



Living Fossils of the Sea



Key Learning Points

Overview

Provides a multi-perspective introduction to horseshoe crabs—ancient "living fossils"— by examining how their unique, unchanged body structures have enabled them to adapt and survive from antiquity to the present. The unit covers lesser-known ecological knowledge, their significance to ecosystems and human society, and the impacts of human activities, fostering ecological conservation awareness and actionable marine stewardship.

Learning Objectives

1. Explore the evolutionary background, key physical traits, and life history of horseshoe crabs
2. Understand their interrelationships with other marine organisms and intertidal habitats
3. Analyse their ecological functions and critical contributions to human medicine and society
4. Inspire students to engage in proactive behaviours to protect horseshoe crabs and their habitats

Values and Attitudes

Empathy, Responsibility, Commitment

Lesson Duration

Two 40-minute lessons (80 minutes in total)



1. **Evolutionary History**
2. **Taxonomic Classification**
3. **Unique Blood**
4. **Body Structure**
 - a. Book Gills
 - b. Appendages
 - c. Eyes
5. **Global Distribution**
6. **Life Cycle**

A Creature From Ancient Times...



Greetings, everyone. As a palaeontologist, I study prehistoric life. The organism I'm holding today also inhabited our planet during ancient geological eras. However, **this isn't a fossil**—it is a living, breathing organism! Do you know what it is?



A Creature From Ancient Times...



Greetings, everyone. As a palaeontologist, I study prehistoric life. The organism I'm holding today also inhabited our planet during ancient geological eras. However, **this isn't a fossil**—it is a living, breathing organism! Do you know what it is?

It's a horseshoe crab!





Living Fossils of the Sea

✧✧ Horseshoe Crabs ✧✧



Facts About Horseshoe Crabs...



Although horseshoe crabs have persisted from prehistoric eras into the present day, they are actually **closely linked to our daily lives**. Before we explore their biology, let's test your background knowledge: **what do you already know about their ancient history?**



Facts About Horseshoe Crabs...



Let me share some fascinating facts about horseshoe crabs that you might not know!



1

Horseshoe Crabs Are Living Fossils!



The ancestors of horseshoe crab species first appeared during the Ordovician period of the Palaeozoic Era **more than 400 million years ago**. Their population has persisted to this day, having survived and overcome unprecedented climatic extremes.

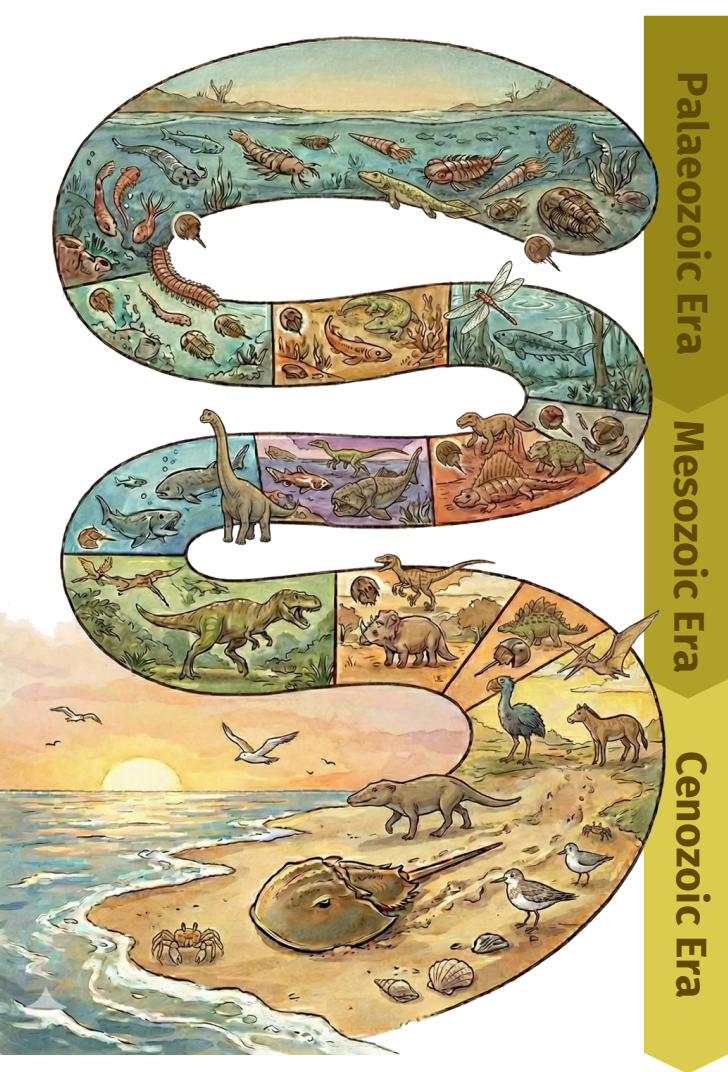
Geological Time Scale



A chronological framework categorising Earth's history using eons, eras, periods, epochs, and ages. **Differing geological conditions throughout Earth's history shaped distinct landscapes and climates, driving the evolution of unique flora and fauna.**

e.g., Dinosaurs flourished during the Jurassic **Period** of the Mesozoic **Era**





Palaeozoic Era

Mesozoic Era

Cenozoic Era

530 million years ago

Ordovician Period



@HCRC

250 million years ago

Jurassic Period



© Raul Martin

66 million years ago to Present

1

Horseshoe Crabs Are Living Fossils!

Fossil records show that horseshoe crab ancestors emerged during the **Ordovician Period**, coexisting in ancient oceans with organisms like trilobites, *Anomalocaris*, and *Pikaia*.



© Nobu Tamura

Trilobites



© Paleozoo

Anomalocaris



© Entelognathus

Pikaia

Chordate

Pikaia was a primitive **chordate**. As human beings are vertebrates within the phylum Chordata, our distant evolutionary ancestors once shared the same prehistoric oceans with the ancestors of horseshoe crabs.

Horseshoe crab ancestors survived major extinction events prior to the Jurassic Period, becoming **one of the species that coexisted with dinosaurs.**





Paleozoic Era

Mesozoic Era

Cenozoic Era

530 million years ago

250 million years ago

66 million years ago to Present

Mass Extinctions



Based on fossil evidence, palaeontologists infer that Earth's biosphere has endured **five major mass extinction events**.

1. Ordovician–Silurian Extinction

2. Late Devonian Extinction

3. Permian–Triassic Extinction

4. Triassic–Jurassic Extinction

5. Cretaceous–Paleogene Extinction



Horseshoe crabs successfully survived all the major prehistoric mass extinctions, persisting virtually unchanged into the present day. Throughout their evolutionary trajectory, horseshoe crabs endured **ice ages, intense volcanic eruptions, and meteor impacts**—yet their body structure remains almost identical to that of their ancestors.



@HCRC



©Shubham Chatterjee



2

What Kind of Organism Is the Horseshoe Crab?

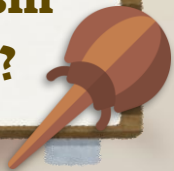


Now you know that horseshoe crabs are far more resilient than many ancient organisms! But what kind of animal are they, exactly?



2

What Kind of Organism Is the Horseshoe Crab?



Now you know that horseshoe crabs are far more resilient than many ancient organisms! But what kind of animal are they, exactly?

Guess which of these animals is a close relative of the horseshoe crab!

?



© OWLHK

Insect



© OWLHK

Scorpion



© Vito | OWLHK

Crab



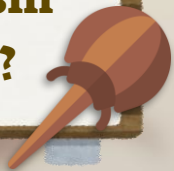
© OWLHK

Centipede



2

What Kind of Organism Is the Horseshoe Crab?



Now you know that horseshoe crabs are far more resilient than many ancient organisms! But what kind of animal are they, exactly?

Guess which of these animals is a close relative of the horseshoe crab!

?



Insect



Scorpion



Crab



Centipede



2

Horseshoe Crabs Are Not Crabs!

Despite having "crab" in their common name, horseshoe crabs are taxonomically more closely related to spiders and scorpions than to true crustaceans!



Trilobite

Trilobita

Extinct



Scorpion

Arachnida



Horseshoe
Crab

Merostomata



Centipede

Chilopoda



Crab

Malacostraca



Insect

Insecta



Taxonomy

Organisms are classified into a hierarchy of **kingdom, phylum, class, order, family, genus, and species** based on physical traits. For example, the horseshoe crab falls into the kingdom **Animalia**, phylum **Arthropoda**, subphylum **Chelicerata**, class **Merostomata**, order **Xiphosura**, and family **Limulidae**.

2

Horseshoe Crabs Are Not Crabs!

So, how do horseshoe “crabs”
and true crabs actually differ?



Merostomata

Malacostraca

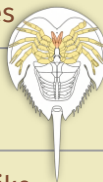
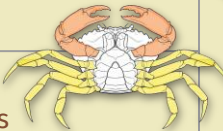


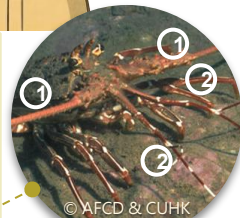
Crab

VS



Horseshoe
Crab

	Horseshoe Crabs	Crabs, Shrimps, Lobsters, etc
Body Structure	Divided into three main parts: 1. Horseshoe-shaped head and thorax 2. Hexagonal abdomen 3. Long tail spine 	Divided into three main parts: 1. Flattened head and thorax 2. Segmented abdomen 3. Shortened tail 
Antennae	None	2 pairs
Mouthpart	Lack mandibles (jaws), use specialised appendages	With mandibles (true jaws)
Legs	1 pair of chelicerae + 5 pairs of walking legs 	1 pair of claws + 4 pairs of walking legs 
Gills	Book gills: external, page-like structures	Filamentous / Lamellar gills: enclosed internally



© AFCD & CUHK



© Saxophute

2

Horseshoe Crabs Are Not Crabs!



However, taxonomically speaking, horseshoe crabs are actually more closely related to spiders and scorpions!

Chelicerata

The class Merostomata (horseshoe crabs) and the class Arachnida (spiders, scorpions, mites, and ticks) are closely related because both belong to the **subphylum Chelicerata**.

They possess a pair of specialised appendages called **chelicerae situated in front of the mouth**, which they use mainly to **hold and manipulate food**. In some arachnids, chelicerae can **inject venom into prey to pre-digest tissues**.



Scorpion

Arachnida



Horseshoe
Crab

Merostomata



© Marshal Hedin

Sun Spider



© Mila

Horseshoe
Crab



© Steven Clark

Spider

2

Horseshoe Crab Are Not Crabs!



However, taxonomically speaking, horseshoe crabs are actually more closely related to spiders and scorpions!



Merostomata

Horseshoe crabs are classified under the class Merostomata (meaning 'thigh mouth') because their **feeding appendages are situated around their mouth** to assist in food processing.



Scorpion

Arachnida



Horseshoe Crab

Merostomata



Appendages

Mouth



The Remarkable Body of Horseshoe Crabs



As we have seen, horseshoe crabs occupy a unique place in biological and taxonomic classification.

This uniqueness is also clearly reflected in their **body structure**—possessing distinct features that are virtually absent in other living species!

Now, let's closely examine the fascinating functional morphology of the horseshoe crab.



The Remarkable Body of Horseshoe Crabs



Guess the colour of oxygenated
blood in horseshoe crabs!



Red



Blue



Colourless



No Blood



3

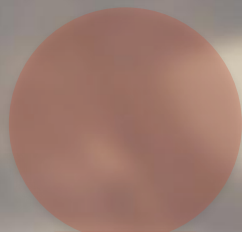
The “Blue-Blooded” Horseshoe Crabs



Do you know what colours human blood turns under oxygenated and deoxygenated conditions, respectively?

Guess the colour of oxygenated
blood in horseshoe crabs!

?



Red



Blue



Colourless



No Blood

Color-Changing



In fact, when a horseshoe crab's blood is **deoxygenated**—such as when returning from its body tissues—it appears completely **colourless**.

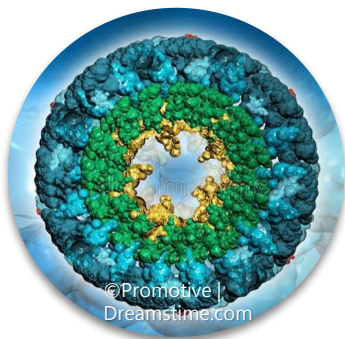


3

The “Blue-Blooded” Horseshoe Crabs



Horseshoe crab blood utilizes a copper-based protein called haemocyanin to transport oxygen. When oxygen binds to these copper ions, it triggers a structural transformation that shifts the fluid to a vibrant blue colour.



Haemocyanin

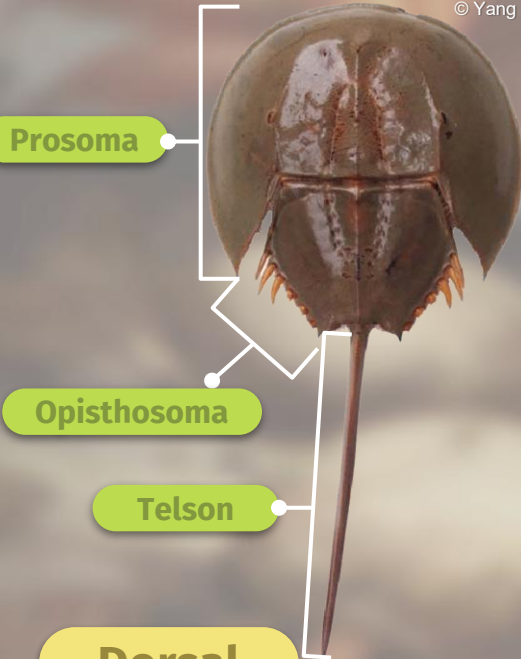


Blue

The Remarkable Body of Horseshoe Crabs



© Yang & Ko, 2015



Prosoma

Opisthosoma

Telson

Dorsal



Mouth

6 pairs of
appendages

Layers of gills
(book gills)

Ventral

It is precisely through these unique physiological adaptations that horseshoe crabs have successfully overcome countless environmental challenges!



4

The Horseshoe Crab's Breathing Secret



© Casey R. Culligan

Book Gills

- Use gills to extract dissolved oxygen from water
- Multiple layered, leaf-like membranes stacked together like pages of a book
- Moisture-trapping stacked design for survival out of water
- First pair of book gills (operculum) protecting reproductive organs
- Capable of absorbing water during moulting to swell and split the old exoskeleton
- Assist in underwater locomotion



© Baylon & Alcantara-Creencia, 2022

5

The Multi-Functional Legs of Horseshoe Crabs



Appendages

- Horseshoe crabs possess one pair of chelicerae and five pairs of walking legs.
- Each walking leg moves independently, allowing agile navigation across varied substrate surfaces.
- In adult males, the first two pairs of walking legs are modified into **hook-like structures** to securely grasp the female during mating.
- The final pair of legs branches features flattened **leaf-like flap structures**, acting as paddles to push them through water.
- **Chemoreceptors** covering the legs detect the environment and “taste” food to locate prey.



Chemoreceptors



Both horseshoe crab species native to Hong Kong possess two pairs of highly specialized walking legs adapted for mating and locomotion!

5

The Multi-Functional Legs of Horseshoe Crabs



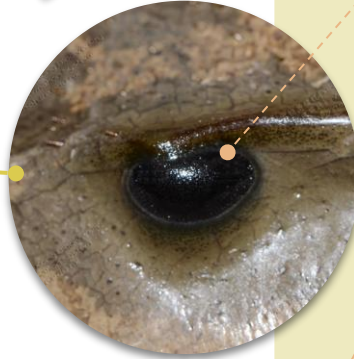
Modes of Locomotion



- Spend the vast majority of their time walking along the seabed
- **Flip upside down and swim** using their abdominal book gills and legs for propulsion on specific occasions (e.g., escaping predators or migrating nearshore to spawn)

6

The Amazing Vision of Horseshoe Crabs



Compound Eyes

- A pair of large **compound eyes** on the dorsal carapace providing motion detection and high-contrast acuity exceeding many insects
- **Rudimentary lateral eyes** behind each compound eye
- Three anterior dorsal eyes (ocelli) detecting **visible, ambient, and ultraviolet (UV) light**
- Light-sensing cells along the telson (tail)
- A pair of **ventral eyes** near the mouth assisting with orientation and benthic prey detection while crawling



Anterior oral eyes

© sierra_b

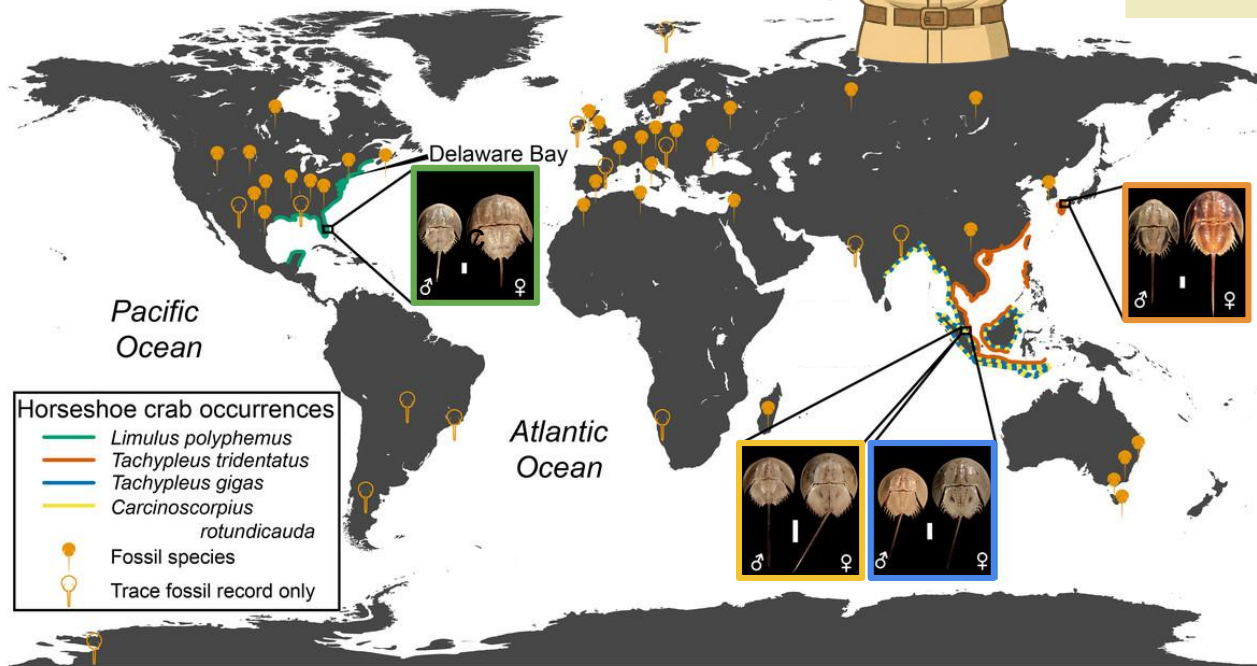
7

The Global Footprints of Horseshoe Crabs



You don't need to visit an archaeological site to encounter a “living fossil”!

Today, there are only **4 extant (living) species** of horseshoe crabs remaining worldwide, restricted to the **North America** and **Asia**.



Atlantic Horseshoe Crab



Chinese Horseshoe Crab



Indo-Pacific Horseshoe Crab



Mangrove Horseshoe Crab

8

A Moonlight Date for Horseshoe Crabs



How do horseshoe crabs locate each other across the open ocean?

?



- Mature males and females **gather on beaches** at high tide to mate and lay eggs, then return to the deep ocean.
- Spawning peaks during **summer full moons and high tides**.
- Ocelli **detect lunar UV light** to precisely time onshore spawning migrations.



© Erica Lauer Vose



REMINDER

Though we know where they are, horseshoe crabs only appear onshore during these precise seasonal high tides!



A Moonlight Date for Horseshoe Crabs

Hatching:

Newly hatched larvae lack a tail (telson). They drift in shallow water feeding on organic debris.

Growing:

Juveniles hide in mudflats, feeding on algae and worms. Takes 10+ years and multiple moults to mature.

Maturing:

Adults move to the seabed to live.

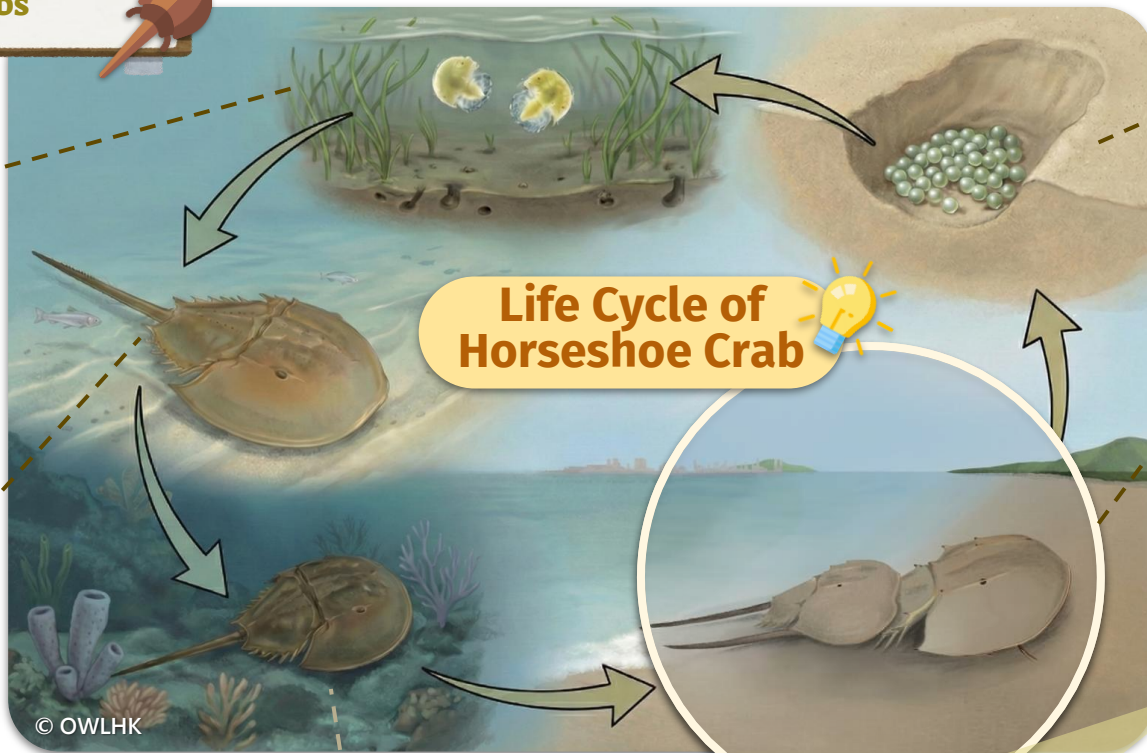
Spawning:

Females bury eggs in the sand, where solar heat hatches them.

Mating:

Adults return to intertidal beaches to mate.

Life Cycle of Horseshoe Crab



The life cycle of the horseshoe crab is a grand migration traversing coastal fringes and the benthic ocean!



A Moonlight Date for Horseshoe Crabs



Life Cycle of Horseshoe Crabs



- Juvenile horseshoe crabs spend their first 10 years inhabiting intertidal sandy beaches and mudflats.
- Upon reaching sexual maturity, adults migrate to inhabit deeper ocean sea beds.

初生馬蹄蟹的寬度和長度約半厘米。
牠們約需要十個年頭。

A newly hatched horseshoe crab is about 0.5 cm in length and width. After moulting for about 17 times (at about age 10), they reach sexual maturity at a length of more than 40 cm



© OPCFHK



Playback Time: 00:00 – 00:13

The Amazing Horseshoe Crabs



As we have seen, the horseshoe crab possesses truly unique physiological and behavioural adaptations. Maintaining this primitive form and surviving unchanged through millions of years is a remarkable achievement.

In our next lesson, we will explore the environmental pressures and human-induced challenges threatening their survival today.





Summary



- Horseshoe crabs have existed on Earth for over 400 million years, retaining their **primitive morphological traits** while successfully adapting to modern marine environments, making them true “**living fossils**”.
- Belonging to the class **Merostomata (subphylum Chelicerata)**, horseshoe crabs are more closely related to arachnids (spiders and scorpions) than to true crustaceans.
- Their life history is tightly linked to **tidal regimes**; **intertidal sandy beaches and mudflats** serve as critical spawning grounds and juvenile nursery habitats.





1. Threats Faced by Horseshoe Crabs

- a. Coastal Development
- b. Marine Pollution
- c. Ghost Nets
- d. Overexploitation
- e. Harvesting for Medical Use

2. Current Conservation Status

3. Conservation Efforts

- a. Habitat Preservation
- b. Legal Protection
- c. Fisheries Restrictions
- d. Monitoring & Research
- e. Citizen Science
- f. Breeding & Rehabilitation
- g. Ghost Net Removal
- h. Public Education



Recap of the Last Session



Can you recall these key biological terms and concepts?



Geological timescale

Haemocyanin

Taxonomic classification

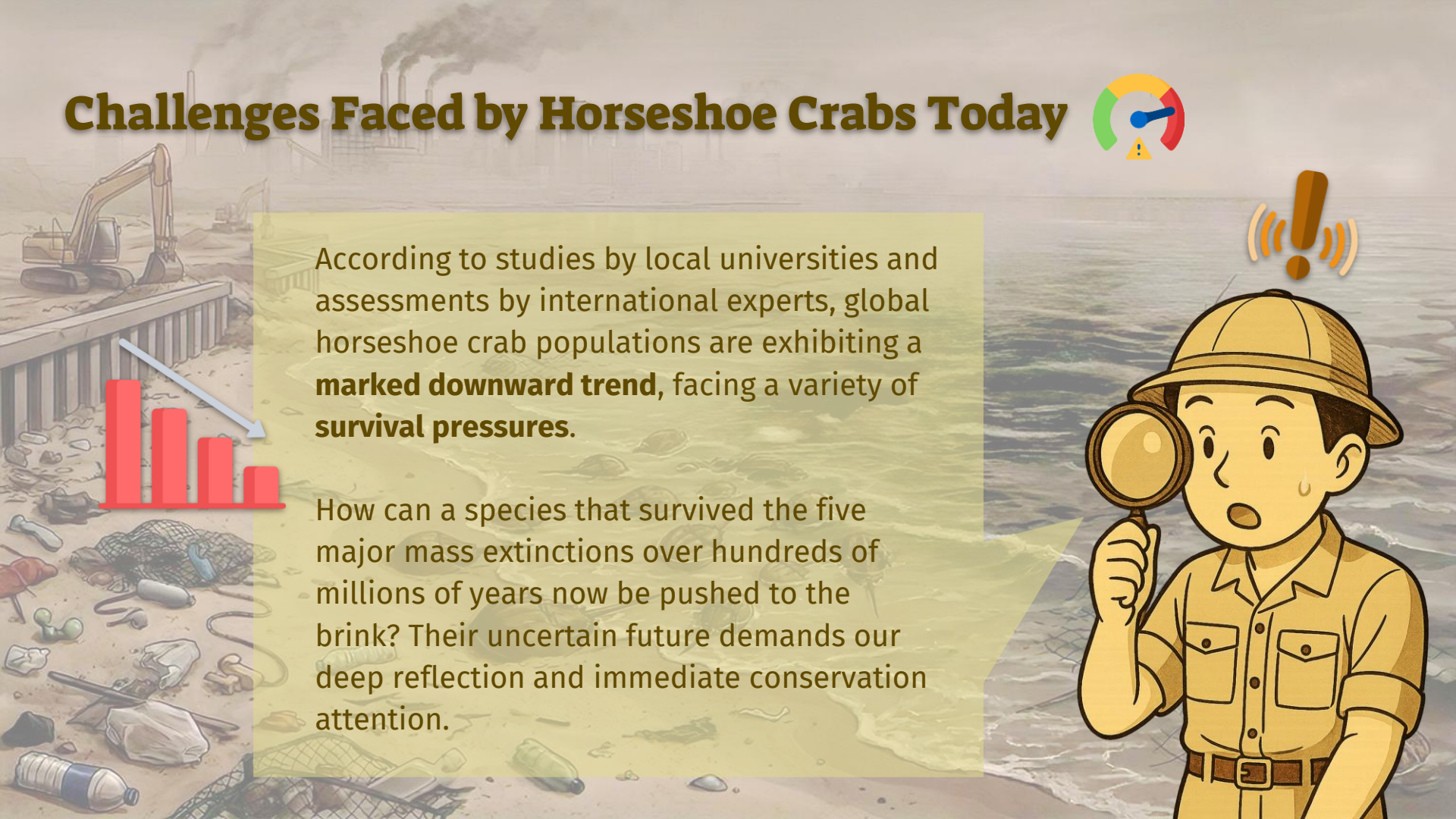
Modes of locomotion

Mass Extinctions

- Horseshoe crabs have existed on Earth for over 400 million years, retaining their **primitive morphological traits** while successfully adapting to modern marine environments, making them true “**living fossils**”.
- Belonging to the class **Merostomata (subphylum Chelicerata)**, horseshoe crabs are more closely related to arachnids (spiders and scorpions) than to true crustaceans.
- Their life history is tightly linked to **tidal regimes**; **intertidal sandy beaches and mudflats** serve as critical spawning grounds and juvenile nursery habitats.



Challenges Faced by Horseshoe Crabs Today



According to studies by local universities and assessments by international experts, global horseshoe crab populations are exhibiting a **marked downward trend**, facing a variety of **survival pressures**.

How can a species that survived the five major mass extinctions over hundreds of millions of years now be pushed to the brink? Their uncertain future demands our deep reflection and immediate conservation attention.



Challenges Faced by Horseshoe Crabs Today



- In 1980s, populations of two local species have experienced drastic declines due to urban development, overfishing and pollutions.
- The long maturity periods and low growth of the juveniles make horseshoe crabs highly susceptible to costal developments in the vicinity of their nursery grounds.
- Adult horseshoe crabs of both species were vulnerable to bottom trawling, but since this was banned in Hong Kong in December 2012, this threat to adult horseshoe crabs no longer exists, which could result in a stabilization of adult populations.

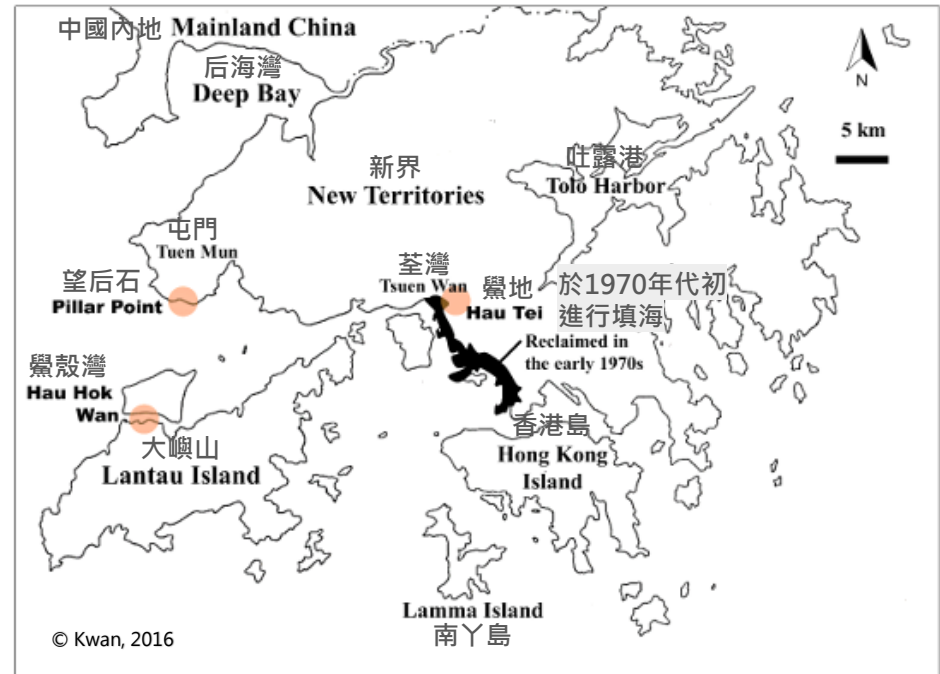


Threat: Coastal Development



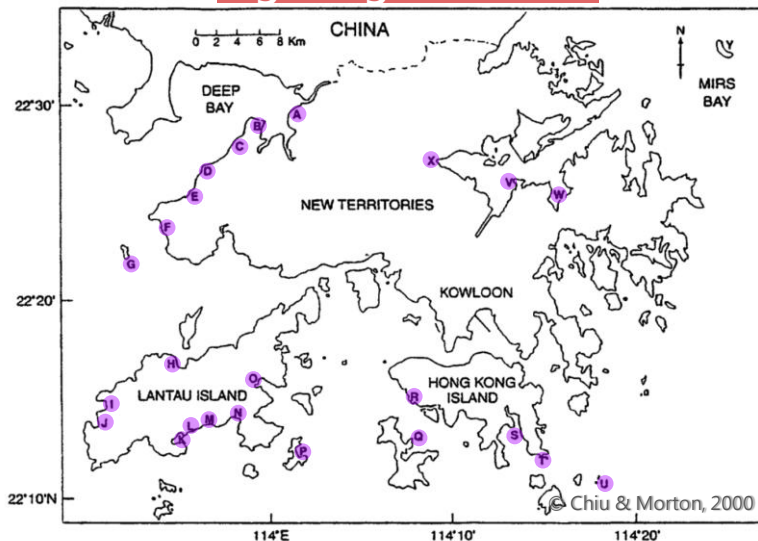
Places Across Hong Kong Named After the Horseshoe Crab

Over 60 years ago, shallow mudflats along the Tsuen Wan coast served as a thriving natural habitat for horseshoe crab populations.



Threat: Coastal Development

Historical Horseshoe Crabs Sighting Locations



Before 1995

Rapid urban reclamation and coastal infrastructure projects have destroyed key **spawning and juvenile nursery sites**. In locations where horseshoe crabs were once abundant, land-use changes have completely eliminated their habitats—leaving no trace of their presence today.



Which historical horseshoe crab habitats have been lost to land reclamation?



Threat: Marine Pollution



Polyethylene Terephthalate (PET) is a widely used thermoplastic polymer, most commonly found in commercial single-use beverage containers such as water bottles.

Over time, discarded PET plastics undergo weathering and mechanical breakdown, fragmenting into pervasive microplastics.



© Fred Dott / Greenpeace

Microplastics are defined as synthetic plastic particles measuring less than 5mm in diameter.

Threat: Marine Pollution



- Funded by the Marine Ecology Enhancement Fund (MEEF) of the Airport Authority Hong Kong, a collaborative research team from PolyU and CityU **investigated the threat of common local microplastics to the Chinese Horseshoe Crab.**
- Laboratory-reared juveniles exposed to environmental concentrations of microplastics exhibited severe physiological and behavioural impairments:
 - **Growth rates for total body weight and prosomal dimensions decreased by 3% to 7%.**
 - **Activity and movement inclination dropped by 60%.**



Threat: Marine Pollution



再從中辨識不同種類的微塑膠

Threat: Ghost Nets



**“Ghost Nets”:
abandoned nets in the Sea**

- Entanglement in ghost nets causes severe injuries and can even be fatal.
- While clearing ghost nets off Lantau Island, a conservation group discovered that just two large discarded nets had trapped 12 adult Mangrove Horseshoe Crabs.

Can you locate the horseshoe crab in the photo below?



© 風火山林

Threat: Overexploitation

- In Hong Kong, fishermen generally would not catch horseshoe crabs as locals rarely eat them.
- Horseshoe crabs are still consumed as **food** in certain parts of Asia.



Threat: Overexploitation



In 1998, 2.7 million horseshoe crabs were harvested to serve as bait for fisheries

- Atlantic horseshoe crabs were harvested to **serve as bait** for the American eel (*Anguilla rostrata*) and conch fisheries along the Atlantic coast.
- Severe bait shortages in North America shifted commercial pressure onto Asian species. In 2011, approximately **2,000 Asian-native horseshoe crabs were exported** to the United States to supply the commercial bait market.



© Tommy Eskridge



© Ellen Edmonson and Hugh Chrisp

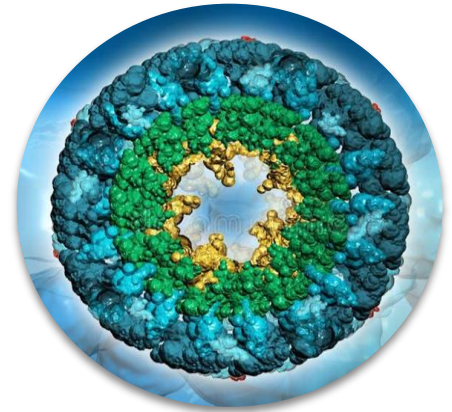
Threat: Harvesting for Medical Use



- The blue blood of horseshoe crabs has antibacterial properties and is used to produce LAL (Limulus ameocyte lysate) to test vaccines and medicines (such as COVID-19 vaccines) for harmful bacteria.
- While some countries cap blood extraction at 30% per session, others have no such restrictions.



Studies indicate that in the United States, up to 30% of harvested individuals die post-extraction following their release back into the marine environment.



How Do We Know If Species Are Threatened?



國際自然保護聯盟

International Union for
Conservation of Nature (IUCN)

International Union for Conservation of Nature (IUCN) is the world's largest conservation organization, consisting of government and non-government members worldwide.

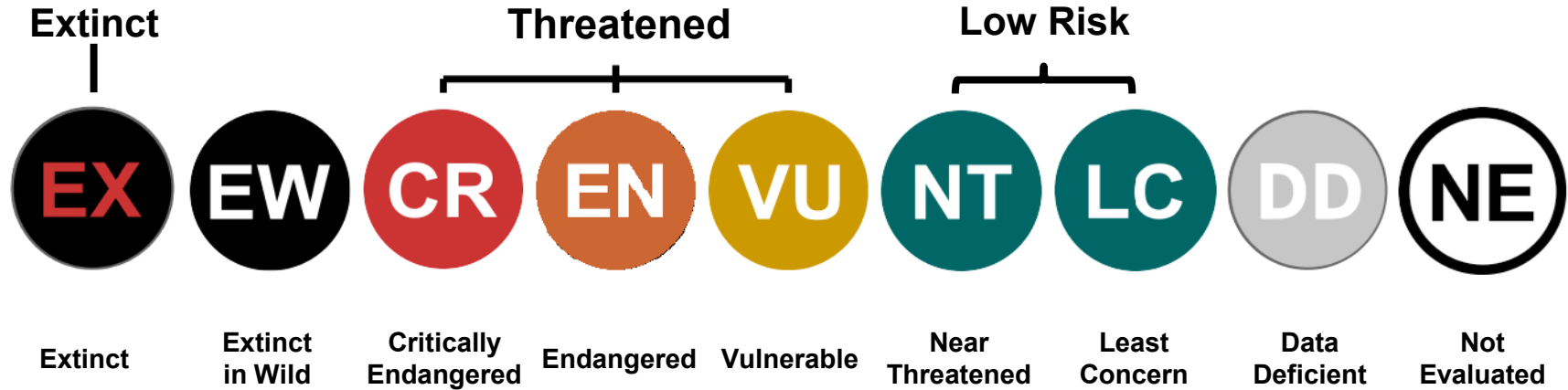
How Do We Know If Species Are Threatened?



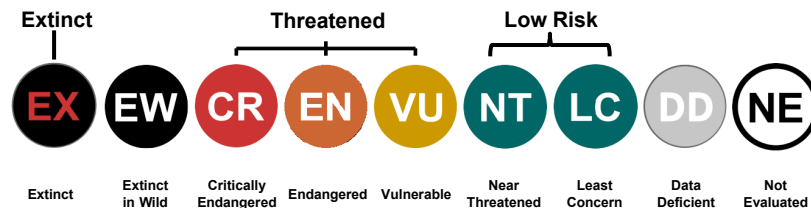
瀕危物種紅色名錄 Red List

- To assess the **conservation status** of animals, plants, and fungi, the IUCN compiles a dedicated list that categorises species according to their level of threat.

How Do We Know If Species Are Threatened?



Current Conservation Status of Species in HK



Can you identify the IUCN Red List category for the following native species?



© OPCF

Chinese White Dolphin



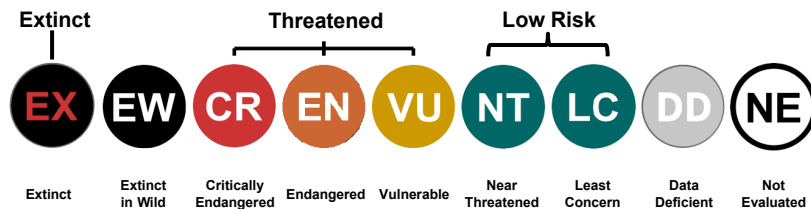
© OWLHK

Romer's Tree Frog



Chinese Pangolin

Current Conservation Status of Species in HK



< VULNERABLE >

VU



Chinese White Dolphin



< ENDANGERED >

EN



Romer's Tree Frog



< CRITICALLY
ENDANGERED >

CR



Chinese Pangolin

Current Conservation Status of Horseshoe Crabs



Think About It!

Does "Data Deficient" imply a lack of threat?



< VULNERABLE >

VU



Atlantic Horseshoe Crab



< ENDANGERED >

EN



Chinese Horseshoe Crab



DATA
DEFICIENT
DD



Indo-Pacific Horseshoe Crab



DATA
DEFICIENT
DD



Mangrove Horseshoe Crab

Current Conservation Status of Horseshoe Crabs



Chinese Horseshoe Crab



Mangrove Horseshoe Crab

The two species also belong to Grade II National Key Protected Species under “China's List of Wildlife under Special State Protection”

国家重点保护野生动物名录

中文名	学名	保护级别	备注
阿波罗绢蝶	<i>Parnassius apollo</i>	二级	
君主绢蝶	<i>Parnassius imperator</i>	二级	
灰蝶科	<i>Lycaenidae</i>		
大斑鑫灰蝶	<i>Maculinea arionides</i>	二级	
秀山白灰蝶	<i>Phengaris xiushani</i>	二级	
蛛形纲 ARACHNIDA			
蜘蛛目	ARANEAE		
捕鸟蛛科	Theraphosidae		
海南塞勒蛛	<i>Cyriopagopus hainanus</i>	二级	
肢口纲 MEROSTOMATA			
剑尾目	XIPHOSURA		
鲎科#	Tachypleidae		
*中国鲎	<i>Tachypleus tridentatus</i>	二级	
*圆尾蝎鲎	<i>Carcinoscorpius rotundicauda</i>	二级	
软甲纲 MALACOSTRACA			
十足目	DECAPODA		
龙虾科	Palinuridae		
*锦绣龙虾	<i>Panulirus ornatus</i>	二级	仅限野外种群
软体动物门 MOLLUSCA			
双壳纲 BIVALVIA			
珍珠贝目	PTERIOIDA		
珍珠贝科	Pteridae		
*大珠母贝	<i>Pinctada maxima</i>	二级	仅限野外种群
帘蛤目	VENEROIDA		
砗磲科#	Tridacnidae		

Conservation Efforts of Agriculture, Fisheries and Conservation Department (AFCD)



1. Establishing and managing **Marine Parks and Marine Reserves** to protect critical coastal habitats and vulnerable marine species
2. Reviewing the ecological impacts of designated development projects under the **Environmental Impact Assessment Ordinance** to minimize adverse impacts on horseshoe crabs
3. Partnering with diverse stakeholders to **conduct systematic monitoring** of local horseshoe crab demographics and spatial distribution
4. Enforcing the **ban on commercial bottom trawling and destructive fishing methods** to restore benthic habitats and marine ecosystem health
5. Conducting marine debris clearance operations to **remove ghost nets** and rescue entangled horseshoe crabs
6. Organising **education and promotional activities** to raise awareness regarding horseshoe crab conservation



Conservation Efforts: Legal Protection



Marine Parks Ordinance (Cap. 476)

- ✓ Horseshoe crabs are listed as "Protected Marine and Coastal Species" under the ordinance.
- ✓ It provides legal protection for horseshoe crabs living within Marine Parks and Marine Reserves.



No person shall take, remove, injure, destroy or willfully disturb a nest, egg, young, or nesting ground of any protected marine and coastal species in a marine park or marine reserve.

Conservation Efforts: Habitat Preservation



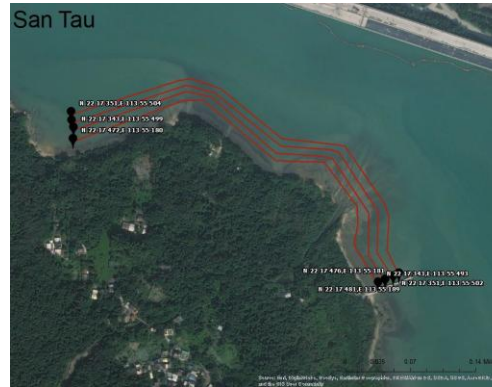
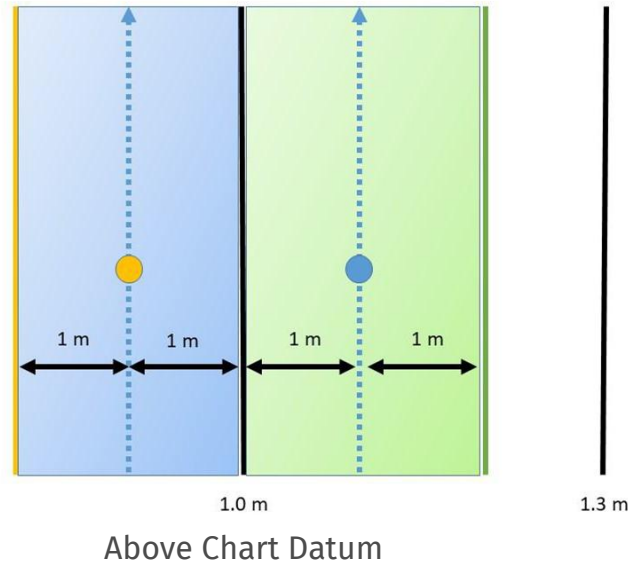
- Key intertidal horseshoe crab habitats, such as critical spawning beaches and nursery mudflats, have been designated as **Sites of Special Scientific Interest (SSSIs)** to safeguard their exceptional ecological value.
- When **development projects are proposed near or within these SSSIs**, environmental planning regulations require rigorous evaluation to prevent, minimize, and mitigate adverse impacts on the surrounding ecological environment.



Conservation Efforts: Monitoring & Research



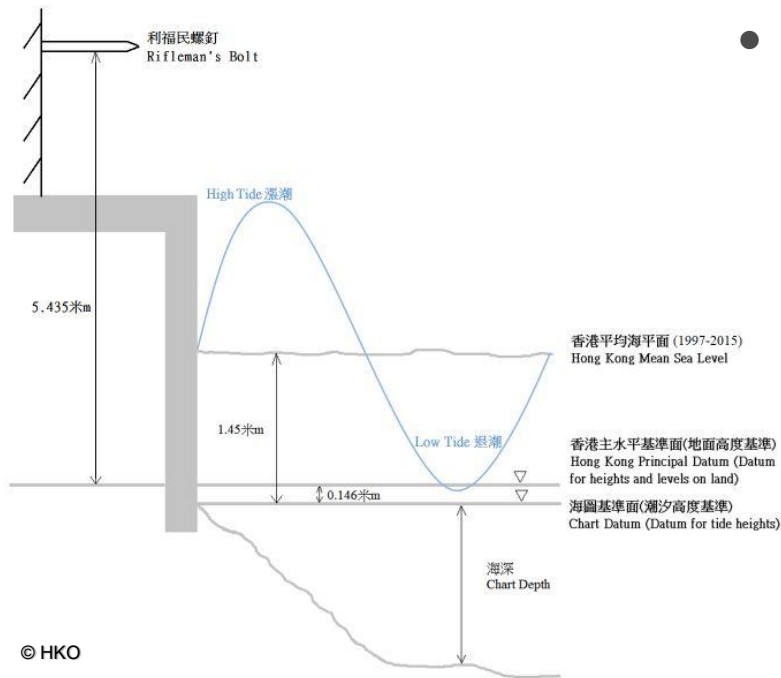
Transect Survey



- Area searched by Person A for 1.0 m above CD
- Area searched by Person B for 1.0 m above CD
- Person A
- Person B
- Transect line
- Survey path

- Long-term AFCD-commissioned university censuses across intertidal mudflats monitoring juvenile horseshoe crab abundance and spatial distribution
- Record prosomal width, total length, species, and environmental variables (e.g., water temperature, salinity, and pH levels)
- Successful identification of living juvenile populations at Hau Hok Wan (鰲殼灣), a historical site previously presumed to have suffered local extirpation

Conservation Efforts: Monitoring & Research (Population)



- **What is “Chart Datum (CD)”?**
 - A standardized reference vertical baseline to measure sea level elevations, tidal heights, and water depths
 - Establishing a fixed reference level to standardise navigational and ecological measurements amidst continuous tidal fluctuations
 - Conventionally set close to the lowest predicted tide level

Conservation Efforts: Monitoring & Research (Population)



Quadrat Survey



	Transect Survey	Quadrat Survey
Primary Objective	Assess spatial distribution and total abundance across entire coastlines	Collect high-precision quantitative metrics (density, body size, age/instar classes)
Spatial Scale	Broad coverage; evaluates large contiguous intertidal zones	Micro-scale; bound within defined metric frames
Target Detection	Visually prominent juveniles and adult individuals	Able to captures tiny, newly settled early-stage instars
Primary Application	Rapid ecological screening and initial baseline assessments	Long-term standardized monitoring for historical trend analysis

Conservation Efforts: Monitoring & Research (eDNA)



- Deoxyribonucleic acid (DNA) is the fundamental molecule storing hereditary information in living organisms.
- As organisms interact with their surroundings, they shed metabolic waste and biological material—including bodily fluids, epidermal cells, and faecal matter—which releases trace extracellular DNA that accumulates in marine sediments and the water column.
- Commissioned by the AFCD, a research team from CUHK **collects water and benthic sediment samples** from intertidal mudflats to screen for horseshoe crab **environmental DNA (eDNA)**.

Conservation Efforts: Horseshoe Crab Sighting Report



感謝你提供在本地自然生境發現馬蹄蟹的報告。這些資料將幫助我們更了解馬蹄蟹在自然生境中的分布、品種和數量。請注意，如果你發現馬蹄蟹被困於棄置漁具中，可於自身安全情況下將其救出，並在附近適合的地方釋放。如有需要協助，請致電3468 5394與我們聯絡（辦公時間：星期一至五早上9點至下午5點30分，公眾假期除外）。



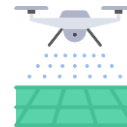
- Members of the public who spot horseshoe crabs in the wild are encouraged to report their sightings to AFCD via an official **online reporting form**.
- To enhance data quality, citizens can submit key ecological observations alongside the discovery date and precise geolocation: **habitat type, species identification, body size**, etc.

Conservation Efforts: Market Surveys & Outreach



- Commissioned by the AFCD, WWF-HK launched the “Horseshoe Crab Counts” campaign. The initiative encourages local seafood restaurants and market stalls to **pledge not to sell or display horseshoe crabs**, issuing window stickers for public recognition.
- Market surveys indicate that commercial horseshoe crabs offered in seafood outlets primarily originate from **waters outside Hong Kong**.
- Local fishers report that adult horseshoe crabs possess low market value; consequently, most **indicate a willingness to release individuals** accidentally caught as bycatch.

Conservation Efforts: Monitoring & Research (Artificial Intelligence)



Think About It!

What are the advantages of AI-powered drone surveys?

An ECF funded joint initiative by OPCFHK, CUHK, and CityU utilising unmanned aerial vehicles (drones) and AI computer vision to detect, identify, and map native horseshoe crabs while collecting environmental spatial data

Conservation Efforts: Monitoring & Research (Underwater Acoustic)



Think about It!

**Beyond tracking movement patterns,
what additional ecological and
environmental data can be collected?**

- Conducted by the OPCFHK in partnership with corporate
- Monitoring coastal marine waters along East Lantau, primarily Tung Chung Bay, Hau Hok Wan, and Sha Lo Wan
- Submerged acoustic receivers deployed on the seafloor
- Acoustic transmitters/tags secured externally onto adult carapaces prior to release back into the study area



Conservation Efforts: Breeding & Rehabilitation



Survival rate jumped
from 0.01% to 76%.

CityU breeds
juvenile horseshoe
crabs in
laboratories.



© OPCFHK



Secondary students
monitor and **care**
for the juveniles in
schools.



© OPCFHK



Microchips are
implanted to track
survival rates.



© OPCFHK



Horseshoe crabs are
released into natural
habitats with
ongoing monitoring.



© OPCFHK



© OPCFHK



© OPCFHK



© OPCFHK



© OPCFHK

Conservation Efforts: Prohibiting Trawling & Destructive Fishing Practices

Enacted subsidiary regulations under the Fisheries Protection Ordinance (Cap. 171)

- ✓ Banned non-selective bottom trawling on Dec 31, 2012, and further regulated collapsible cage traps ("snake cages") over 5 meters on Apr 1, 2022
- ✓ Post-ban studies demonstrating a significant **increase in marine benthic abundance and biodiversity**, helping stabilize Hong Kong's adult horseshoe crab populations

Ecology and Biodiversity of Benthic Marine Ecosystems Before and After the Trawling Ban in Hong Kong Coastal Waters

Fisheries resources in Hong Kong had been overexploited since the 1970s. Yet, approximately 400 bottom trawlers still operated in our coastal waters, accounting for 80% of the total fishing effort, nearly double the environmentally-sustainable level. These bottom trawlers capture fishes, shrimps and crabs unselectively, irrespective of their commercial or ecological value, and have demonstrably overexploited many stocks. The process of bottom trawling also leads to severe and repeated physical damage to marine benthic ecosystems, with negative effects on biodiversity. To mitigate these impacts, the Hong Kong SAR Government has imposed a territory-wide ban on bottom trawling from 31 December 2012; this is intended to allow recovery of the seabed and associated marine resources.



Our project team tested the overarching hypothesis that the trawl ban would result in the recovery of HK's benthic marine ecosystems and associated fisheries. The research team collected sediment samples with five replicates from each of 28 locations in Hong Kong waters in June 2012 (prior to the trawl ban) and two and a half years after the trawl ban, and then examined for physicochemical properties and macro-benthic animals.



Conservation Efforts: Ghost Net Removal



Conservation Actions by AFCD and Local Environmental Groups (Since 2024):

- **Regular Patrols and Monitoring:** Patrolling critical intertidal spawning beaches and juvenile nursery grounds to protect vulnerable breeding populations
- **Wild Emergency Rescue:** Actively clearing "ghost nets" and immediately rescuing trapped or stranded horseshoe crabs

Conservation Efforts: Public Education



主辦機構 協辦機構

賞·惜 海洋野生動物
MARINE WILDLIFE APPRECIATION

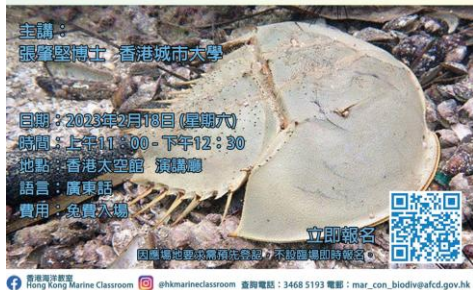
13/1 至 13/2 (逢星期六、日及新年紅日)
10:30am-7:00pm
威威天地@海洋公園

重點推介：
四大體驗攤位！
可愛手偶劇！
教育講座及導賞團！
及更多！

A colorful cartoon illustration of a coastal scene. On the left, a grey whale breaches the water. In the center, two pink dolphins leap. The foreground shows a sandy beach with various sea creatures: a green horseshoe crab, several small fish, and coral. The background features a blue sky and a green hill.

Government departments partner with environmental organisations and academic institutions to organise public education campaigns and conservation initiatives (e.g., joint educational booths and guided eco-tours organised by AFCD and Ocean Park Hong Kong).

Conservation Efforts: Public Education



The government organises public education campaigns—including academic lectures, interactive exhibitions, field excursions, coastal cleanup activities, and portable display board loan services—to enhance public awareness regarding horseshoe crab conservation.

Conservation Efforts: Be a Horseshoe Crab Guardian



Participate in beach cleanups to remove ghost nets

Do not buy or eat horseshoe crabs

Choose reusables to prevent ocean pollution

Share horseshoe crab sightings with the AFCD

Avoid destructive tours or non-scientific release events

Do not disturb or harm horseshoe crabs

Conservation Efforts: Be a Horseshoe Crab Guardian



**Beyond ongoing initiatives,
what further measures can the government and scientific
community implement to protect horseshoe crabs?**

(Discuss based on the prompts below)



Government

How can we prohibit or restrict specific human activities that threaten horseshoe crabs?



Scientist

What research projects should be conducted to mitigate the impacts of marine pollution on horseshoe crabs?

Summary (1)

- Major Threats to Horseshoe Crabs
 - Coastal Development
 - Marine Pollution
 - Ghost Nets
 - Overexploitation
 - Harvesting for Medical Use
- Utilising the IUCN Red List of Threatened Species to assess global extinction risks and vulnerability levels
- Threatened Species: Chinese Horseshoe Crab and Atlantic Horseshoe Crab

Summary (2)

- Insufficient data currently available to evaluate the Indo-Pacific Horseshoe Crab and Mangrove Horseshoe Crab
- Collaborative Conservation Actions with AFCD and the society
 - Habitat Protection
 - Legal Compliance
 - Monitoring & Research
 - Market Surveys & Outreach
 - Rehabilitation Programs
 - Sightings Report
 - Public Education
 - Personal Action