



馬蹄蟹(蠶)從4.75億年前的上奧陶紀活到今天, 希望未來的4.75億年仍然能夠見到這神奇
的海洋生物。



Horseshoe crabs have existed for 475 million years, since the Upper Ordovician period. We hope this fascinating marine creature will be around in another 475 million years.



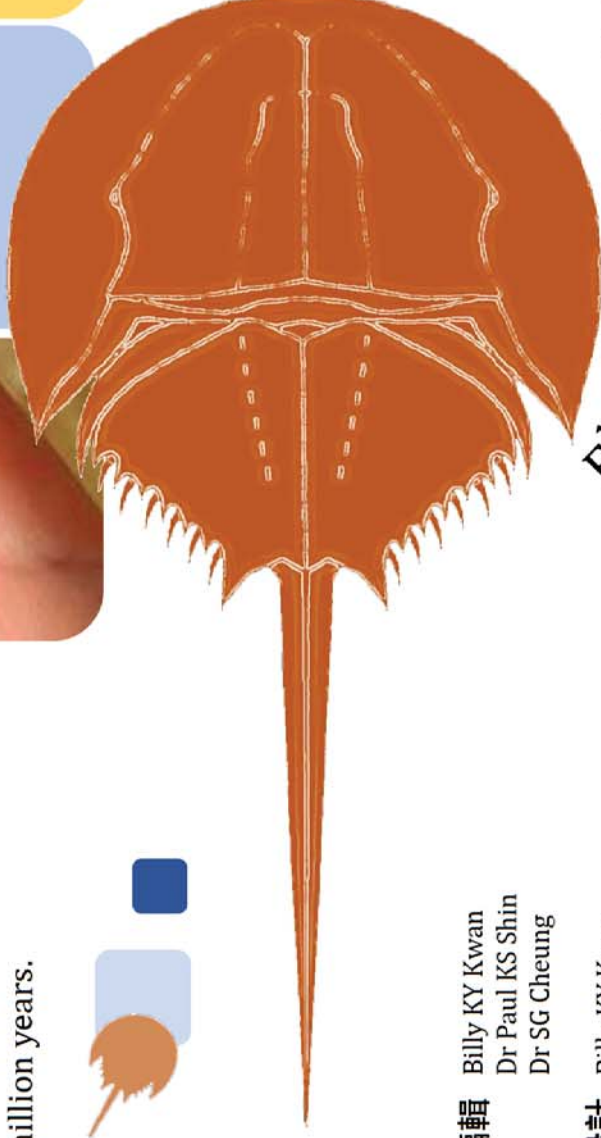
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「蠶」 年 億 四



The 475 million-year-old horseshoe crab

Educationl guide 教育指南 2015



香港城市大學
City University
of Hong Kong



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Hong Kong

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幼年馬蹄蟹野外食物成份
**Diet composition of juvenile
horseshoe crabs**

Kwan BKY, Cheung SG,
Shin PKS
Marine Biology 2015
Abstract can be accessed from:
<http://link.springer.com/article/10.1007%2Fs00227-015-2647-3#page-1>

實驗室飼養幼年馬蹄蟹
**Laboratory culture of juvenile
horseshoe crabs**

Chen Y, Lau CW, Cheung SG,
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Full text can be accessed from:
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幼年馬蹄蟹在香港的分佈
**Distribution of juvenile horseshoe
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Abstract can be accessed from:
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Documentaries



刪海經
The Lost Sea

導演: 洪淳修 2014
同喜文化出版工作室

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**Survivors: Nature's Indestructible
Creatures, The Great Dying**

Director: Shaun Trevisick 2012
British Broadcasting Corporation (BBC)
https://www.youtube.com/watch?v=cqEtqTw_26Y





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海洋護理 - 馬蹄蟹
Marine Conservation-
Horseshoe Crab

香港特別行政區政府 漁農自然護理署
Agriculture, Fisheries and Conservation Department,
The HKSAR Government
http://www.afcd.gov.hk/tc_chi/conservation/con_mar/con_mar_hor.html

馬蹄蟹校園保母計劃 Facebook Page
Juvenile Horseshoe Crab
Rearing Programme

香港海洋公園保育基金
Ocean Park Conservation Foundation, Hong Kong
<https://www.facebook.com/Horseshoecrab2012>

蠶居香港
Horseshoe Crab in Hong Kong

<https://www.hschk.org/>
<https://www.facebook.com/hschk>

馬蹄蟹 The Horseshoe Crab

Ecological Research & Development Group
<http://horseshoecrab.org/>

蟹績

Further reading

書籍

Books

倒寫籬蟹

保良局羅氏基金中學
Po Leung Kuk Laws Foundation College
2012
快樂書房 Joyful Books Co. Ltd

中國蠶生物學研究

洪永根 Hung Shuigen 2011
廈門大學出版社
Xiamen University Press

The American Horseshoe Crab

Shuster Carl N., Jr., Barlow Robert B.,
Brockmann H. Jane 2003
Harvard University Press, Cambridge

兩億年之蠶

陳章波、葉欣宜、林柏芬、吳松霖
Chen Chang-Po et al. 2002
金門縣政府
Kinmen County Government, Taiwan

*Limulus in the limelight: a
species 350 million years in the
making and in peril?*

Tanacredj John T., Earle Sylvia A.,
Eldredge Niles 2001
Kluwer Academic/Plenum Publishers,
New York



蟹出沒注意

Existence

活化石: 馬蹄蟹早於恐龍
時代現身地球

Living fossil: horseshoe crabs
are older than dinosaurs

馬蹄蟹是一種非常古老的海洋動物,牠的化石可以追溯到4.75億年前的上奧陶紀,但至今形態卻沒有重大改變,故被稱為“活化石”。雖名為馬蹄“蟹”,但牠並不是蟹,而是蜘蛛和蠍子的近親。

Horseshoe crabs belong to an archaic group of marine animals, with the oldest fossils dating back to the Upper Ordovician 475 million years ago, and have remained unchanged in appearance up to the present. Thus, horseshoe crabs are commonly referred to as “living fossils”. Though the horseshoe “crab” is called a “crab”, it is not classified as a true crab. They are more closely related to spiders and scorpions.



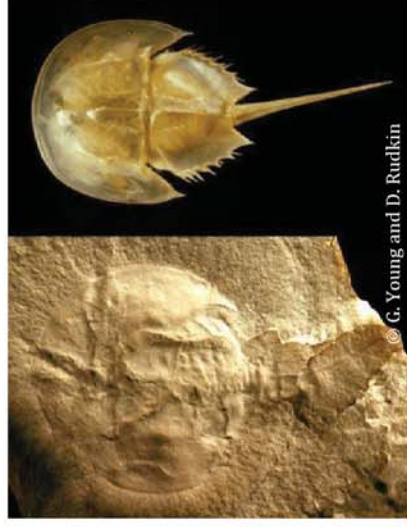
馬蹄蟹的口部
The mouth of
horseshoe crab



蜘蛛、蝎子及
螃蟹的口部
The mouthparts of
spider, scorpion
and crab



馬蹄蟹的口部結構較螃蟹的簡單,與蜘蛛及蝎子較為接近。
The mouthpart structure of horseshoe crab is simpler than a crab, and morphologically similar to spider and scorpion.



© G. Young and D. Rudkin

▲ 最古老的馬蹄蟹化石
The oldest known horseshoe crab fossil, *Limulaspis aurora polyphemus*

▲ 現存的美洲蠶
Present American horseshoe crab, *Limulus polyphemus*



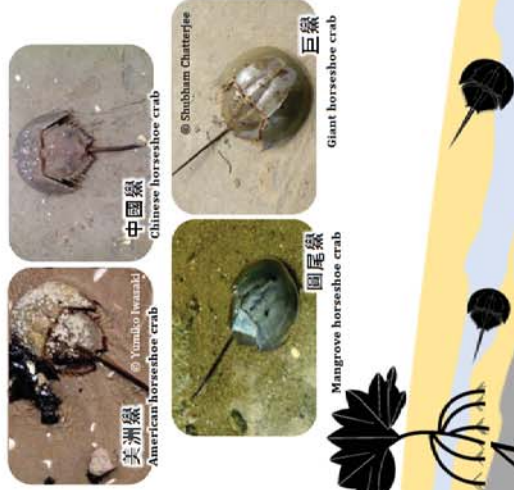
有蟹之地

Distribution

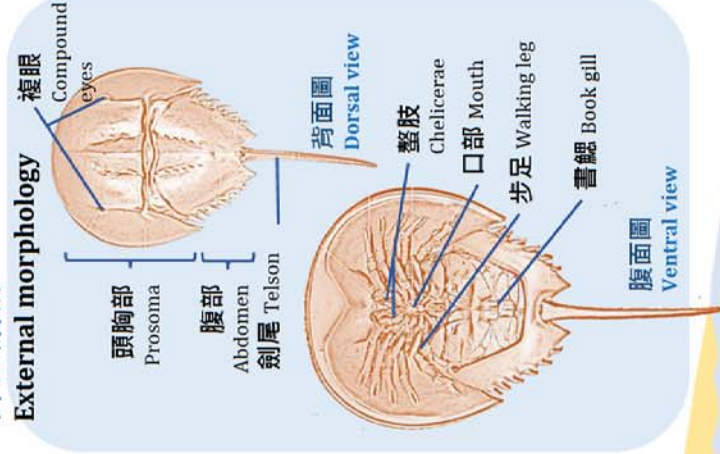


全世界現存4種馬蹄蟹，包括美洲蟹、中國蟹、巨蟹以及圓尾蟹。

There are four living horseshoe crab species in the world: the American horseshoe crab (*Limulus polyphemus*), Chinese horseshoe crab (*Tachypileus tridentatus*), giant horseshoe crab (*Tachypileus gigas*) and mangrove horseshoe crab (*Carcinoscorpius rotundicauda*).



外部結構



寄望 Conservation



"亞洲馬蹄蟹保育國際工作坊"於2011年在香港舉辦，就亞洲區內的馬蹄蟹保育策略進行商討。

The 2011 "International Workshop on the Science and Conservation of Asian Horseshoe Crabs", conducted in Hong Kong, developed a strategy to conserve horseshoe crabs in Asia.

來自中國大陸、香港和台灣的機構在2014年成立了"兩岸三地蟹保育聯盟"，以實踐區域性馬蹄蟹資源綜合保育和近海生態保護。

In 2014, the Mainland, Hong Kong and Taiwan Horseshoe Crab Conservation Alliance was established to integrate regional efforts to conserve horseshoe crabs and protect the coastal ecosystem.

試從以下的角色討論保育香港馬蹄蟹的方案:

Please suggest ways to conserve horseshoe crabs in Hong Kong in the following roles:



討論 Discussion



試分析一個良好的保育方案所需的條件，再以這些條件去構思一個保育香港馬蹄蟹的方案。

Identify the criteria for a good conservation strategy, and use these criteria to come up with a proposal for protecting horseshoe crabs in Hong Kong.

一齊來保育馬蹄蟹!
Let's conserve horseshoe crabs together!



探討

Explore

香港特區政府環境局與漁農自然護理署因應《生物多样性公约》的要求正著手制定本港的《生物多样性策略及行動計劃》。

The Environment Bureau and Agriculture, Fisheries and Conservation Department of the HKSAR government have embarked on an exercise to develop a city-level Biodiversity Strategy and Action Plan (BSAP) under the Convention on Biological Diversity.

請參考計劃的簡介內容，並探討此計劃將如何保護本土馬蹄蟹種群。

Refer to the introduction of the Plan and discuss how BSAP can protect the local horseshoe crab populations.

http://www.afcd.gov.hk/tc_chi/conservation/con_bsap/bsap_intro/intro_p_intro.html

國際合作

International collaborations



現時所有亞洲馬蹄蟹品種都被國際自然保護聯盟瀕危物種紅色名錄歸入“數據缺乏”級別。因現有初步數據指出近乎所有馬蹄蟹種群在亞洲地區都出現急降的情況，故此針對亞洲蟹的保育策略的管理系統是有急切需要的。

All Asian horseshoe crabs are currently listed as “Data Deficient” on the IUCN Red List of Threatened Species. However, present preliminary population data show that there has been a steep decline in nearly all Asian horseshoe crab populations. Thus, there is an urgent need for a management system to implement specific conservation strategies across their distribution range.



國際自然保護聯盟物種存續委員會馬蹄蟹專家小組在2012年成立。世界各地科學家攜手監察馬蹄蟹的種群狀況以及提高公眾對保育的意識。

The IUCN Species Survival Commission (SSC) Horseshoe Crab Specialist Group was established in 2012. The scientists monitor horseshoe crab population status and raise public conservation awareness.



香港馬蹄蟹的品種

Horseshoe crab species in Hong Kong



香港可找到中國蟹和圓尾蟹的蹤跡。

The Chinese and mangrove horseshoe crabs can be found in Hong Kong.



中國蟹 Chinese horseshoe crab

別名 Other name
三棘蟹、夫妻魚
Tri-spine horseshoe crab, Couple fish

出世時間 Birth period
4月至9月
April to September

身長 Length
50至60厘米
50 to 60 cm

體重 Weight
2至5公斤
2 to 5 kg

出生地 Location
中國、香港、台灣、日本、斐羅洲
China, Hong Kong, Taiwan, Japan, Borneo

壽命 Life expectancy
約15至20年
About 15 to 20 years

喜愛棲息地 Preferred habitat
砂質泥灘
Sandy mudflat

特徵 Characteristics
劍尾橫切面呈三角形
Telson cross section is triangular
體型為全世界四種蟹中最大
The largest body size among the world's four species
雄性成蟹額頭有兩個凹位
Male adult has two grooves at the head front

圓尾蟹 Mangrove horseshoe crab

--

4月至9月
April to September

30至40厘米
30 to 40 cm

0.2至0.5公斤
0.2 to 0.5 kg

中國、香港、印度、印尼、馬來西亞、新加坡
China, Hong Kong, India, Indonesia, Malaysia, Singapore

約10至15年
About 10 to 15 years

泥灘
Mudflat

劍尾橫切面呈圓形
Telson cross section is round
體型為全世界四種蟹中最小
The smallest body size among the world's four species
身體可能含河豚毒素
Body may contain tetrodotoxin



有翼之地

Distribution

香港幼年馬蹄蟹的分佈

Juvenile horseshoe crab distribution in Hong Kong

香港的幼年馬蹄蟹現時分佈於后海灣(下白泥、尖鼻咀)、香港新界東北(鹿頸、沙頭角)和大嶼山(水口、東涌灣、鹹頭)沿岸的泥灘上。白泥及下白泥為幼年中國蟹密度最高的泥灘，而沙頭角則為幼年圓尾蟹的主要棲息地。

Juvenile horseshoe crabs in Hong Kong are found along the coastline of Deep Bay (Ha Pak Nai, Tsim Bei Tsui), the northeastern New Territories (Luk Keng, Sha Tau Kok) and Lantau Island (Shui Hau, Tung Chung Wan, San Tau). Ha Pak Nai and Pak Nai are currently the shores with the highest density of juvenile Chinese horseshoe crabs, while Sha Tau Kok is the major nursery habitat for mangrove horseshoe crabs.



1975 - 1998^[1]



2004^[2]



2014^[3]

1 Chiu HMC, Morton B. (1999) The distribution of horseshoe crabs (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*) in Hong Kong. *Asian Marine Biology* 16, 185-194

2 Morton B, Lee CN (2010) Spatial and temporal distributions of juvenile horseshoe crabs (Arthropoda: Chelicerata) approaching extripation along the northwestern shoreline of the New Territories of Hong Kong SAR, China. *Journal of Natural History* 45, 227-251

3 Kwan BKY, Cheung SG, Shin PKS. Unpublished data

寄予冀望

Conservation



Community outreach



種群普查
Population surveys

香港現時的保育工作

Current conservation efforts in Hong Kong



晶片追蹤
Tag tracking



校園保育計劃
School rearing programme

馬蹄蟹在生態上扮演什麼角色?
What are the ecological roles of horseshoe crabs?



馬蹄蟹卵是候鳥重要的蛋白質來源
Horseshoe crab eggs are an important protein source for migratory birds



在活動過程中攪動底泥，促進養份的循環和氣體交換
Sediment movement during activities enhances nutrient cycling and gaseous exchange



為附生生物的寄主
Host for epibionts



拒絕摸蜆活動

Say no to clam-digging activity



對於摸蜆活動會否干擾生態，大家或會持有不同的意見，科學上也未有一致的定論。但每逢夏天，香港數個較有名的淺灘（例如水口、貝澳灣、東涌灣）都會聚集很多摸蜆人士，盡享“親子之樂”。當小小的灘上有太多人在同一時段進行摸蜆活動，或多或少都會干擾到泥灘上的生態。如東涌灣、磡頭等泥灘上具高生態價值的海草床會遭人無心踐踏；很多動物（包括幼年馬蹄蟹）的主要食物如蜆肉也有機會被過度採集。綜合以上種種因素，我們不應參與摸蜆活動。

Whether clam-digging causes ecological disturbance remains a controversial scientific issue. In Hong Kong, people go clam-digging as a family gathering activity during the summer, and sometimes hundreds of people gather at some popular spots (such as Shui Hau, Pui O Wan, Tung Chung Wan). However, due to the over-crowding of people on these small shores, the ecological disturbance on such sandy habitat is unavoidable. For some shores including Tung Chung Wan and San Tau, where ecologically important seagrass beds are located, people may unintentionally step on and destroy them. Clam meat, which is the main food source of many animals living on the shore including the juvenile horseshoe crabs, can be over-harvested. Because of these factors, clam-digging should be discouraged.



幼年馬蹄蟹種群普查

Juvenile horseshoe crab population survey



目的: 記錄香港幼年馬蹄蟹在其產卵及育幼地的密度及分佈情況
時間: 夏季 (7-9月) 潮退時分 (參考香港天文台潮汐預報)
人數: 約 7 人

體驗

- 地點:** 幼年馬蹄蟹棲息地 (例如: 下白泥、水口)
方法¹: a) 潮漲最高與潮退最低的水位之間設4條平行於海岸線且等距的樣線, 樣線長度與海岸線長度相若。
b) 兩位調查員於樣線上相距2米位置行走, 沿樣線尋找幼年馬蹄蟹並記錄數量以及品種。
c) 其他調查員測量及記錄幼年馬蹄蟹頭胸甲寬度、附近的水溫、鹽度、酸鹼度和溶氧量。

Get involved

Aims: To record the population density and distribution of juvenile horseshoe crabs at different spawning/nursery shores in Hong Kong
Period: Low tides during summer (July-September; please refer to the predicted tides by the Hong Kong Observatory)
No. of people: About 7 persons

Venue: Habitat of juvenile horseshoe crabs (e.g. Ha Pak Nai, Shui Hau)

Method¹: a) Set four horizontal transects equally apart between the highest and lowest astronomical tide lines. The length of each transect is similar to the shore width.
b) Two surveyors walk along each transect 2 m apart to search for juveniles and record the species found.

c) Other surveyors measure and record the juveniles' prosomal width, and the surrounding water temperature, salinity, pH and dissolved oxygen content.



© OPCFHK

在樣線上行走

Walk along the transect



© OPCFHK

尋找並記錄其品種

Search for and record the species



測量馬蹄蟹頭胸甲寬度

Measure the juvenile prosomal width

¹ Shim PKS, Li HY, Cheung SG (2009) Horseshoe crabs in Hong Kong: Human exploitation and current population status. In: Tancredi JT, Botton ML, Smith DR (eds), Biology and conservation of horseshoe crabs. Springer, New York, p 347-360



有蟹之地

Distribution

有蟹字的香港地名

Places named for "horseshoe crab" in Hong Kong



蟹地坊

Hau Tei Square

蟹殼灣

Hau Hok Wan



蟹殼灣是一位於大嶼山東澳古道的泥灘。雖然無法確定這泥灘的歷史，但根據其名可猜測蟹在泥灘上的數量並不少，處處可見蟹殼。但自2004年的普查這泥灘已找不到蟹的族群了。

Hau Hok Wan is located along the Tung O Ancient Trail, Lantau Island. Its name suggests many horseshoe crabs can be found there. However, there have been no horseshoe crab sightings since the population survey in 2004.

蟹地坊現為荃灣一塊具舊市集特色的地方，街坊亦稱之為“荃灣女人街”，主要售賣日常用品與乾貨。蟹地坊在填海前為沿海地區，據說經常有蟹出沒因此得名。

Hau Tei Square is a marketplace for daily necessities in Tsuen Wan. Local people also call it the "Tsuen Wan Ladies Market" now. Some say that it got this name because there were many horseshoe crabs on the shore before reclamation.

寄予蟹望

Conservation

放生馬蹄蟹前再三思

Think twice before the wild release activity

對香港人來說，放生可救助受苦的動物，也有宗教人士覺得放生可以為信徒積福消災。可是試想想馬蹄蟹為何會落入你手，其實牠們就是因為放生活動而被捕捉。根據城市大學在2004-2005年的調查¹指出，香港人購買馬蹄蟹作放生佔最多數(62%)。放生活動使馬蹄蟹在市場上的需求增加，造成更多漁民去捕捉牠們，這些馬蹄蟹在等待被購買的過程中，經常因脫水(尤其在天氣炎熱下)而奄奄一息。即使大難不死回到大海，也很容易因環境不適應或染病而死亡，所以放生隨時就變成了殺生。



Local people may think that releasing horseshoe crabs back to the sea can save the animals from suffering. Some religious followers even believe that wild release activity can bring good fortune. According to data collected by CityU in 2004-2005¹, most horseshoe crabs are bought for wild release purposes (62%). Because of the high market demand for horseshoe crabs, more fishermen catch the adults intentionally. While waiting for purchase, the crabs often die because of dehydration from inappropriate storage, especially during warm weather. Even those crabs that survive to be released back to the sea may also die because of their failure to adapt to a new environment or microbial infection. These wild release activities therefore increase the mortality of horseshoe crabs.



© 央視網

¹ Li HY (2008) The conservation of horseshoe crabs in Hong Kong, MPhil thesis, City University of Hong Kong, Hong Kong

寄予蟹望

Conservation

保育馬蹄蟹，你我做得到!

Together, we can conserve horseshoe crabs!



拒食馬蹄蟹 Avoid eating horseshoe crabs

在中國廣東、廣西、海南沿海和某些東南亞國家都有食用馬蹄蟹的習慣。在香港也有美食雜誌甚至電視節目宣傳馬蹄蟹的菜式。根據城市大學在2004-2005年的訪問結果¹，這些餐廳多位於西貢、南丫島、長洲和銅鑼灣，每年平均烹煮約200隻馬蹄蟹。食用的人相信馬蹄蟹具有高的營養及醫藥價值，但其實並沒有科學根據。相反，中國、泰國和緬甸等地曾發生食蟹中毒事件。

It is common for people to eat horseshoe crabs in Guangdong, Guangxi and Hainan Provinces in Mainland China, and some Southeast Asia countries. In Hong Kong, we can also find some magazines and even TV programmes introducing horseshoe crab dishes as exotic delicacies. According to a study conducted by CityU in 2004-2005¹, restaurants located in Sai Kung, Lamma Island, Cheung Chau and Causeway Bay serve in total an average of 200 horseshoe crabs per year. Some local people believe that horseshoe crabs have high nutritional and medical value, but these claims have no scientific support. On the other hand, food poisoning due to horseshoe crabs has been reported in China, Thailand and Myanmar.

¹ Li HY (2008) The conservation of horseshoe crabs in Hong Kong. MPhil thesis, City University of Hong Kong, Hong Kong



蟹的一生

Life cycle

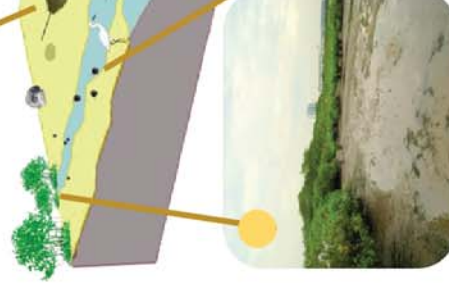
成蟹和幼蟹因不同需要而棲息於不同地方。一般幼蟹在廣闊的泥灘或紅樹林邊的潮間帶覓食，用10至15年成長至成蟹後再遷移到淺海生活。待每年繁殖季節（4至9月），雌蟹會揀著雄蟹成雙成對爬上泥灘產卵。



Habitat requirements of juvenile and adult horseshoe crabs are different. Juveniles live on the sandy-mudflat or intertidal areas near mangroves. They generally spend 10 to 15 years on the shore before migrating to the sea bottom as adults, where they will spend the rest of their lives except for spawning. During the spawning season (April to September), adult mating pairs, with the males mounted on the females' backs, return to the shore to spawn.

成蟹爬上泥灘產卵

Mating pairs spawn on the shore



潮間帶是幼蟹賴以生存的地方

Juvenile horseshoe crabs inhabit intertidal areas

生活在海底的成蟹

Adults stay at the sea bottom

幼蟹在泥灘上覓食

Juvenile horseshoe crab is feeding on the mudflat

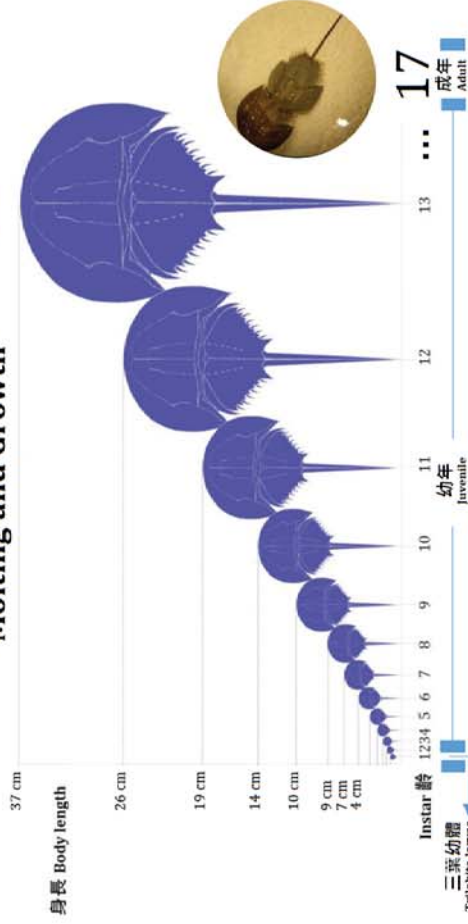


蟹的一生

Life cycle

脫殼與成長

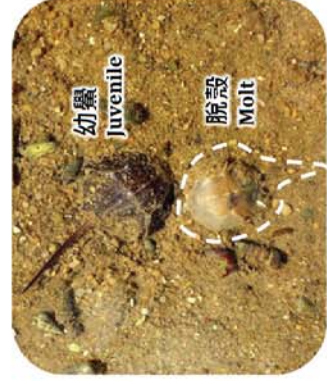
Molting and Growth



馬蹄蟹和甲殼類動物一樣，在成長時需要脫去舊殼，再長出新殼。每一次脫殼，馬蹄蟹頭胸寬度會比之前增大20-30%。由受精卵孵化出來的“三葉幼體”被稱為“一齡”，第一次脫殼後被稱為“二齡”，以此類推。脫殼相隔的時間也隨著身長而增加，例如中國鬩一齡約50天後就會脫殼變成二齡，但九齡脫殼變成十齡就需要相隔約460天。所以為了避免混淆，一般都會使用“齡”來形容馬蹄蟹的成長，而不是“歲”或“年齡”。中國鬩要經過約17次脫殼後才達成熟期。科學家推斷馬蹄蟹的壽命為15-20年。



Like crustaceans, horseshoe crabs grow through molting by shedding their old exoskeletons. The prosomal width of horseshoe crabs increases 20-30% after each molt. A horseshoe crab which hatches out from an egg is called "1st instar", becomes "2nd instar" after first molt, and so on so forth. The number of days elapsed between molting events increases with body size. For example, Chinese horseshoe crab takes about 50 days before 1st instar to molt into 2nd instar, but 9th instar requires about 460 days before it molts again into 10th instar. To avoid confusion, normally we use "instar" to describe their growth instead of "age" or "year". A Chinese horseshoe crab molts about 17 times before reaching sexual maturity. It is estimated that horseshoe crabs can live up to 15-20 years.



棲息地受破壞
Habitat destruction

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食用
Consumption for food



過度採集鬩血
Over-collection of blood

© 楊明哲

絕鬩危機

Threats



不當放生
Inappropriate wild release



© 新華網

海洋垃圾
Marine debris



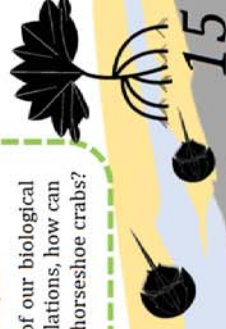
Marine debris

討論

Discussion

最近常提及應用“可持續發展”的概念來管理生物資源。對於馬蹄蟹面對的種種威脅，我們應如何應用此概念於馬蹄蟹的保育呢？

People talk about sustainable development or management of our biological resources. With such potential threats to horseshoe crab populations, how can the concept of sustainability be applied to the conservation of horseshoe crabs?



血液 Blood

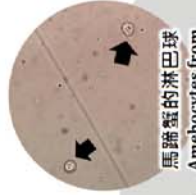
馬蹄蟹血液中的銅離子與攜帶氧氣的呼吸蛋白質發生化學反應，所以其血液是藍色的。

The horseshoe crab's blood is blue due to a chemical reaction between copper and an oxygen-carrying protein called hemocyanin.



由馬蹄蟹血液加工而成的鱗試劑廣泛用於藥物及醫用儀器的無菌檢測。

Limulus amebocyte lysate, or LAL, produced by the blue blood of horseshoe crabs is applied as a bacterial test for pharmaceutical drugs and prosthetic devices.



馬蹄蟹的淋巴球
Amebocytes from
horseshoe crab

幫馬蹄蟹做身體檢查!

Body check for horseshoe crabs!

馬蹄蟹的血液除了可以提煉鱗試劑外，血液也可反映馬蹄蟹的身體健康狀況。馬蹄蟹血液中的呼吸蛋白濃度、淋巴球數量與外型、血清蛋白質濃度等會因環境污染、飼養環境不佳¹、食物來源不足等情況而改變。

Besides extracting *Limulus* amebocyte lysate (LAL), horseshoe crab blood can also be used to assess their health status. The respiratory protein hemocyanin density, amebocyte density and morphology, as well as serum protein concentration can change due to environmental pollution, captivity stress¹ and a lack of food sources.

¹ Kwan BKY, Chan AKY, Cheung SG, Shin PKS (2014) Hemolymph quality as indicator of health status in juvenile Chinese horseshoe crab *Tachypleus tridentatus* (Xiphosura) under laboratory culture. *Journal of Experimental Marine Biology and Ecology* 457, 135-142.

蟹與人 Contribution



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成年馬蹄蟹以海底的雙殼軟體動物(例如蜆、甲殼動物、蠕蟲及螺為主要食物。至於幼年馬蹄蟹，曾經有科學家於其腸胃內找到昆蟲幼體、蠕蟲、小蟹、雙殼軟體動物以及海藻碎片¹。但此腸胃食物分析只能知道該動物在短時間內吃過甚麼，而這些食物樣本都具有外殼或不容易被消化的部份，所以只能提供片面的資訊，未能全面分析馬蹄蟹的食性。

野外觀察也能了解幼年馬蹄蟹食性。考察時小心地掀起幼年馬蹄蟹，有時可觀察到牠們正進食貝類、蠕蟲或體型較小的甲殼類動物。但從野外觀察而獲得的食性數據也受許多限制因素影響。



蠕蟲
Marine worm



雙殼軟體動物
Bivalves

Adult horseshoe crabs feed on bivalves (such as clams), crustaceans, marine worms and gastropods. For juvenile horseshoe crabs, scientists found insect larvae, marine worms, small crabs, bivalves and seagrass detritus in their guts¹. However, this gut content analysis (i.e., examining the remaining food content in the gut) may only provide their short-term diet composition or be biased towards animals with shells and others which are not readily digested.

Field observation is another way to understand the feeding habit of juvenile horseshoe crabs. During field surveys, carefully pick up a juvenile and you may find that it is feeding on bivalves, tube worms or small crustaceans. However, field observations also have limitations.

¹Zhou H, Morton B (2004) The diets of juvenile horseshoe crabs, *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda* (Xiphosura), from nursery beaches proposed for conservation in Hong Kong. *Journal of Natural History* 38, 1915-1925



What do juvenile horseshoe crabs eat in the wild?

1. 試分析以野外觀察的方法了解動物食性的限制。
2. 除了野外觀察和腸胃食物分析之外，試建議其它可了解幼年馬蹄蟹食性的方法。
3. 試考究馬蹄蟹食性與保育馬蹄蟹的關係。



1. Identify the limitations of using field observations to understand the diet composition of the animal.
2. Suggest any other methods besides field observations and gut content analysis to determine the diet of the juvenile horseshoe crabs.
3. Examine the relationship between the feeding ecology of horseshoe crabs and its conservation implications.

討論

Discussion

要推測動物食性，同位素碳¹³C和氮¹⁵N分析是科學上較準確且常用的方法。從這分析方法得知，幼年美洲鬚於2至3齡時以浮游有機物質為食物，其後到5至11齡逐漸轉食蠕蟲¹。香港下白泥海草床上的幼年中國鬚(6-11齡)主要進食蠕蟲、甲殼類和雙殼類動物；而季節的變化不會改變幼年馬蹄蟹的食物選擇²。

Analysis of stable carbon (¹³C) and nitrogen (¹⁵N) isotopes are the most scientifically accurate and commonly applied method to estimate the diet composition. From the results of such analyses, we know that the juvenile American horseshoe crab shifts diet from suspended particulate organic matter (2nd-3rd instars) to mainly marine worms (5th-11th instars)¹ as it grows. Juvenile Chinese horseshoe crabs (6th-11th instars) on the seagrass-covered Ha Pak Nai mudflat similarly feed on marine worms, but their main diet also includes crustaceans and bivalves. Seasonal change does not alter their diet composition².



馬蹄蟹因沒有上下顎，所以會用螯肢和步足將食物推入口中

Since horseshoe crabs do not have any jaws, they push the food towards their mouths using the chelicerae and walking legs.

¹ Carmichael RH, Gaines E, Sheller Z, Tong A, Clapp A, Valiela I (2009) Diet composition of juvenile horseshoe crabs: implications for growth and survival of natural and cultured stocks. In: Tanacredi JT, Botton ML, Smith DR (eds), *Biology and conservation of horseshoe crabs*. Springer, New York, p 521-534

² Kwan BK, Cheung SG, Shin PKS (2015) A dual stable isotope study for diet composition of juvenile Chinese horseshoe crab *Tachyplesus tridentatus* (Xiphosura) on a seagrass-covered intertidal mudflat. *Marine Biology* 162, 1137-1143



鬚與人

Contributions

複眼

Compound eyes



1967年，Hartline教授因研究馬蹄蟹複眼的側抑制現象成為諾貝爾生理/醫學獎得主，對了解視覺訊息融合貢獻巨大。此技術也被應用於電視和雷達系統中，提高了電視影像的清晰度。

In 1967, Prof. Haldan Keffler Hartline received the Nobel Prize in Physiology/Medicine for his research on the lateral inhibition mechanism of horseshoe crab vision, which is important in understanding the integration of visual information. The mechanism of lateral inhibition is also applied to radar systems and to improve the clarity of television images.

甲殼素 Chitin

馬蹄蟹外殼中高純度的甲殼素常用於外科手術以加速傷口愈合，亦用於污水處理以吸附水中懸浮物質和毒性有機物等。

Because of its high purity, chitin from the horseshoe crab carapace is commonly used in surgical procedures to accelerate healing, as well as in wastewater treatment to adsorb particulates and toxic organic compounds.

