馬蹄蟹(蟹)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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Educational guide 教育指南 2015
學術論文
Research articles

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, Shin PKS
Aquatic Biology 2010
Full text can be accessed from:

幼年馬蹄蟹在香港的分佈
Distribution of juvenile horseshoe crabs in Hong Kong
Shin PKS, Li HY, Cheung SG
Springer 2009
Abstract can be accessed from:

紀錄片
Documentaries

剞海經
The Lost Sea
導演: 洪淳揚 2014
同喜文化出版工作室

守漁的人
Waiting for Our Ocean
導演: 洪淳揚 2013
台灣農委會林務局

Survivors: Nature’s Indestructible Creatures, The Great Dying
Director: Shaun Trevisick 2012
British Broadcasting Corporation (BBC)
https://www.youtube.com/watch?v=cqEtq1w_26Y
**Further reading**

**Books**

- **The American Horseshoe Crab**
  Shuster Carl N. Jr., Barlow Robert B., Brockmann H. Jane 2003
  Harvard University Press, Cambridge

- **Limulus in the limelight: a species 350 million years in the making and in peril?**
  Tanacredi John T., Earle Sylvia A., Eldredge Niles 2001

**Websites**

- **Ocean Park Conservation Foundation, Hong Kong**
  [https://www.opcc.org.hk/](https://www.opcc.org.hk/)

- **The Horseshoe Crab in Hong Kong**
  [https://www.hschk.org/](https://www.hschk.org/)

- **Juvenile Horseshoe Crab Rearing Programme**

- **The mouthparts of spider, scorpion and crab**
  [https://www.facebook.com/hschk](https://www.facebook.com/hschk)

- **The mouth of horseshoe crab**

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**Living fossil: horseshoe crabs are older than dinosaurs**

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.

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**The mouthparts of spider, scorpion and crab**

The mouthpart structure of horseshoe crab is simpler than a crab, and morphologically similar to spider and scorpion.
"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:

- 非牟利機構 (NGOs)
- 一般市民 (Local communities)
- 大學 (Universities)

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.
寄予展望

生物多樣性策略及行動計劃

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.

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


探索

香港特區政府環境局與漁農自然護理署因應《生物多樣性公約》的規定，制定香港《生物多樣性策略及行動計劃》。

國際合作

現時所有亞洲馬蹄蟹品種皆被國際自然保護聯盟列為瀕危物種“數據缺乏”級別。因現有由於數據不足，現有所有馬蹄蟹種群在亞洲地區都出現急昇的情況，故此針對亞洲馬煩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.

IUCN SSC

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

香港馬蹄蟹的品種

Horseshoe crab species in Hong Kong

<table>
<thead>
<tr>
<th>別名</th>
<th>Chinese horseshoe crab</th>
<th>Mangrove horseshoe crab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other name</td>
<td>三棘蟹、夫妻魚</td>
<td>Tri-spine horseshoe crab, Couple fish</td>
</tr>
<tr>
<td>出生時間</td>
<td>4月至9月</td>
<td>4月至9月</td>
</tr>
<tr>
<td>Birth period</td>
<td>April to September</td>
<td>April to September</td>
</tr>
<tr>
<td>身長</td>
<td>50至60厘米</td>
<td>30至40厘米</td>
</tr>
<tr>
<td>Length</td>
<td>50 to 60 cm</td>
<td>30 to 40 cm</td>
</tr>
<tr>
<td>體重</td>
<td>2至5公斤</td>
<td>0.2至0.5公斤</td>
</tr>
<tr>
<td>Weight</td>
<td>2 to 5 kg</td>
<td>0.2 to 0.5 kg</td>
</tr>
<tr>
<td>出生地</td>
<td>中國、香港、台灣、日本、婆羅洲</td>
<td>中國、香港、印度、印尼、馬來西亞、新加坡</td>
</tr>
<tr>
<td>Location</td>
<td>China, Hong Kong, Taiwan, Japan, Borneo</td>
<td>China, Hong Kong, India, Indonesia, Malaysia, Singapore</td>
</tr>
<tr>
<td>壽命</td>
<td>約15至20年</td>
<td>約10至15年</td>
</tr>
<tr>
<td>Life expectancy</td>
<td>About 15 to 20 years</td>
<td>About 10 to 15 years</td>
</tr>
<tr>
<td>喜愛棲息地</td>
<td>砂質泥灘</td>
<td>泥灘</td>
</tr>
<tr>
<td>Preferred habitat</td>
<td>Sandy mudflat</td>
<td>Mudflat</td>
</tr>
<tr>
<td>特徵</td>
<td>劍尾橫切面呈三角形</td>
<td>劍尾橫切面呈圓形</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Telson cross section is triangular</td>
<td>Telson cross section is round</td>
</tr>
<tr>
<td>體型為全世界四種鰍中最大</td>
<td>The largest body size among the world’s four species</td>
<td></td>
</tr>
<tr>
<td>雄性成體頭部有兩個凹位</td>
<td>Male adult has two grooves at the head front</td>
<td></td>
</tr>
<tr>
<td>身體可能含河豚毒素</td>
<td>Body may contain tetrodotoxin</td>
<td></td>
</tr>
</tbody>
</table>

有贊之地

Distribution

香港可找到中國鰍和圓尾鰍的蹤跡。
The Chinese and mangrove horseshoe crabs can be found in Hong Kong.
**Juvenile horseshoe crab distribution in Hong Kong**

Hong Kong's juvenile horseshoe crabs 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, Sau Tai). 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.

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


**Say no to clam-digging activity**

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, Pai 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.

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**Juvenile horseshoe crab population survey**

- **Objective**: 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).

**Method**

1. 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.
2. Two surveyors walk along each transect 2 m apart to search for juveniles and record the species found.
3. Other surveyors measure and record the juveniles’ prosomal width, and the surrounding water temperature, salinity, pH and dissolved oxygen content.

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In Hong Kong, juvenile horseshoe crabs in the wetland areas are often monitored to understand their population density and distribution. This monitoring is crucial for conservation purposes.

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**Distribution**

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有鱗之地

Distribution

放生馬蹄蟹前要三思
Think twice before the wild release activity

對香港人來說，放生可救助受苦的動植物，也有宗教人士認為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年的調查指出，香港人購買馬蹄蟹作放生佔最多數(62%)。放生活活
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感染而死亡，所以放生隨時就變成了殺生。

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.

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 2004-2005, 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.

1 Li HY (2008) The conservation of horseshoe crabs in Hong Kong. MPhil thesis, City University of Hong Kong, Hong Kong
拒食馬蹄蟹 Avoid eating horseshoe crabs

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 2004-2005, 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
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，馬蹄蟹的體長會比之前增大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成長的增加。例如中國為一齡約50天後就進入二齡，但九齡脫殼後的十隻就需要相隔約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”。中國為要經過約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 and 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.

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存呢？

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

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

馬蹄蟹血液中的銅離子與氧氣產生化學反應，所以其血液是藍色的。

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.

馬蹄蟹血液加工而成的嘗試劑廣泛用於藥物及醫用儀器的無菌檢測。

馬蹄蟹的淋巴球 Amebocytes from horseshoe crab

馬蹄蟹的血液除了可以做嘗試劑外，血液也可反映馬蹄蟹的身體健康狀況。馬蹄蟹血液中的氧氣蛋白濃度、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、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 stress and a lack of food sources.


Feeding 餵食

成年馬蹄蟹以海底的雙殼軟體動物(例如蜆)、甲殼動物、蠕蟲及離為主要食物，至於幼年馬蹄蟹，曾經有科學家於其腸胃內找到昆蟲幼蟲、蠕蟲、小蝦、雙殼軟體動物以及海草碎片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分，所以只能提供片面的資訊，未能全面分析馬蹄蟹的食性。

田野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、管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。

野外觀察也能了解幼年馬蹄蟹的食性。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、管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。

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.

What do juvenile horseshoe crabs eat in the wild?

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.

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 (6th-11th instars) 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 crustacea and bivalves. Seasonal change does not alter their diet composition.


1967年，Harlton教授因研究馬蹄蟹視覚的側抑制現象成為諾貝爾生理/醫學獎得主，對人類視覺訊息融合技術為實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 Keffer 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.

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 absorb particulates and toxic organic compounds.

甲殼素 Chitin

馬蹄蟹外殼中高純度的甲殼素常被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。