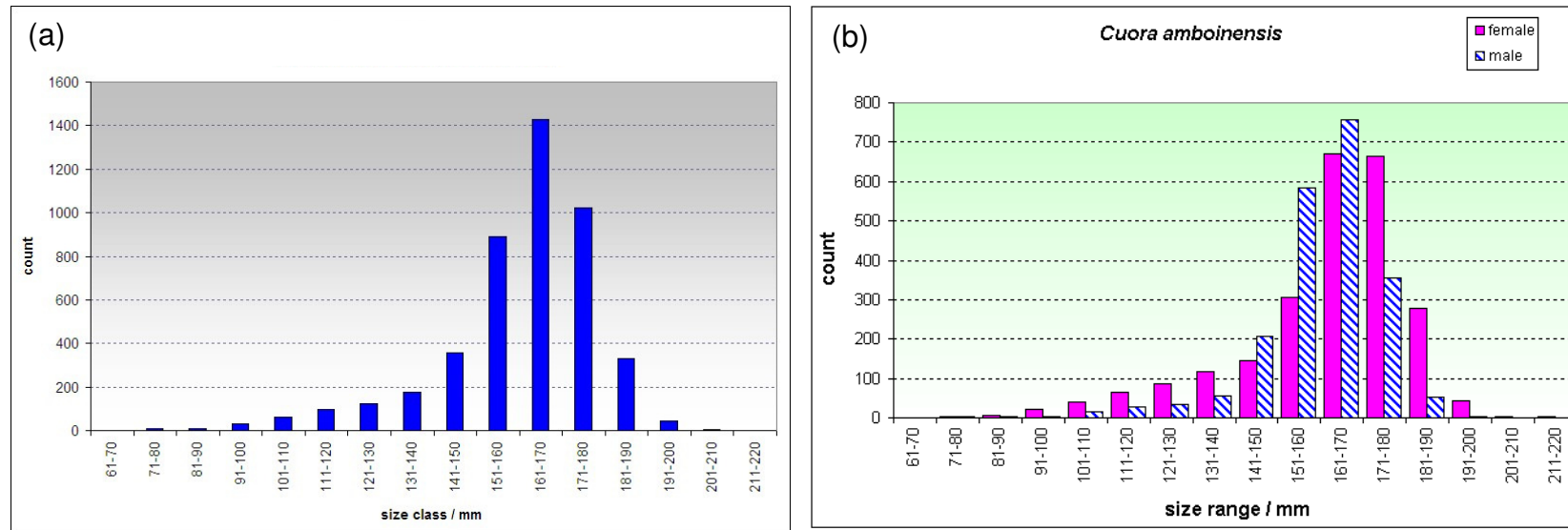
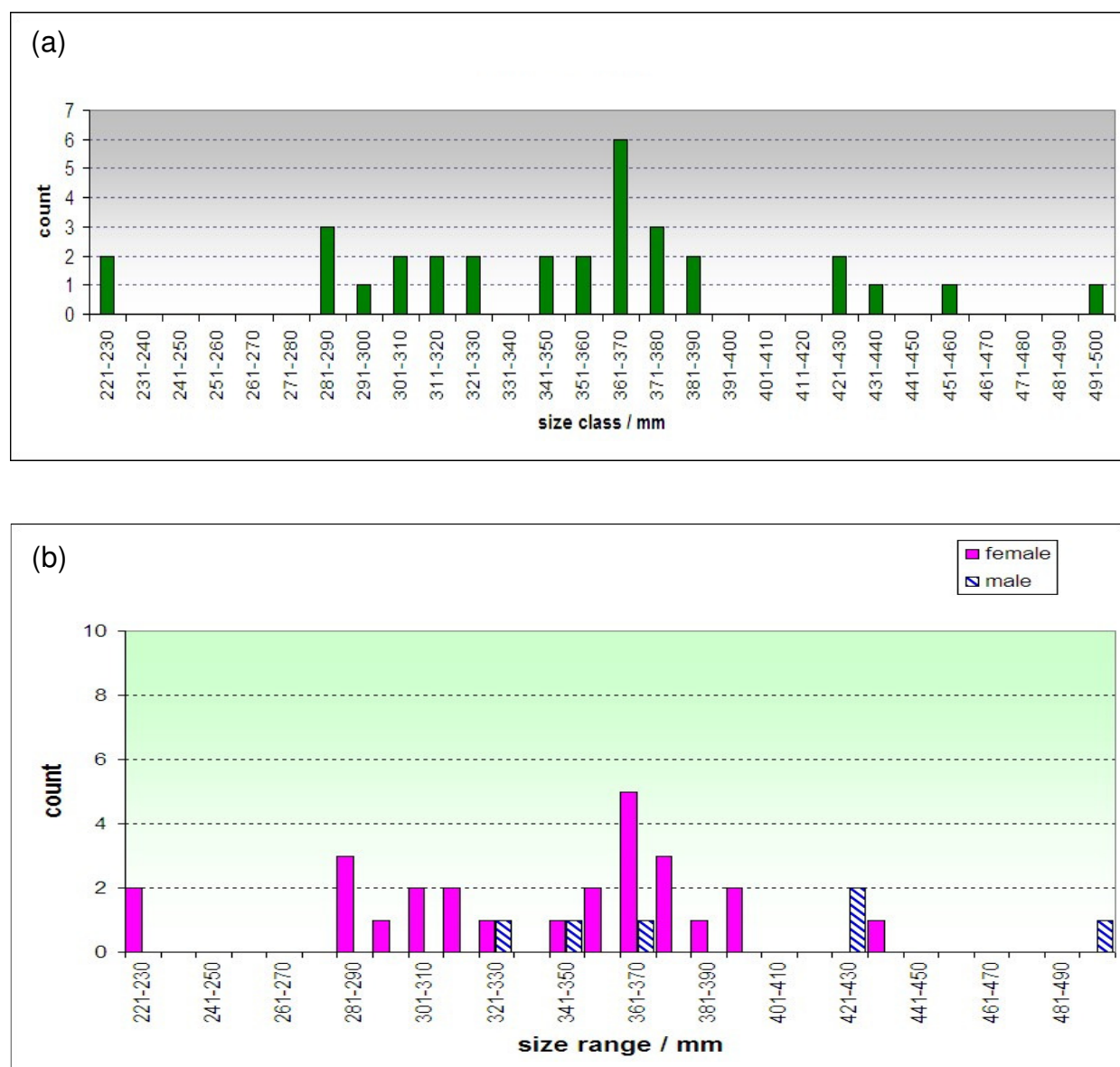


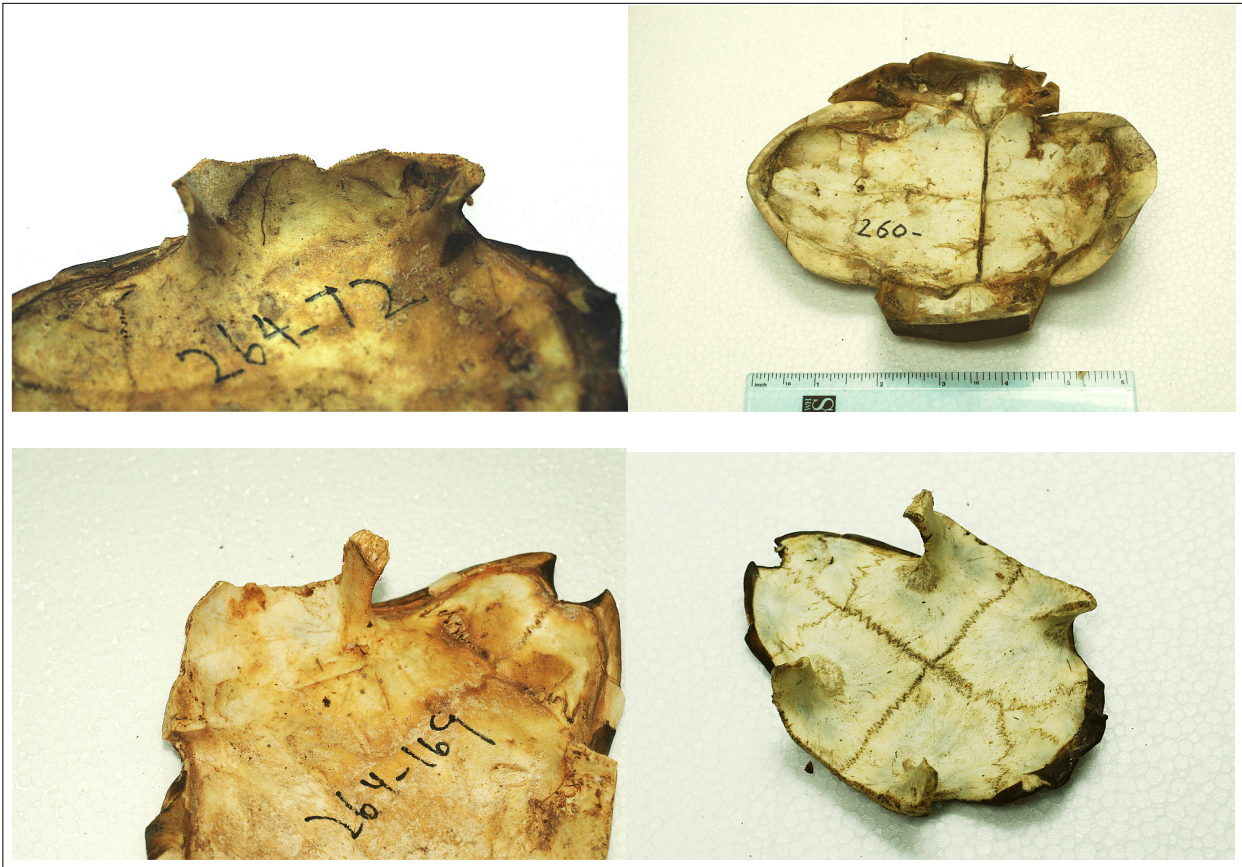
Figure 8. Size distributions of *Orlitia borneensis* turtle plastrons: (a) overall and (b) classed by sex.



Removal of plastrons appears to have been undertaken roughly and without automated tools, as cutting was jagged, inconsistent in terms of the actual cutting location and in some cases dried body tissue was still attached (see Figure 9).

The presence of hundreds of *Pyralis manihotalis* (a meal moth species that specialises in animal detritus) pupae amongst the plastrons upon arrival at KFBG indicated that there had been significant amounts of body tissue remaining during shipment. It is not known if the moth pupae were derived from eggs laid in Hong Kong whilst the shipment was being held by AFCDD, or from the original location (Java), though the latter is more likely as this tropical moth species is not normally found in sufficient abundance in Hong Kong to have been able to produce such a large infestation, especially during the winter in Hong Kong, when *P. manihotalis* is normally in a prolonged diapause (hibernation) phase.

Figure 9. Variation in cutting of plastrons from carapaces



Discussion

The distribution patterns (Figures 6 and 7) for both *S. crassicollis* and *C. amboinensis* plastron lengths were skewed normal distributions, with few large adults. This suggests that at the time of capture, the wild population(s) still contained representatives of all age classes.

Based on the knowledge that most species of Southeast Asian freshwater turtles are under intense collecting pressure for the food market in China (Shi *et al.*, 2009), the three species involved in this study are unlikely to be being harvested from the wild in a sustainable manner. Removal of large numbers of sub-adults and young adults from the wild population will have a detrimental impact upon the future breeding stock of the species. Under the current practice, we agree with observations reported by Cheung & Dudgeon (2006) and Chen *et al.* (2009), that the capture and trade of wild populations of these species is unsustainable.

This seizure represents just a small part of the overall illegal trade in these species and clearly is another indication of the unsustainable trade that is affecting turtles across South East Asia (Hudson, 2009; Philippen, 2009).

Proposed follow-up

1. Heavy Metal Content Analysis

For all species City University, Hong Kong, has offered to collaborate with analytical research into the plastron's heavy metal content [HMC]. Such data may later aid attempts to match HMC signatures in the plastrons to known HMC signatures for river systems in Indonesia.

For each species, ideally 15 males, 15 females and 5 specimens of old age / large plastrons are requested for the analysis. This is not a problem for *S. crassicollis* and *C. amboinensis*, though for *O. borneensis* only a small sample can be provided due to the much smaller number of samples (n=33) in the seizure. It is hoped that this phase of the study will be completed in December 2009.

2. *Cuora amboinensis* Plastron Pattern Analysis

Merijn J. Kerlen, ESF Studbook keeper for *Cuora amboinensis*, has suggested it may be possible to determine the geographic source of each plastron by assessing the plastron pattern. A sample of 18 plastrons was photographed and compiled into a reference sheet (Appendix 2), which was sent to MJK for further reference.

3. Further Demographic analysis

The data from the 2006 Hong Kong seizure could be compared with the published data to gain a better understanding of the effect of the food trade on the wild *C. amboinensis* populations. It is hoped that the data collected during this study will be useful for further research that highlights the effect of the food trade on remaining wild turtle populations.

4. Asian Turtle Crisis education

Some of the measured plastrons are currently part of a KFBG educational exhibit raising public awareness about the devastating effects the food trade and Traditional Chinese Medicine are having on many species of wild turtles.

5. Sharing information

Distribution of study results with other chelonian researchers. The report is also placed on the KFBG website.

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Appendix 1. Morphometric data entry log sheet

Box No.	Record Sheet No.	Date		Recorder:			
				Plastron dimensions (mm)			
Plastron No.	Species	sex M / F	age A / J	widest point	middle	length	remarks

Appendix 2. Examples of variation in plastron patterning exhibited by *Cuora amboinensis*

Reference: XXX-YYY, where XXX=original packing box number and YYY = plastron number in box XXX



228-191



228-217



228-218



258-036



258-037



258-054



258-069



258-070



258-104



258-106



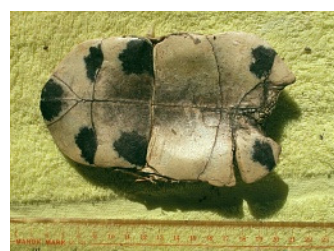
258-140



258-152



258-199



260-042



260-186



260-215



260-220



260-242

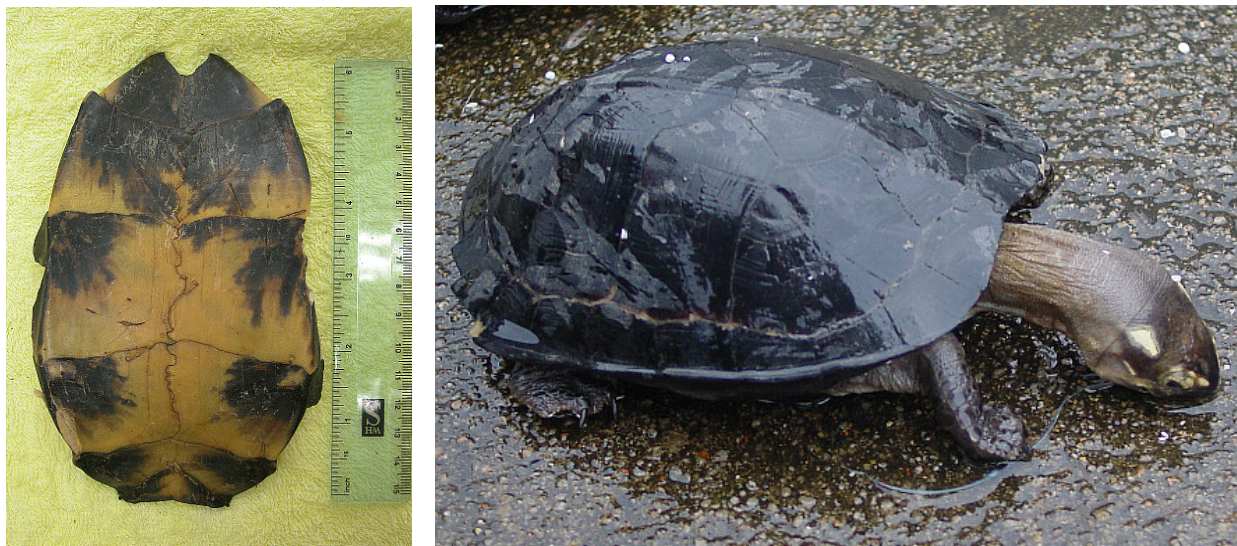
Appendix 3. Turtle Identification Sheet.

Plastrons from the January 2006; with illustrations of live turtles from the KFBG archives.

Orlitia borneensis plastron (left) and live adult (right)



Siebenrockiella crassicollis plastron (left) and live adult (right)



Cuora amboinensis plastron (left) and live adult (right)



About KFBG

Kadoorie Farm and Botanic Garden (KFBG) is situated on the northern slopes of Hong Kong's highest mountain – Tai Mo Shan (957 metres). Within KFBG are streams, woodlands, orchards and vegetable terraces – together with conservation and education facilities.

KFBG, today, is a unique public-private partnership, incorporated and designated as a conservation and education centre by Ordinance (Chapter 1156) in the Legislative Council of Hong Kong on 20th January, 1995. While KFBG is a public organisation, it is privately funded by the Kadoorie Foundation.

Since 1995, KFBG has focused on promoting conservation and sustainable living in Hong Kong and South China, with programmes on flora and fauna conservation and the promotion of organic agricultural practices.

KFBG's mission statement is “We exist to increase the awareness of our relationship with the environment and bring about positive change in the world through conservation and education”.



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