出國報告（出國類別：開會）

出席「國際自然保育聯盟（IUCN）第5屆國際鱟工作坊」會議報告

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派赴國家/地區：新加坡
出國期間：113 年 6 月 19 日至 6 月 23 日
報告日期：113 年 9 月 23 日

摘要

國際自然保育聯盟（IUCN）第 5 屆國際鱟工作坊於 6 月 19 日至 23 日假新加坡聖淘沙名勝世界會議中心召開，由 IUCN 鱟專家小組與新加坡自然協會（Nature Society Singapore，NSS）主辦，透過各國專家學者分享及討論關於鱟物種的生物學、公眾教育、保育行動等各方面推動現況，制定清晰且實際的保育行動計畫。

全世界現存的 4 種鱟中以三棘鱟分布最廣，也是臺灣海域分布紀錄的種類，本署自 110 年起透過委託專業團隊、補助地方政府或民間團體等方式，積極辦理族群調查及教育宣導等保復育工作，並於 2023 年在金門縣、澎湖縣及臺灣本島進行標準化的三棘鱟族群量調查，初步建立臺灣三棘鱟族群的基線數據，並首度估算出金門縣成鱟及稚鱟族群量。基於歷年之教育推廣及調查研究成果，今年委請國立中山大學及嘉義縣生態保育協會，共同與會展示我國在三棘鱟之科學調查與保育成果，有助於提升我國在海洋保育工作之國際聲譽，並在會議期間蒐集 IUCN 及各國鱟保育策略，可作為我國三棘鱟保育工作推動之參考依據。

本次工作坊中多數研究主題聚焦於族群與棲地的保育，其中僅有美洲鱟有完整且長期的族群量評估數據，亞洲鱟族群調查及長期監測方面的研究至今仍不足，過去的研究無法提供有效的基礎數據來釐清物種的族群分布情況；相較之下，金門縣早期的基礎調查與標誌放流工作使其在族群評估與監測方面的研究成果豐碩，顯示長期投入三棘鱟野外族群調查之效益，臺灣本島其他地區則有待更多的資訊蒐集。人工復育是增加野外族群的重要方式之一，然而讓野外族群得以在自然環境下自力存續，才是物種保育之終極目標，由此可見棲地的保護尤為重要，我國隨著政府、研究學者及民間對三棘鱟的關注日益提升，物種保育漸入軌道，目前對於棲地的調查與持續監測，是族群復育工作應努力的方向。

目錄

壹、目的

國際自然保育聯盟（IUCN）第 5 屆國際鱟工作坊於 6 月 19 日至 23 日假新加坡聖淘沙名勝世界會議中心召開，由 IUCN 鱟專家小組與新加坡自然協會（Nature Society Singapore，NSS）主辦，透過各國專家學者分享及討論關於鱟物種的生物學、公眾教育、保育行動等各方面推動現況，制定清晰且實際的保育行動計畫。

全世界現存的 4 種鱟中，美洲鱟（*Limulus Polyphemus*）於 2016 年列入 IUCN 紅色名錄的易危等級（Vulnerable），於 2022 年被評估為資源中度耗盡；三棘鱟（*Tachypleus tridentatus*）於 2018 年列入紅色名錄為資料缺乏（Data Deficient），於 2019 年更新為瀕危等級（Endangered），然而對於三棘鱟之評估結果仍缺乏足夠科學資料；圓尾鱟（*Carcinoscorpius rotundicauda*）及巨鱟（*Tachypleus gigas*）目前則在紅色名錄顯示為資料缺乏（Data Deficient），正持續更新中。

IUCN 考量鱟族群皆面臨沿岸棲地被人為破壞、族群存續壓力升高等問題，自 2007 起極積投入資源，每 4 年舉辦 1 次全球性的鱟工作坊，第 1 屆 2007 年於美國紐約長島舉行，第 2 屆 2011 年於香港舉行，第 3 屆 2015 年於日本佐世保舉行，第 4 屆 2019 年於中國廣西舉行。第 5 屆因 COVID-19 大流行而推遲，在今（2024）年於新加坡以實體方式進行，內容包含特邀講座、主題演講及海報展示等，並分為 5 大主題共 7 場主題演講，茲述如下：

1. 族群與遺傳研究（Population & Genetics）
2. 公民科學與公眾意識（Citizen Science and Public Awareness）
3. 生物醫學與科技（Biomedical and Technology）
4. 生物學、生態學與人為影響（Biology, Ecology & Human Impacts）
5. 保育行動（Conservation I、II、III）

全世界現存的 4 種鱟中以三棘鱟分布最廣，也是臺灣海域分布紀錄的種類，本署自 110 年起透過委託專業團隊、補助地方政府或民間團體等方式，積極辦理族群調查及教育宣導等保復育工作，並於 2023 年在金門縣、澎湖縣及臺灣本島進行標準

化的三棘鱟族群量調查，初步建立臺灣三棘鱟族群的基線數據，並首度估算出金門縣成鱟及稚鱟族群量。基於歷年之教育推廣及調查研究成果，今年委請國立中山大學及嘉義縣生態保育協會，共同與會展示我國在三棘鱟之科學調查與保育成果，有助於提升我國在海洋保育工作之國際聲譽，並在會議期間蒐集 IUCN 及各國鱟保育策略，可作為我國三棘鱟保育工作推動之參考依據。

貳、過程

本屆工作坊匯集來自 19 個國家超過 50 篇論文，透過口頭演講及海報展示進行分享與交流，第 1 至 3 天主要為各國與會人員之主題演講，最後根據亞洲鱟面臨威脅的共同點與差異，決定了 4 個分組議題。第 4 天進行分組討論，並於全體會議中報告並達成共識。第 5 天為實地參訪活動，包含雙溪布洛濕地保護區（Sungei Buloh Wetland Reserve，SBWR）及在聖淘沙名勝世界中的 S.E.A.水族館。

一、 開幕典禮（Opening Ceremony）

6 月 19 日首先由本屆主辦方－新加坡自然學會主席 Dr. Yeo Seng Beng 進行開幕致詞，第 5 屆國際鱟工作坊雖因 COVID-19 大流行而推遲，但仍延續先前在中國廣西、日本佐世保、香港及美國紐約舉辦工作坊的傳統。IUCN 17 年來持續關注亞洲鱟的保育，並於 2012 在韓國濟洲島舉辦的會議催生了 IUCN 鱟專家小組，資助許多地區投入鱟的調查與研究。新加坡也長年投入棲地與紅樹林保育、鱟的人工復育與族群風險評估等。

Dr. Yeo Seng Beng 指出本屆大會匯集的論文，多數研究主題聚焦於海岸棲地保育，這的確是鱟保育的關鍵議題，多數研究認為持續的科學研究與鱟資源的管理非常重要，尤其族群調查與風險評估為保育策略之基礎，完善的保育計畫則關乎鱟族群的存續。感謝 IUCN 持續協助各地區的研究伙伴，建構更好的科學資料與管理計畫，以更全面的保護鱟，尤其是三個亞洲物種，包含三棘鱟（*Tachypleus tridentatus*）、巨鱟（*Tachypleus gigas*）及圓尾鱟（*Carcinoscorpius rotundicauda*）。

接著由 IUCN 鱟專家小組聯合主席 Dr. Mark Botton 及 Dr. Paul Shin 等致詞，提及 IUCN 資助了 37 位第一次參加鱟工作坊的與會人員交通費，此方案意在鼓勵更多研究人員投入鱟的研究與成果交流。回顧 2011 年在香港舉辦第 2 屆 IUCN 鱟工作坊，為亞洲鱟的研究者建立了良好的學術網絡，所得相關數據為 IUCN 鱟瀕危等級評估的重要依據，也因此在 2019 年將三棘鱟列為瀕危（Endangered）物種，由此可知持續投入鱟的研究至關重要。

二、特邀講座（Keynote Presentations）

特邀講座 1：美洲鱟的族群現況及復育／Population Status and Recovery of the American Horseshoe Crab

美洲鱟的分布範圍從美國緬因州一直延伸到墨西哥猶加敦半島，覆蓋超過52,000公里的海岸線，因此在生態、豐度、威脅及管理方面皆存在顯著的區域差異。本報告總結近幾十年來管理及監測方面的進步、其分布範圍內的族群現況、未來趨勢及族群復育情形。

藉由回顧已發表的文獻及最近對該區域族群現況與趨勢的評估，重點介紹有關美洲鱟未來族群趨勢及復育潛力的綠色狀態評估（Green Status Assessment，GSA）結果，並提及公民科學及教育宣導在鱟資源管理中的作用。

現在許多關鍵棲地均由專業機構與公民科學進行族群的調查監測，例如大西洋沿岸族群以 4 年為週期的監測數據已納入同儕審查評估，用以調整鱟的允許捕獲量，但墨西哥灣及猶加敦州的族群並未定期評估。美州鱟試劑（LAL）行業已發展出能最大程度降低死亡率的最佳實踐（best practice）做法，但其採用是自願的，且各州的做法不盡相同。2019 年除紐約地區外，大西洋沿岸地區的族群狀況被評估為穩定或成長，關鍵棲地的最新趨勢也證實了目前的狀況，各州也將持續評估及修訂法規。綠色狀態評估（GSA）證實了捕獲量管理的重要，但也暴露出目前對棲地保護的重視不足。

1990年代末期保育提倡者針對鱟的過度捕撈敲響了警鐘，並提升了大眾對鱟資源管理的重視，因此美洲鱟的科學保育在過去 20 年中取得顯著進展。雖然人們越來越了解及可控制短期威脅，但其族群復育潛力仍受到沿岸開發與氣候變遷的長期影響，這些影響的不確定性高，且難以評估並研擬確切的減輕措施。

特邀講座 2：透過重組 C 因子的生物製劑基因工程來保育鱟／Conservation of Horseshoe Crab through Genetic Engineering of Rfc for Biomedical Applications

在革蘭氏陰性菌感染期間，細菌釋放的內毒素與人體細胞受體相互作用，導致發炎及發燒，在嚴重的持續感染中，過量的內毒素會導致感染性休克及死亡，內毒素的普遍存在對於製藥及醫療保健產業構成威脅。過去5年來，注射藥物和外科移植的品質管控（Quality Control，QC）一直依賴從美洲鱟血液中開發的試劑（Limulus Amoebocyte Lysate，LAL），但 LAL 測試需要捕捉鱟並將其放血，甚至會造成鱟的死亡。由於內毒素的變異、LAL的敏感性及特異性等問題，以及製作試劑對鱟族群的威脅，亟需一種更可靠的替代性內毒素測試。

本研究目的為對LAL中的內毒素敏感酶（endotoxin-sensitive enzyme）的生物感測器（biosensor）C因子（Factor C，FC）進行基因改造，以開發內毒素測試的人工合成試劑。透過分子重組技術，從圓尾鱟的變形細胞中分離 mRNA 並逆轉錄成 cDNA，複製並篩選C因子群落。選擇表徵最穩定的群落後，在各種宿主細胞中讓重組C因子（recombinant Factor C，rFC）表現，包含不同的酵母菌株、猴子、人類及昆蟲細胞，結果顯示重組C因子透過重組桿狀病毒系統在昆蟲細胞中有最佳表現。透過擴大表現，重組C因子被開發為具有一致性、快速且靈敏的細菌內毒素測試，等於或優於LAL。重組C因子測試已獲得美國、歐盟、中國及日本藥典的批准，並在全球範圍內採用作為注射藥物及疫苗品質管控的替代測試。

特邀講座 3：覆巢之下無完卵：全球海岸濕地的變遷對鱟保育的影響／No Intact Eggs in an Upturned Nest: Potential Impacts of Global Changes in Coastal Wetlands on Horseshoe Crab Conservation

基於全球最新數據，回顧沿海濕地數量及品質的變化趨勢，尤其是城市化、物種入侵及復育工作與這些變化的交互作用；並基於目前對沿海濕地及其相關動物群之間相互作用與依賴的認識，探討這些變化對沿海濕地無脊椎動物群的潛在影響，尤其是熱帶沿海濕地。

結果顯示沿海濕地擁有及豐富且高度多樣化的無脊椎動物群，其中有許多具有保育或商業價值的物種，城市化、物種入侵及近期大規模的復育工作，沿海濕地都對沿海濕地的數量（例如覆蓋面積）、品質（例如棲地複雜性）及其相關動物群造成了顯著的影響，鱟特殊的生態及生活史特性，可能增加了牠們對面對棲地變化的脆弱性。

全球都面臨沿海濕地面臨著城市化及物種入侵的巨大壓力，雖然復育工作可能增加濕地面積，但更重要的是保護多樣化、具功能性的沿海濕地，避免進一步的棲地喪失及退化，以促進對其相關無脊椎動物群（如鱟）的保護。

特邀講座 4：科學如何改善亞洲鱟的保育策略：中國北部灣的目標／How Science can Improve Asian Horseshoe Crab Conservation Management: Attempts in Beibu Gulf of China

根據2019年對46名鱟專家進行的問卷調查，亞洲鱟保育的未來重點是基線資料蒐集與威脅管理。在過去的 8 年裡，雖然已對中國北部灣的亞洲鱟族群及其棲地分布有更多的了解，但要將科學數據與其資源管理進行連結仍然相當困難，尤其現在亞洲鱟在中國並非重要的經濟物種。

綜觀北部灣許多推動鱟科學化管理的社區服務計畫，可歸納出以下結論：（1）辨識重要的產卵/育苗棲地有利於各海洋公園/保護區的管理及環境影響評估，此外，採用「IUCN 亞洲鱟監測網」的標準監測方法可確保資料品質，並可進行每年的資料比較；（2）了解產卵/育苗的高峰期（季或月份）對於制定有效的監測計畫及採取預警措施十分重要，以避免海岸工程造成沿海地區大規模的棲地喪失；（3）了解繁殖配對的成鱟在海域與陸地之間的移動情形，對於評估人為活動對產卵棲地造成的潛在威脅至關重要；（4）讓漁民社區與非政府組織合作可最大程度的發揮保育影響力。

本計畫顯示進一步了解核心棲地及其產卵、育苗及覓食棲地之謙關聯性的，對基於科學的決策，改善中國北部灣鱟族群的保育及管理具有重要意義。

特邀講座 5：IUCN 物種存續委員會專家小組的保育計畫評估工具簡介／Introduction to the Assess to Plan Conservation Planning Tool of the IUCN SSC Conservation Planning Specialist Group

IUCN物種存續委員會（SSC）保育規劃專家小組（CPSG）透過提高全球保育工作的成效來協助拯救受威脅物種，保育規劃專家小組（CPSG）的工作主要為擴大物種存續委員會（SSC）物種保育計畫的應用範圍，保育計畫過去通常集中於單一物種或族群，但現在正持續擴大至多物種群體。目前 CPSG的兩個主要目標為：（1）強化紅色名錄與保育計畫之間的聯繫，（2）開發一種工具以更快的將更多物種從評估階段轉移到保育規劃（根據物種存續委員會的評估-規劃-行動（ASSESS－PLAN－ACT）模式）。

保育規劃專家小組（CPSG）的評估到規劃（Assess to Plan，A2P）工具利用多個物種的IUCN紅色名錄資料分析及當地專家意見，來擬定對這些群體採取後續保護行動的步驟，以及最適合採取這些行動的人員或機構。此工具可作為IUCN紅色名錄評估框架的一部分（視情況結合紅色名錄評估會議與A2P流程）或已列入紅色名錄的物種規劃保育行動的獨立流程。

三、 主題演講（Sessions）

主題 1：族群與遺傳研究（Population & Genetics）

本節共有 7 位講者，分別介紹印尼、臺灣、印度目前鱟研究的進展。第 1 位講者以宏觀的角度介紹亞洲 3 種鱟的研究歷史及未來發展方向、主要共享棲地的位置及其重要性等，並建立地理分布與基因採樣制度，以評估族群大小並繪製種群遺傳結構圖。透過歷史族群動態及研究成果可了解鱟的分布與多樣性成因，並顯示環境變化顯著影響鱟的分布，但亞洲多數國家仍缺乏對於鱟的深入調查與長期監測研究，為提前布局保護措施，應強化棲地與物種演化間關聯性之研究，且監測工作應被重視並持續進行。

第 2 位講者主要介紹印尼巨鱟在其國內的分布與種群之間的差異，採用粒線體 AT-rich 片段分析了 8 個棲地共 136 個樣本，結果顯示分布於不同地點的巨鱟其遺傳基因呈現有限度的分化，共分離出 40 個單倍型，其中 9 個屬於地區性的共享單倍型，彼此之間也有交流。根據此族群遺傳研究結果，可得知印尼的不同地理區間雖具有一定程度的基因多樣性，但基因仍有交流，建議應整體劃設為一個保護區以管理及保育巨鱟。

第 3 位講者指出印尼水域同時存在 3 種亞洲鱟，具有高度地理生物多樣性，但受到捕撈壓力與人為開發影響，使該區域的物種種群有急遽下降的情況。由於過去的研究無法提供基礎數據以界定各物種分布的位置與範圍，不利於保育策略的制定，故本研究以 DNA 條碼（DNA Barcoding）區分各物種在印尼水域的分布情況。結果顯示目前採樣地點僅區分出巨鱟及圓尾鱟，尚無三棘鱟的存在，而圓尾鱟的遺傳分析也無法顯示不同地理位置具有遺傳差異，將考慮採用其他方法進行遺傳多樣性鑑定，以擬定更完整的保育策略。

第 4 位講者為我國中山大學的施宜佳研究員，報告內容為金門三棘鱟成鱟族群資源量的估算，以及提出其可能洄游的路徑與潛在廊道，並介紹我國目前研究方向及保育策略。成鱟族群資源量評估是了解族群現況及評估保育成效最直接的數據，但過去金門一直缺乏成鱟族群資源量評估相關研究，考量長期的海岸開發、環境變遷及棲地保護區設立等變化，112 年開始採用標誌放流方式進行成鱟資源量評估。除推估族群大小數據外，也針對近 5 年捕撈到的成體進行生物形質分析，以了解族群結構及其健康程度。本調查結果顯示，目前金門的族群量雖尚未恢復到高峰期，但尚未達到瀕危程度，故現階段應著重於棲地的保護及復育，提供合適的環境讓成鱟上岸產卵，對於該族群的保育及復育更具效益。

後續 3 位講者主題皆圍繞於印尼巨鱟及圓尾鱟的基因分化情形，調查結果顯示各地區遺傳基因雖具有多樣性，但彼此之間均可能存在交流現象，因此皆需要進一步探討生物學及地理學的調查方法。本節會議整體而言，由各國人員從遺傳基因及族群層面分享相對應的研究結果，對於國際推動鱟保育工作都具有相當程度的幫助，尤其是在基礎數據的蒐集與建立方面。

主題 2：公民科學與公眾意識（Citizen Science and Public Awareness）

本節分別由來自美國、香港、印尼及臺灣等共 6 位講者，分享鱟或其棲地生物多樣性保育過程中的公民科學推動。第 1 位講者來自美國，提出應將科學研究與傳統非科學性生態知識互相結合，以促進更包容、公平及有效的保育行動，同時尊重人類生存與自然生態的福祉。強調推動保育工作時應保持同理心、平衡性及適度性，使該價值觀可同時滿足自然生態及人類的需求，傳統智慧與科學研究的結合可強化保育策略的彈性及潛力。

第 2 位講者以香港白尼潮間帶為例，分享以在地社區為基礎的生物多樣性保育及棲地管理模式，白尼灘地因其生態重要性而廣泛受到認可，但其對於生物多樣性及鱟族群的法定保護有限，且部分威脅仍持續存在，包含互花米草的快速蔓延、海洋塑膠垃圾、水產養殖廢棄物、非永續性旅遊業的發展等。因此大自然保護協會（The Nature Conservancy，TNC）自 2021 年起實施生態系綜合管理方法，與當地志工共同推動針對鱟棲地的維護及管理，3 年間完成改造廢棄牡蠣養殖場 7,700 平方公尺、清除入侵性互花米草 462 平方公尺、清理海洋塑膠垃圾及牡蠣養殖廢棄物 3 公噸等，積極改善稚鱟的棲地環境與底質，並於 2021 年至 2023 年夏季觀察到鱟的族群數量增加了 56.1%。另透過現地觀察及實驗室研究，探討牡蠣養殖場的牡蠣石柱（障礙物）對稚鱟健康及覓食行為的影響，結果顯示牡蠣石柱對稚鱟有負面影響，但影響程度隨著鱟的成長而減低，對於稚鱟密度的影響並不顯著。

第 3 位講者分享美國長期的鱟族群與棲地監測（紐約鱟監測網計畫），自 2011 年起每年於紐約牙買加灣的數個海灘上進行產卵調查，結果顯示在 Plumb Beach East 及 Big Egg Marsh 產卵場，隨著產卵季的推進，雄性及雌性成鱟的總數都會下降，但雄鱟的相對比例會增加，推測可能為雌鱟因卵子耗盡而向海域遷移或者死亡率增加等，確切原因仍有待進一步研究。

第 4 位講者來自世界自然基金會（World Wide Fund for Nature，WWF）香港分會，藉由市場調查及大規模電話訪問，評估大眾對鱟相關知識的了解及消費模式，結果

發現仍有部分餐廳或群眾販賣或食用鱟。此外自世界自然基金會（WWF）也分別對漁民及宗教組織代表進行深度訪談，進一步了解鱟的供應鏈，並進行相關生態知識推廣。本研究再次強調提升大眾保育意識的重要性，並藉此了解人類消費對鱟族群存續的潛在威脅，並指出海洋保護區的有效管理對鱟及棲地保護至關重要。

第 5 位講者於 2023 年 7 月至 9 月間在印尼進行訪談，以評估當地民眾對鱟相關知識的了解，結果顯示 85%的受訪者認為鱟的數量下降，捕獲的鱟個體中有 95%來自漁業混獲，平均每次捕獲 1-16 隻，其中 40%為巨鱟（*Tachypleus gigas*）、30%為圓尾鱟（*Carcinoscorpius rotundicauda*）、25%同時捕獲 2 物種、5%未辨識種類，此外有 60%混獲鱟的人會選擇將其賣給販商。

最後由我國成功大學楊明哲博士分享基於社區的公民科學調查現況及保育實踐，臺灣持續透過中央及地方政府、研究單位及非政府組織之間的合作，積極建立鱟保育網絡，包含澎湖地區自 2022 年起全境禁止捕鱟、嘉義縣將成立臺灣第 4 處鱟復育中心（繼金門及澎湖水試所、海科館之後，預計 2026 年內完工）。

主題 3：保育行動 I（Conservation I）

首先由 IUCN 鱟專家小組聯合主席 Dr. Paul Shin 回顧近期成就，並概述未來目標，IUCN 鱟專家小組成立於 2012 年，旨在倡導對鱟及其棲息地進行科學性的保育措施。在族群評估方面，美洲鱟（*Limulus Polyphemus*）於 2016 年發布的紅色名錄中，由無危（Least Concern）更新為易危（Vulnerable），並於 2022 年被評估為資源中度耗盡；三棘鱟（*Tachypleus tridentatus*）於 2018 年列入紅色名錄為資料缺乏（Data Deficient），於 2019 年更新為瀕危等級（Endangered）；圓尾鱟（*Carcinoscorpius rotundicauda*）及巨鱟（*Tachypleus gigas*）目前則在紅色名錄顯示為資料缺乏（Data Deficient），正持續更新中。保育網絡建立方面，持續與政府機關及在地非政府組織/保育組織等合作，建立「亞洲鱟監測網」，採用標準化的調查方法，為亞洲鱟族群制定監測指南，並自 2016 年 IUCN 世界大會後與新加坡自然協會會（NSS）合作紅樹林保育行動計畫。國際交流互動方面，於 2019 年訂定每年 6 月 20 日為國際鱟保

育日，定期辦理國際性及地區性活動，並出版相關文宣品。未來目標包含將於本屆工作坊制定亞洲鱟保育行動計畫、實施基於保育行動的試點計畫、教育漁民如何拯救混獲或魚網困住的鱟、與在地社區合作復育已退化的棲地等。

隨後介紹由 IUCN 開發的綠色狀態評估（GSA) 流程，有助於物種復育工作，由 IUCN 鱟專家小組另召集一個具有地域及專業代表性的專家團隊，將此流程應用於三棘鱟，在 5 個月內約每週召開 1 次會議以草擬其綠色狀態評估（GSA)，列出威脅並確立保育行動，同時評估其分布空間上的歷史變化及族群現況，定義了 14 個空間單位來解釋其遺傳結構、生態及威脅範圍內的變化，確定目前持續性的主要威脅包含消費利用、鱟試劑、混獲、外來物種入侵、污染、氣候變遷的直接及間接影響，以及海岸開發、填海造陸、近岸活動及水產養殖造成的棲息地喪失。在評估過程中了解到目前多數地區普遍缺乏穩定存續的族群，是當前復育工作面臨的重大挑戰，並發現各地區間民眾認知的差距，以及該物種能否復育取決於國家之間及國家內部的聯合行動，故應優先考慮推行保育及研究最具效益的國家。

主題 4：生物醫學與科技（Biomedical and Technology）

首先特別邀請來自美國的 Bolden Jay 分享可替代鱟試劑的細菌內毒素檢測方法在科學上的進展。40 多年來，以來自鱟的天然試劑（LAL/TAL）造福了人類健康，但其使用會對野生鱟族群及相關瀕危物種產生負面影響，發展源自鱟 DNA 序列的重組試劑可減少此問題，Eli Lilly 公司使用重組因子 C 螢光分析法或重組試劑顯色法，可根據顯色反應的強度定量檢測內毒素濃度。目前重組試劑已在 60 多種藥品及相關成分中驗證其測試效能，超過 65 個衛生部門正在審查其行銷授權，並已批准 9 種產品使用重組試劑來檢測細菌內毒素。

接著分別由來自印尼及印度的等講者進行報告。印尼團隊於實驗室針對圓尾鱟鱟卵的發育過程進行觀察，發現圓尾鱟與其他 2 種亞洲鱟（三棘鱟、巨鱟）卵的發育具有相似性。印度團隊的研究結果顯示，從死亡的鱟殼中提取的殼聚醣（生醫材料）其品質優於其他來源。來自印度的另外 1 位講者分享其團隊開發了可監測鱟卵

內部及表面連續性變化的系統，使用 Raspberry Pi V3 連接 5MP 相機感測器作為連續監測，並定義 Python 程式碼自動儲存資料，目前已用於監測巨鱟鱟卵的受精及發育過程。

主題 5：生物學、生態學與人為影響（Biology, Ecology & Human Impacts）

本節由 6 位講者進行報告，從生物學、生態學及人為活動影響等方面探討鱟面臨的威脅。第 1 位講者報告了美國福羅里達州一家發電廠，藉由改善其取水設備結構降低了對鱟族群的衝擊；北美及亞洲沿岸的鱟分布範圍內，同時建有數百座發電廠，包含核電廠、天然氣及煤炭電廠等，需取用當地自然環境的水源，因此魚類及鱟等水生生物可能被困在其取水結構中。2015 年卡納維拉角能源公司（CCEC）與鱟專家合作，監測其取水結構中困住的鱟數量，發現每年平均有 84,028 隻被困個體，且死亡率為 100%；在設置防護圍籬以防止其遭受撞擊致死後，被困個體降至每年約 46,848 隻，死亡率降為 12%；後續更在進水池上建造了一面牆，結果顯示被困個體數量下降了 98%（每年約 647 隻，死亡率 49%），有效降低了鱟被困及其死亡數量。

第 2 位講者報告了廣西傳統手工捕撈活動對三棘鱟棲地產生的潛在影響，並提出相關管理建議。本研究在廣西北海的 3 個三棘鱟核心棲地每月進行 1 次無人機樣線調查，持續 1 年多，以了解 Beachcombing 傳統手工捕撈法的時空變化趨勢，結果顯示漁民的手工捕撈活動集中於 10 月至隔年 3 月，為稚鱟的非活躍期（活躍期為 4 月至 9 月），但遊客體驗手工捕撈的活動在不同季節並無顯著差異。且本次調查定義了 2 個手工捕撈的熱點區域，指出漁民的活動集中在中潮帶及低潮帶，而遊客則經常在紅樹林邊緣進行體驗。由於稚鱟常聚集於紅樹林邊緣附近，因此建議控制遊客數量，並引導他們遠離紅樹林邊緣，以減少對稚鱟的潛在干擾。

第 3 位講者對紐約市牙買加灣的美洲鱟卵、稚鱟及成鱟消化系統內的微塑膠進行調查，結果顯示在所有受精卵及未受精卵中都可發現微塑膠，據估計 1 克鱟卵含有約 426-840 個微塑膠，春季穿越牙買加灣遷徙的濱鳥主要以鱟卵為食，因此可能攝入大量的微塑膠。稚鱟及成鱟的消化系統中也發現微塑膠，且稚鱟體內的數量為

成鱟體內的 2 倍以上，推測與稚鱟攝入更多的沉積物顆粒有關。本研究雖然尚無法確定微塑膠是否存在不利影響，但鱟卵中含有的高比例微塑膠 對以鱟卵為食的遷徙性鳥類來說是一個潛在的問題。

第 4 位來自廣東的講者針對三棘鱟對鎘的解毒途徑進行研究，以揭示該物種如何適應在重金屬污染的環境中生存，結果顯示 ARP5 首次成為金屬汙染壓力下的最佳內參基因，稚鱟會藉由改變甘油磷脂的代謝能力，減輕鎘的毒性。本研究突顯了三棘鱟稚鱟的自身恢復能力及保育該物種的迫切需求，以及三棘鱟保育對於維護海洋生物多樣性的重要性，強化其保育工作，可為環境修復作出貢獻。

第 5 位講者針對福建省沿海地區的三棘鱟分布地點及稚鱟族群進行現況調查，並依此提出相關保育建議。在 2021 年至 2023 年間的夏季低潮期進行了實地調查，2021 年共發現 16 個繁殖地點，然而 2023 年廈門集美南堤公園沙灘被填海造陸改造成旅遊勝地，導致三棘鱟棲地消失，另有 4 個棲地也被破壞，調查期間記錄的稚鱟族群密度持續下降，從 2022 年 0-0.1578 隻/100m^2，降至 2023 年每 0-0.0910 隻/100m^2。，並觀察到其中 4 個繁殖地點已無稚鱟，推測已在部分地區滅絕。福建省曾是三棘鱟重要的分布區域，然而隨著沿海經濟的迅速發展及大量灘塗地的圍墾，造成三棘鱟棲地受到嚴重的破壞與喪失，建議在現有的育幼場建立保護區，加強人工繁殖放流以增加野外族群量，並進一步對淤積灘塗進行生態修復。

第 6 位講者針對新加坡北部海岸圓尾鱟的附著生物進行初步調查，尤其是入侵物種美洲貽貝（*Mytella strigata*）對當地圓尾鱟的影響，在克蘭芝泥灘、克蘭芝蓄水池公園、雙溪布洛濕地保護區及林厝港泥灘採集了 481 隻個體。結果顯示所有地點的圓尾鱟身上附著的生物共有 4 種，發生率與其生命階段的大小顯著相關，但與地點無相關性，其中高度入侵物種美洲貽貝主要發現於腹側平面，推測可能與該生物的需求有關。

主題 6：保育行動 II（Conservation II）

本節主題為介紹各國目前的鱟保育工作及科學教育內容。第 1 位講者回顧從 1909 年至 2023 年印度鱟研究及保育工作的進展。自 1909 年以來，人們就知道西孟加拉邦及奧里薩邦沿海地區存在巨鱟及圓尾鱟，多數的調查研究在 1909 年至 1930 年、1980 年至 1990 年、2006 年至 2021 年期間完成，印度政府的資助鮮少涉及族群分布、棲地測繪、保育研究等。鱟物種於 1972 年已被列入「野生動物保護法」的附表 IV，隨後又被納入 2023 年修訂的「野生動物保護法」附表 II，但整體而言印度對鱟的研究工作是零散的，且尚未啟動保護這些物種的永續策略。

第 2 位講者分享中國對於三棘鱟保育的進展與挑戰。根據實地調查顯示，中國鱟族群量嚴重下降，在部分地區已發生區域性滅絕，2021 年將所有鱟物種正式列為國家二級重點保護野生動物，期透過嚴格的管理措施扭轉過度捕撈的問題。在北部灣潮間帶稚鱟棲地的評估結果顯示，人類干擾指數與稚鱟豐度之間呈現顯著負相關，養殖區、居民區、港口碼頭等是鱟棲地保護應優先考量的因素。為吸引公眾關注及參與鱟保育活動，需藉由廣泛的媒體宣傳，如何吸引媒體報導是科學研究人員值得嘗試的另一項任務，例如宣傳具有中國特色的鱟保育工作等。將科學理論及知識轉化為保育行動，有效引導保育實踐是當務之急，而充分利用媒體報導對於連結物種研究與當地管理至關重要。

第 3 位講者分享中國福建省推動三棘鱟保護之社區網絡建立。中國鱟保護共同體是由熱衷於鱟保育的沿海居民人士成立，旨在整合各方資源，搭建聯合平臺，探索以沿海居民為主的鱟保護模式，2022 年七夕在民間環保基金「為海洋行動」計畫支持下，在晉江市金井鎮塘東村成立首個福建省鱟保護社區，塘東村稚鱟資源豐富，是亞太地區重要的稚鱟棲地。在沿海生物多樣性保護與漁村華僑文化傳播並行的情況下，發展福建沿海「鱟保護社區」新模式，推動當地生態旅遊經濟，實現生態、經濟與文化的共贏。

第 4 位講者為我國中山大學張懿教授，報告金門稚鱟長期調查工作與族群量評估，藉由科學性的調查監測，採用標誌再捕法估計金門稚鱟的族群數量，並透過前

體寬確定個體的齡期分布，初步評估稚鱟族群量與自然死亡率，可作為保護區劃設與管理策略擬定的重要參據。同時提出保護區內的主要棲地未受到良好的保護，建議規劃一個新的保護區以保護自然海岸的產卵場及棲地，並加速推動利害關係人參與；也分享臺灣其他海洋保護區劃設與管理的實務經驗，並提出金門執行三棘鱟保護工作的策略與建議。張懿教授於會後受到 IUCN 鱟專家小組之邀請加入，希望未來能提供更多來自臺灣的科學數據，以作為紅色名錄評估（RLA）及綠色狀態評估（Green Status of Species Assessment）之參據，尤其族群量評估是未來關注重點，期許各國研究人員投入該項工作。

主題 7：保育行動 III（Conservation III）

第 1 位講者基於分析全球貿易數據，以評估族群利用程度，並確定由全球貿易需求驅動的亞洲鱟非永續捕撈相關的保育挑戰。研究中全面分析 10 個亞洲國家的全球貿易數據，以了解鱟及其衍生物的貿易模式及趨勢，確定主要貿易區域，並仔細審查這些區域的數據，以確定鱟的需求規模及捕撈方式的影響。結果顯示尤其是鱟肉的市場正不斷增長，某些地區將其視為美味，與這種貿易相關的非永續捕撈法對鱟族群構成了重大威脅，導致其數量下降及生態失衡，全球貿易中對亞洲鱟及其衍生物的需求不斷上升的趨勢令人擔憂。研究中強調包含棲息地退化、過度捕撈、混獲死亡及監管框架不足等已確定的保育挑戰，同時指出迫切需要採取積極的保護措施，以維護生態完整性並確保亞洲鱟族群的永續利用。首先，利害關係人之間的合作對於解決全球貿易需求驅動的非永續捕撈所帶來的挑戰至關重要；其次，有效的管理策略，包含配額規定及棲地保護措施等，對於減輕貿易的不利影響並確保亞洲鱟種群的長期生存至關重要。

第 2 位日本講者分享了生物記錄智慧平臺（Biologging intelligent Platform，BiP）的研發，介紹從三棘鱟獲得的紀錄數據，強調共享及分析數據的優點，本研究於日本瀨戶內海東部及馬來西亞婆羅洲沙巴東部進行，在鱟身上配戴速度、深度及溫度記錄器。在瀨戶內海獲得其在限制性水域內的活動週期及野外越冬行為等訊息，在沙巴則蒐集到野外活動週期及深度利用等數據，深度資料包含深度利用、活動週期、

產卵週期、混獲事件的頻率及時間等訊息，可藉此了解該物種的生態特徵，例如地理分布與活動模式，為海洋保護區規劃及保護政策推動提供科學數據。

第 3 位講者報告孟加拉境內鱟的保育現況、挑戰與建議，研究結果指出孟加拉的鱟數量大幅下降，主要是由於沿海開發、污染及非永續捕撈法造成的棲地喪失，氣候變遷引起的此外海平面上升等也進一步影響並威脅物種的存續。孟加拉的鱟保育工作面臨的挑戰包含法律保護不足、利害關係人保育意識有限、缺乏全面的管理計畫等，這些挑戰需要政府機構、非政府組織、研究機構及當地社區共同努力。透過棲地復原、永續捕撈法規、公眾教育及研究合作等多方面的措施，才能確保鱟族群的長期生存能力，並保護孟加拉沿海生態系的完整性。

第 4 位講者分享印尼鱟的捕撈與販運現況，指出印尼有多個鱟捕撈及貿易地點，包含蘇門答臘島、爪哇島及蘇拉威西島，並介紹當地消費情形及非法國際貿易案例，同時探討執法能力、公眾對鱟受法律保護地位的認識等問題。

第 5 位講者報告了日本鱟產卵的適宜性建模結果。在 2018 至 2019 年間日本津崎 5 個地點總共發現 43 個巢穴，使用科學模型估算並繪製鱟的適宜產卵棲地，研究發現海灘潮位高低是預估適宜產卵棲地的最重要參數，平均高水位為適合的產卵棲地，共有 74%的巢穴位於此區域，適合產卵棲息地的面積估計僅 476 平方公尺，佔研究地點沙灘的 24%，因此產卵場的保護及復育是該地區的當務之急。此模型可有效確定合適的產卵棲地，並有助於為此全球瀕臨滅絕的物種建立海洋保護區。

四、亞洲鱟保育計畫（Conservation Planning for Asian Horseshoe Crabs）

在所有主題演講結束後，根據亞洲鱟所面臨已識別威脅的共同點與差異，決定 4 個分組議題，與會者根據自己的興趣或專業選擇組別，於研討會第 4 天進行分組討論，確定具體保育行動，並於全體會議中報告討論結果，就後續步驟達成共識，分別歸納出以下優先行動方向：

1. 物種保育（族群管理）：

(1) 減少直接捕獲、混獲、廢棄魚網纏繞等的影響

(2) 將物種保護納入人為活動或開發案件的規劃

(3) 人工繁殖復育、原地或異地放流、重新引入或移地保育

(4) 管理合法貿易、杜絕非法貿易

(5) 針對被扣押的動物制定野放流程

2. 棲地保育

(1) 強化管理並檢討現有保護區的保育成效

(2) 評估劃設新的保護區或其他棲地保護區域

(3) 釐清並降低特定棲地的特定威脅

(4) 釐清氣候變遷對棲地的影響並制定調適方案

(5) 建立跨單位或跨國的合作關係

3. 教育宣導

(1) 多管道宣導以提升大眾保育意識

(2) 制定社區計畫鼓勵社區參與

(3) 非政府組織的能力建構及需求補助

(4) 公民科學推廣

(5) 募款或尋求贊助投入保育行動

4. 優先研究重點

(1) 長期的族群監測以評估保育成效

(2) 基因遺傳學研究以作為相關保復育措施之參據

(3) 生化學研究以取代鱟試劑的消耗

(4) 定期檢討資料空缺以針對不足處進行研究

多國強調漁業混獲為亞洲鱟面臨的主要威脅之一，必須持續關注不同地區漁業混獲的威脅程度，進行應對措施，以提升漁業作業的人員的通報率及其保育意識，此外亞洲鱟的非法貿易在部分國家盛行，無論作為商用、食用或觀賞用，均需持續關注。大家也一致認同公民科學及公眾意識的推動，對生物多樣性及鱟族群保育十分重要，並應將當地知識納入海洋保護框架，促進傳統智慧與科學調查結果之間協同作用，例如與當地社區或漁民共同建立並管理保護區有助於提升管理效果，鼓勵與會者充分利用目前的資訊影響政策推動。

教育宣導組的討論過程中馬來西亞代表 Choong Baiqi 向大家推薦嘉義縣生態保育協會蘇銀添總幹事分享推動鱟保育的歷程，首先由民眾的認知開始，先讓民眾接觸鱟這種古生物，產生好奇後由簡入繁，逐步介紹鱟的生態習性，及與沿海居民生活息息相關，再到醫學上鱟試劑的運用；第二階段正式進入人員培訓，訓練課程包含海岸環境的變遷及解說、訓練如何進行成鱟收容養護與生態；第三階段開始進入與公部門合作，進行有規劃、持續性的調查及推廣工作，並提到把七夕情人節定為每年的「七夕鱟保育日」，辦理大型鱟生態保育活動，由縣長參加開幕儀式，因此得到很好的媒體宣傳與訊息擴散效應；第四階段鱟苗培育成功並進行放流的重要里程碑，地方政府也向中央爭取經費建造結合鱟復育的濱海環境教育館，擴大影響層面，並期盼鱟的保育復育成果能讓世界看見臺灣。

五、其他交流

臺灣鱟保育教育宣導交流攤位由嘉義縣生態保育協會林雯君，攤位上的展示品以鱟相關文創品為主，輔以趣味科普知識及介紹，也展出嘉義在地皮雕藝術家手工製作的各式皮雕鑰匙圈、髮束、集線器、杯墊等，以及「添鱟宮」鴨舌帽、鱟博士設計的資料夾、海科館設計的鱟迴力車等，相當多元吸睛。各國與會者對臺灣保育教育宣導攤位都印象深刻且喜愛，馬來西亞 NGO 團體也分享了在地織染工藝結合鱟圖樣設計的文創品及鱟故事繪本，中國團隊則有另一種前衛新潮的風格，設計擬貓化的 Q 版鱟。

6 月 20 日國際鱟保育日於本署臉書直播分享新加坡國際鱟工作坊的現場實況，讓大眾初步了解工作坊的具體辦理內容，進而關注各國保育趨勢，以提升大眾保育意識及增加相關訊息曝光度，並由嘉義縣生態保育協會張弘傑導演拍攝 6/18~6/23 國際鱟工作坊現場影像紀錄，並剪輯成 30~60 秒短影音及 3~5 分鐘宣傳短片 ，可供後續教育推廣及成果展示等用途。

另為增加國際交流與合作機會，與國立中山大學老師前往參訪新加坡國立大學，拜訪李光前博物館前館長、新加坡國立大學 Peter Kee Lin Ng 教授，Peter Kee Lin Ng 教授介紹新加坡對於海洋永續發展方面的努力與面臨的問題，亦指出新加坡動物園及聖淘沙名勝世界等事業單位積極投入自然、環境保護，提供許多資金的支持。張懿教授則分享了臺灣漁業、三棘鱟及海洋保護方面的研究成果，以及政府的關注與積極作為，雙方也在亞洲鱟基因遺傳方面的鑑別及標誌放流技術（晶片）方面的重疊之處引起共鳴。

六、閉幕典禮（Closing Ceremony）

6 月 22 日的閉幕同樣由新加坡自然學會主席 Dr. Yeo Seng Beng、IUCN 鱟專家小組聯合主席 Dr. Mark Botton 及 Dr. Paul Shin 致詞，感謝來自世界各地專業團隊對鱟研究的貢獻，今年大家共同推動了許多保育工作以充實基線數據，並透過主題分享及討論會議歸納出下個 4 年推進鱟保育工作的主要目標。

七、 實地考察活動（Field Trip Activities）

第 5 天為實地考察活動，可於雙溪布洛濕地保護區（Sungei Buloh Wetland Reserve，SBWR）及在聖淘沙名勝世界中的 S.E.A.水族館中擇一參加，我們選擇前往雙溪布洛濕地保護區（SBWR），其為新加坡第一個受保護的溼地，佔地 130 公頃，由泥灘地、紅樹林及淡水池塘組成，是國內重要的鷺棲地之一，也是國際重要的候鳥遷徙棲地。

該保護區基於 4 個目標：（1）成為自然科學、地理及其他相關學科的教育中心；（2）改善場棲地，吸引更多鳥類及野生動物；（3）提升民眾的環境保護意識；（4）兼具教育及娛樂的旅遊景點。設立後開展了一系列涉及公眾、志工、學校及企業贊助商的保育擴展計畫，經常性地進行野生動物調查，以確定使用該棲地的物種及數量，保護區內池塘、河流及海洋的水質也定期採樣分析進行監測，並定期與志工、學生及其他單位合作，清除沖上海岸的垃圾，並致力於重新種植本地物種，以恢復過去的自然生態系。

參、心得及建議

本次工作坊中多數研究主題聚焦於族群與棲地的保育，其中僅有美洲鱷有完整且長期的族群量評估數據，亞洲鱷族群量評估的研究投入仍然有限，儘管三棘鱷已於 2019 年列入 IUCN 紅色名錄，有多國講者表明族群量仍持續下降，且在部分地區已發生區域性滅絕。具體保育策略方面並無一體式解決方案，必須基於不同的空間單位評估目前及未來的威脅，制定因地制宜的保育措施，且族群復育必須將不同生命史階段的所有類型的棲地保護納入保育政策中，同時搭配長期的監測管理計畫，才能有機會恢復其族群量。

整體而言，亞洲鱷族群調查及長期監測方面的研究至今仍不足，過去的研究無法提供有效的基礎數據來釐清物種的族群分布情況；相較之下，金門縣政府自 2002 年開始持續對潮間帶稚鱷族群及棲地環境進行調查，有助於初步了解潮間帶稚鱷分布概況，更藉由 2018 年至 2023 年的成鱷標誌放流，評估其族群量約為 4~6 萬隻，雖與過去推測數十萬隻之數量無法相比，但尚有穩定之族群，在保育措施上應著重於棲地保護及限制捕撈等管理。金門縣早期的基礎調查與標誌放流工作使其在族群評估與監測方面的研究成果豐碩，顯示長期投入三棘鱷野外族群調查之效益，臺灣本島其他地區則有待更多的資訊蒐集。

人工復育是增加野外族群的重要方式之一，然而讓野外族群得以在自然環境下自力存續，才是物種保育之終極目標，由此可見產卵地保護尤為重要。本次會議中日本講者分享當地三棘鱷適宜的產卵場建模結果，指出海灘潮位高低是預估適宜產卵棲地的最重要參數。辨識潛在棲地對於族群保育十分重要，我國隨著政府、研究學者及民間對三棘鱷的關注日益提升，物種保育漸入軌道，目前對於棲地的調查與持續監測，是族群復育工作應努力的方向。

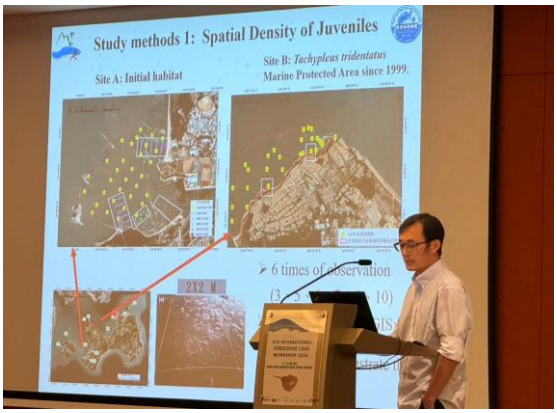
肆、附錄

附錄一、與會相片

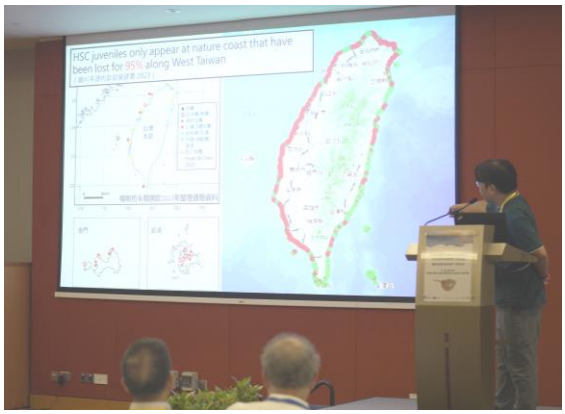
本屆代表於會場合影

特邀講座及主題演講會場

國立中山大學施宜佳研究員
報告金門三棘鱟成鱟族群量評估



國立中山大學張懿教授
報告金門稚鱟長期調查與族群量評估



國立成功大學楊明哲博士
分享基於社區的公民科學調查現況

海報展示區交流

分組討論制定亞洲鱟保育計畫

臺灣鱟保育教育宣導交流攤位

拜訪李光前博物館前館長、新加坡國立大學 Peter Kee Lin Ng 教授

李光前博物館的鱟展示

雙溪布洛濕地保護區泥灘地

泥灘地中的稚鱟

附錄二、會議議程及相關資料

5TH INTERNATIONAL HORSESHOE CRAB WORKSHOP 2024

19 - 23 JUNE 2024

RESORTS WORLD CONVENTION CENTRE, SENTOSA, SINGAPORE

E-PROGRAMME BOOK

SCIENCE AND CONSERVATION OF HORSESHOE CRABS

Organised by

NATURE SOCIETY SINGAPORE

IUCN SSC HORSESHOE CRAB Specialist Group

Supported by

RESORTS WORLD SENTOSA

S.E.A. AQUARIUM

IUCN SSC Species Survival Commission

CONSERVATION PLANNING SPECIALIST GROUP

Mandai NATURE

Table of Content **Page**

WELCOME MESSAGE FROM PROGRAMME COMMITTEE

The Nature Society Singapore is delighted to welcome everyone to the 5th IUCN International Horseshoe Crab Workshop on the science and conservation of horseshoe crabs, to be held in Singapore on 19-23 June 2024. The NSS is honoured to be hosting this event in conjunction with the IUCN Species Survival Commission Horseshoe Crab Specialist Group.

This 5th IUCN HSC Workshop, although delayed by the covid-19 pandemic, follows on the tradition of previous workshops in Guangxi, China (4th, 2019), Sasebo, Japan (3rd, 2015), Hong Kong (2nd, 2011) and New York (1st, 2007). It is not by coincidence that these workshops have been held at locations within the spawning range of the world's 4 extant "living fossil" horseshoe crab species.

We hope delegates and participants at the 5th IUCN HSC Workshop will quickly make up for lost time, discuss science, share ideas and formulate conservation plans to better protect and preserve horseshoe crabs, especially our three Asian species, namely the tri-spine horseshoe crab (Tachypleus tridentatus) which is endangered, and the coastal horseshoe crab (Tachypleus gigas) and mangrove horseshoe crab (Carcinoscorpius rotundicauda) which are listed as data deficient.

We have invited keynote speakers to present on the most urgent aspects of horseshoe crab conservation, and welcome many oral and poster presentations from our delegates. We have added breakout discussion sessions to formulate clear and practical conservation plans during the workshop.

The main 5th IUCN HSC workshop venue will be held at the Resorts World Convention Centre at Resorts World Sentosa, but off-site field trips to experience Singapore's flora and fauna, are also part of the programme.

We look forward to personally meeting all speakers, delegates and participants, as this is not just an opportunity for the sharing of ideas, but also for the forging of friendships!

Dr. YEO Seng Beng
President, Nature Society Singapore
Organising Co-Chairperson, 5th International HSC Workshop
Singapore

WELCOME MESSAGE FROM PROGRAMME COMMITTEE

On behalf of the IUCN Horseshoe Crab Specialist Group, I am pleased to welcome you this morning to the 5th International Workshop on the Conservation of Asian Horseshoe Crabs. We are extremely grateful to our hosts, the Nature Society Singapore, for hosting this event.

The four extant species of horseshoe crabs are subjected to overfishing for use as food, bait, the production of biomedical products derived from their blood, and habitat loss or alteration due to shoreline development and armouring against coastal erosion. The Horseshoe Crab Specialist Group seeks to protect horseshoe crabs through collaborative efforts to conserve their populations and essential spawning and nursery habitats, and in raising public awareness of their importance in evolutionary history, marine coastal ecology and biomedical uses.

The conservation of horseshoe crabs and their essential habitats is the core mission of the IUCN Horseshoe Crab Specialist Group. Since our formation in 2012, our membership has increased to nearly 100 individuals. 35% of our members are female, and 65% are male. Our members come from 19 different countries, with the majority (65%) based in Asia. Many of you at this meeting are members of the Horseshoe Crab Specialist Group, and we welcome new applications for membership from all interested persons, including students.

The Horseshoe Crab Specialist Group can proudly point to several significant accomplishments in the past few years. The status of the American horseshoe crab, Limulus polyphemus, was re-evaluated as Vulnerable after previously been categorized as Least Concern, and a Green Status Assessment has also been completed. The tri-spine horseshoe crab, Tachypleus tridentatus, previously categorized as Data Deficient, is now Endangered. Our group has also supported and helped to sponsor a number of local and regional meetings focused on horseshoe crab conservation. This work could not have been successful without the hard work and contributions from people in this group and I want to express my gratitude for your efforts.

Much more remains to be accomplished. A priority is to complete the Red List Assessments for the coastal horseshoe crab, Tachypleus gigas, and mangrove horseshoe crab, Carcinoscorpius rotundicauda. More broadly, we must continue our efforts to advocate for the conservation of horseshoe crabs and their habitats and emphasize the importance of horseshoe crabs to resource managers and the public at large.

Unlike many conferences, where the focus is on contributed talks and posters emphasizing current research, informal workshops are an integral part of our mission. Beginning on Friday afternoon, and continuing into Saturday, we will have workshops with two focal objectives, first to begin the process of a Red List Assessment for the coastal horseshoe crab, Tachypleus gigas, and second, to begin to develop a Conservation Action Plan for Asian Horseshoe Crabs with the guidance of the IUCN Conservation Planning Specialist Group. In-person workshops such as this give us an ideal opportunity to work collaboratively to develop effective conservation strategies for Asian horseshoe crabs.

Thank you for attending, and I look forward to having an enjoyable and productive meeting.

Dr. Mark L. BOTTON
Co-Chair, IUCN SSC Horseshoe Crab Specialist Group
USA

WELCOME MESSAGE FROM PROGRAMME COMMITTEE

Good morning, and welcome again to the 5th International Workshop on the Science and Conservation of Horseshoe Crabs. Organizing such an international meeting requires much time and effort. In this regard, the IUCN Horseshoe Crab Specialist Group would like to thank the Nature Society Singapore to host this workshop, Resort World Convention Centre to sponsor the meeting venue, EVENTS 360 to manage the workshop webpage and event logistics, as well as our keynote and invited speakers, and all the oral and poster presenters, who have agreed to showcase their work related to horseshoe crab studies. We would also like to thank members of the Planning Committee for their advice and input on the workshop program over the past six months. More importantly, we offer our gratitude to the Ocean Park Conservation Foundation Hong Kong for the continuous funding support to the travel grant for the present and previous workshops. In particular, the additional funding from the Indianapolis Zoo Conservation Grant Program has made us possible to partially support a total of 37 participants to attend this meeting. Last but not the least we thank the IUCN Conservation Planning Specialist Group and Mandai Nature, Singapore to lead the Conservation Action Planning workshop on the three Asian horseshoe crab species. Thanks again to the Indianapolis Zoo Conservation Grant Program, we will offer "The Asian Horseshoe Crab Conservation Award" to support pilot implementation projects designed to put into action the Conservation Action Plan. Details of the award and the call for proposals will be announced later at the workshop.

I have been involved in organizing this series of International Workshops since the meeting in Hong Kong in 2011, and have witnessed the increase in the number of presentations from participants over the years. At this meeting, apart from the five keynote speeches, we will have a total of 70 oral and poster presentations, covering a variety of topics on population and genetics, biomedical and technology, biology, ecology and human impacts, citizen science and public awareness, and conservation. I am very glad to report that of these presentations, 27 (~ 40%) are related to various aspects of conservation work, ranging from community-based activities to review of region-wide conservation strategies. I look forward to hearing from all of you how your efforts have further advanced our Specialist Group's objective to advocate for science-based conservation of horseshoe crabs and their habitats.

In closing, I wish participants can reconnect with old friends, make new acquaintances, and share your thoughts and experiences in the science and conservation of horseshoe crabs during these few days. Have a fruitful meeting. Thank you.

Dr. Paul K. S. SHIN
Co-Chair, IUCN SSC Horseshoe Crab Specialist Group
Hong Kong

PLANNING COMMITTEES

Nature Society Singapore Organising Committee

Co-chairmen	Dr. Yeo Seng Beng	President, Nature Society Singapore
	Mr. Lester Tan	Chair, Marine Conservation Group
Scientific Committee Representative	Dr. (Ms.) Ngo Kang Min	Vice President, Nature Society Singapore
Fundraising	Ms. Natasha Raina	Honorary Secretary, Nature Society Singapore
Logistics & Accommodation	Ms. Huang Ningxin	Assistant Secretary, Nature Society Singapore
Field Trips & Education	Mr. Kua Kay Yaw	Marine Conservation Group
	Ms. Tan Beng Chiak	Chair, Education Committee
	Ms. Sng Bee Bee	Nature Society Singapore Member Plant Group
	Ms. Kathy Xu	Marine Conservation Group Founder, The Dorsal Effect
Advisor	Dr. Shawn Lum	Immediate Past President, Nature Society Singapore
	Mr. Leong Kwok Peng	Chair, Conservation Committee

PLANNING COMMITTEES

5th International Horseshoe Crab Workshop - Singapore Scientific Committee

Co-chair	Dr. Yeo Seng Beng	President, Nature Society Singapore
	Mr. Lester Tan	Chair, Marine Conservation Group, Nature Society Singapore
Vice-chair	Dr. (Ms.) Ngo Kang Min	Vice-President, Nature Society Singapore PhD (Tokyo MU), MSc (NTU), Ecology
	Mr. Albert Liu	Exco Member, Nature Society Singapore; MSc (Oxford) Biodiversity, Conservation and Management
Member	Dr. Shawn Lum	Immediate Past President, Nature Society Singapore; Senior Lecturer, Asian School of the Environment, Nanyang Technological University
Member	Dr. Hsu Chia Chi	Founder, Horseshoe Crab Rescue & Research, Ex-Chair MCG, Nature Society Singapore
Member	Prof. Ding Jeak Ling	Emeritus Professor, Department of Biological Sciences, National University of Singapore
Member	Prof. Chou Loke Ming	Emeritus Professor, Department of Biological Sciences, National University of Singapore; Research Affiliate, Tropical Marine Science Institute Singapore
Member	Dr. Tang Qian	Research Associate, Rowland Institute at Harvard University
Member	Dr. Karenne Tun	Director, Coastal & Marine and Terrestrial Branches, National Biodiversity Centre, National Parks Board (NParks)
Member	Dr. Laura Yap	Programme Chair (Diploma in Environmental & Marine Science), School of Applied Science, Republic Polytechnic
Member	Mr. Linus Mak	School of Applied Science, Republic Polytechnic

PLANNING COMMITTEES

IUCN SSC Horseshoe Crab Specialist Group

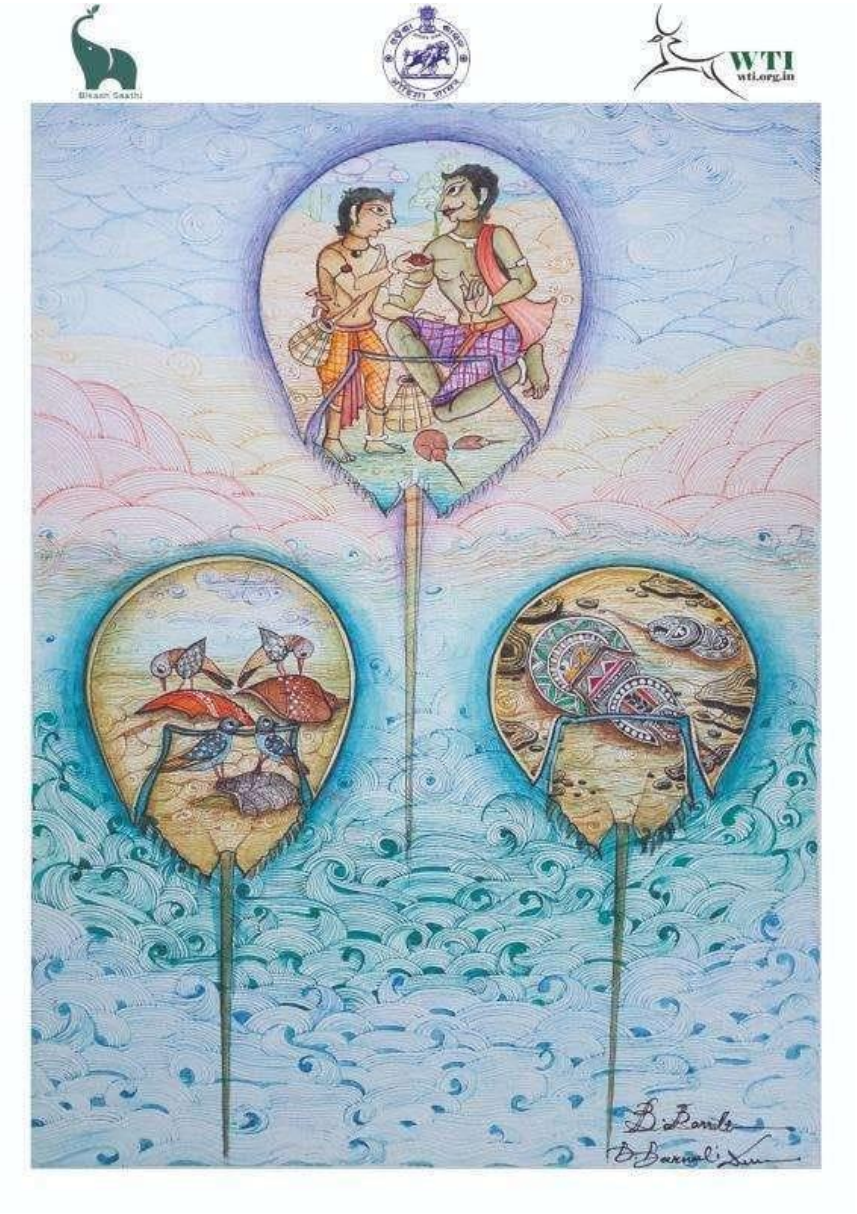
Group leadership	Dr. Mark BOTTON	Co-Chair
	Dr. Paul SHIN	Co-Chair
	Dr. Kit Yue, Billy KWAN	Red List Authority Coordinator
Steering Committee	Dr. Ruth CARMICHAEL	Dauphin Island Sea Lab
	Dr. Punyasloke BHADURY	Indian Institute of Science Education and Research Kolkata
	Dr. David SMITH	U.S. Geological Survey
	Dr. John TANACREDI	Molloy University
	Dr. Faridah MOHAMAD	Universiti Malaysia Terengganu
	Mr. Glenn GAUVRY	Ecological Research and Development Group
	Dr. Siu Gin CHEUNG	City University of Hong Kong
	Mr. Kevin LAURIE	Hong Kong Coast Watch
Planning Committee Members	Dr. Christina COLON	Kingsborough Community College
	Dr. Akbar JOHN	Universiti Sains Malaysia
	Dr. Judy WAN	Ocean Park Conservation Foundation, Hong Kong
	Dr. Ding Jeak LING	National University of Singapore

ACKNOWLEDGEMENTS

The Planning Committees would like to thank the support provided by the following organizations:

HORSESHOE CRAB ARTWORK BY DR BISWAJEET PANDA

The Horseshoe Crab Conservation painting is a captivating fusion of three distinguished art forms – the renowned Patta painting of Odisha, the intricate Madhubani art of Bihar, and the vibrant Gond painting of Madhya Pradesh. This unique amalgamation not only celebrates the rich cultural diversity of India but also symbolizes a harmonious convergence in the pursuit of marine conservation. The artwork serves as interconnectedness of artistic expression and environmental protection, highlighting a visual narrative for the protection of these ancient arthropods. This artwork is designed under the Horseshoe Crab Conservation Program.



PROGRAMME OVERVIEW

Note: All meeting events will be held at the Resorts World Convention Centre, Sentosa, Singapore

Day 1, 19 Jun	Day 2, 20 Jun	Day 3, 21 Jun	Day 4, 22 Jun	Day 5, 23 Jun
0930 – 1010 Opening Ceremony	0900 – 1015 Session 3: Conservation I	0845 – 1015 Session 7: Conservation III	0900 – 1015 Conservation Planning for Asian Horseshoe Crabs	Optional Field Trip Activities
1010 – 1030 Coffee & Tea Break / Poster Presentations	1020 – 1035 Coffee & Tea Break	1015 – 1030 Coffee & Tea Break	1015 – 1030 Coffee & Tea Break	
1030 – 1230 Keynote Presentations	1035 – 1150 Session 4: Biomedical and Technology	1035 – 1150 Introduction to Workshop Themes: *T. gigas* Red Listing and Developing Conservation Action Plan for Asian Horseshoe Crabs	1030 – 1230 Conservation Planning for Asian Horseshoe Crabs	
1230 – 1330 Lunch & Poster Presentations	1150 – 1345 Lunch & Poster Presentations	1150 – 1345 Lunch & Poster Presentations	1230 – 1330 Lunch	
1330 – 1545 Session 1: Population & Genetics	1345 – 1515 Session 5: Biology, Ecology & Human Impacts	1345 – 1515 Conservation Planning for Asian Horseshoe Crabs	1330 – 1515 Conservation Planning for Asian Horseshoe Crabs	
1445 – 1500 Coffee & Tea Break	1515 – 1530 Coffee & Tea Break	1515 – 1530 Coffee & Tea Break	1515 – 1530 Coffee & Tea Break	
1545 – 1745 Session 2: Citizen Science and Public Awareness	1530 – 1645 Session 6: Conservation II	1530 – 1730 Conservation Planning for Asian Horseshoe Crabs	1530 – 1800 Conservation Planning for Asian Horseshoe Crabs	
1615 – 1630 Coffee & Tea Break	1645 – 1700 Coffee & Tea Break	1900 – 2100 Workshop Dinner	1800 Closing Ceremony	
	1700 – 1730 Keynote Presentation 5			

PROGRAMME

DAY 1: WEDNESDAY, 19 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
0800 – 0915	**Registration & Young Scientists Poster Preparation**	**Corridor of Aquarius Room 4**
0915	**All guests and participants to be seated**	
0930 – 1010	**OPENING CEREMONY**	**Aquarius Room 3 & 4**
0930 – 0940	**Welcome Message** Dr Yeo Seng Beng, President, Nature Society Singapore	
0940 – 0950	**Welcome Message** Dr Mark Botton & Dr Paul Shin, Co-Chairmen, IUCN Horseshoe Crab Specialist Group	
0950 – 1000	**Opening Speech** Mr Tan Hee Teck, CEO, Resorts World Sentosa	
1000 – 1010	**Opening Speech** Mr Desmond Lee, Minister for National Development & Minister-in-Charge of Social Services Integration	
1010 – 1030	**Coffee & Tea Break / Young Scientists Poster Presentations**	**West Lobby / Aquarius Room 1**
1030 – 1230	**KEYNOTE PRESENTATIONS**	**Aquarius Room 3 & 4**
Session Chair	**Mark BOTTON**	
1030 – 1100	Keynote 1: Population Status and Recovery of the American Horseshoe Crab	Dr. SMITH, David
1100 – 1130	Keynote 2: Conservation of Horseshoe Crab through Genetic Engineering of Rfc for Biomedical Applications	Dr. DING, Jeak Ling
1130 – 1200	Keynote 3: No Intact Eggs in an Upturned Nest: Potential Impacts of Global Changes in Coastal Wetlands on Horseshoe Crab Conservation	Dr. LEE, Shing Yip
1200 – 1230	Keynote 4: How Science can Improve Asian Horseshoe Crab Conservation Management: Attempts in Beibu Gulf of China	Dr. KWAN, Kit Yue
1230 – 1330	**Lunch & Poster Presentations**	**West Lobby / Aquarius Room 1**
1330 – 1545	**SESSION 1: POPULATION & GENETICS**	**Aquarius Room 3 & 4**
Session Chair	**Punyasloke BHADURY**	
1330 – 1345	Invited 1: Past, Present, and Future of the Asian Horseshoe Crabs from the Perspective of Evolution	RHEINDT, Frank
1345 – 1400	Oral 1: Keeping Up Observation of Coastal Horseshoe Crabs (*Tachypleus gigas*) Across Major Habitats in Sunda Shelf, Indonesia: High Genetic Diversity and Mixing Population	MASHAR, Ali

PROGRAMME

DAY 1: WEDNESDAY, 19 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
1400 – 1415	Oral 2: Genetic Diversity on Horseshoe Crab from Sumatra and Java, Indonesia: A Preliminary Data	NURSALIM, Nining
1415 – 1430	Oral 3: Adult Population Estimate to the *Tachypleus tridentatus* along Kinmen County, Taiwan	SHIH, Yi-Jia
1430 – 1445	Oral 4: Habitat and Population Recovery of Mangrove Horseshoe Crab after a Major Cyclonic Event in the Bay of Bengal	BHADURY, Punyasloke
1445 – 1500	**Coffee & Tea Break**	**West Lobby**
1500 – 1515	Oral 5: Molecular Ecology of the Mangrove Horseshoe Crab *(Carcinoscorpius rotundicauda*) in Indonesia: Evidence for High Genetic Diversity and Limited Gene Flow	KURNIASIH, Eka Maya
1515 – 1530	Oral 6: Molecular Identification of Horseshoe Crab from Bangladeshi Coast Using DNA Barcoding Technique	RAHMAN, Shafiqu
1530 – 1545	Oral 7: Genetic Differences of Mangrove Horseshoe Crabs *Carcinoscorpius rotundicauda* Along the Bay of Bengal Coast in Odisha, India	TUDU, Sanatan
1545 – 1745	**SESSION 2: CITIZEN SCIENCE AND PUBLIC AWARENESS**	**Aquarius Room 3 & 4**
Session Chair	**Christina COLON, S. G. CHEUNG**	
1545 – 1600	Oral 8: Horseshoe Crab Conservation Reimagined: The Path of Balance and Harmony	GAUVRY, Glenn
1600 – 1615	Oral 9: A Community-Based Habitat Management Model in an Under Protected Biodiversity Hotspot: The Intertidal Shores of Pak Nai of Hong Kong	CHAN, Tsz Kin
1615 – 1630	**Coffee & Tea Break**	**West Lobby**
1630 – 1645	Oral 10: The Boys of Summer: A Shift in Gender Ratio of American Horseshoe Crabs (*Limulus polyphemus*) During the Spawning Season in Jamaica Bay, New York	COLON, Christina
1645 – 1700	Oral 11: Human Exploitation Survey of Adult Horseshoe Crab and Public Awareness Campaign in Hong Kong SAR, China	TANG, Pui Yi
1700 – 1715	Oral 12: Field Observations and Laboratory Manipulations Reveal the Significance of Beach Cleanup in Improving the Body Condition of Juvenile Horseshoe Crabs	CHEUNG, S. G.
1715 – 1730	Oral 13: Exploring Local Knowledge Information of Horseshoe Crabs in Banten and Central Java	SUPADMININGSIH, Fahresa Nugraheni
1730 – 1745	Oral 14: Conservation Network of Horseshoe Crab in Taiwan: Conservation Practice from Community - Based Citizen Science to National Policy	YANG Ming-Che
	End of Day 1	

PROGRAMME

Day 2: Thursday, 20 June 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
0830	**Registration**	**Corridor of Aquarius Room 4**
0900 – 1015	**SESSION 3: CONSERVATION I**	**Aquarius Room 3 & 4**
Session Chair	**Paul SHIN**	
0900 – 0915	Oral 15: A Progress Update of the IUCN Horseshoe Crab Specialist Group	SHIN, Paul
0915 – 0930	Oral 16: Strategies for Building and Optimising A Marine Conservation Network for *Tachypleus tridentatus* in Beibu Gulf	CHEN, Xiao Hai
0930 – 0945	Oral 17: Exploring of Conservation Mechanism of Critical Horseshoe Crab Habitat Overlapping with Tourist Hotspots	TAO, Jingru
0945 – 1015	Oral 18 - 19: The IUCN Green Status Assessment for *Tachypleus tridentatus*	LAURIE, Kevin
1020 – 1035	**Coffee & Tea Break**	**West Lobby**
1035 – 1150	**SESSION 4: BIOMEDICAL AND TECHNOLOGY**	**Aquarius Room 3 & 4**
Session Chair	**Glenn GAUVRY**	
1035 – 1050	Invited 2: Bacterial Endotoxins Testing – Progressive Science and Sustainability	BOLDEN, Jay
1050 – 1105	Oral 20: Limb Development in the Asia Pacific Horseshoe Crab *Tachypleus gigas* Müller	BISWAS, Sumit
1105 – 1120	Oral 21: Promising Antibacterial Activity of Nano Chitosan Prepared from Dead Horseshoe Crab (*Tachypleus gigas*) Broken Carapace in Comparison to Nano Chitosan of Other Sources	PRADHAN, Jyotirmayee
1120 – 1135	Oral 22: Silencing of Novel TTVTG6-Like Induced Ovarian Cell Apoptosis in Ancient Chelicerate *Tachypleus tridentatus*	TAN, Kian Ann
1135 – 1150	Oral 23: A Novel System to Monitor the Growth of Eggs in Horseshoe Crab Species *Tachypleus gigas*	MALLICK, Utpal
1150 – 1345	**Lunch & Poster Presentations**	**West Lobby / Aquarius Room 1**
1345 – 1515	**SESSION 5: BIOLOGY, ECOLOGY & HUMAN IMPACTS**	**Aquarius Room 3 & 4**
Session Chair	**Seng Beng YEO**	
1345 – 1400	Oral 24: Horseshoe Crab Mortality at Power Plants and a Solution	BROCKMANN, H. Jane
1400 – 1415	Oral 25: Artisanal Fishing in the Core Nursery Habitats of Asian Horseshoe Crabs in Guangxi, China: Suggestions for Conservation Management	WANG, Chun-Chieh
1415 – 1430	Oral 26: Microplastics in American Horseshoe Crab Eggs, Juveniles, and Adults from an Urban Estuary in New York City	BOTTON, Mark

PROGRAMME

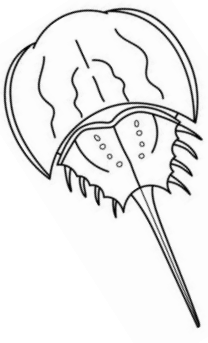
DAY 2: THURSDAY, 20 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
1430 – 1445	Oral 27: Developing Cadmium Detoxification Strategies in the Tri-Spine Horseshoe Crab (*Tachypleus tridentatus*): Insights from a 430-Million-Year-old Species	LUO, Zi Meng
1445 – 1500	Oral 28: The Nursing Ground of Chinese Horseshoe Crab (*Tachypleus tridentatus*) in Fujian: The Present Situation, Threats and Conservation	WENG, Zhao Hong
1500 – 1515	Oral 29: A Preliminary Investigation of Epibiotic Macrofauna on the Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* (Latreille, 1802) in Singapore	TAN, Lester Jin Xiang
1515 – 1530	**Coffee & Tea Break**	**West Lobby**
1530 – 1700	**SESSION 6: CONSERVATION II**	**Aquarius Room 3 & 4**
Session Chair	**David SMITH**	
1530 – 1545	Invited 3: Research and Conservation Efforts on Horseshoe Crabs in India: From 1909 to 2023	DASH, Bisnu Prasad
1545 – 1600	Oral 30: Progress and Challenges in Horseshoe Crab Conservation in China	ZHANG, Wanling
1600 – 1615	Oral 31: Exploration and Practice of Sustainable Development Model of Chinese Horseshoe Crab (*Tachypleus tridentatus*) Conservation Community in Fujian China	LI, Yu Hong
1615 – 1630	Oral 32: Horseshoe Crab Habitat Development and Conservation/Restoration – Lessons from Japan	SEINO, Satoquo
1630 – 1645	Oral 33: Juvenile Population and Conservation Strategies of *Tachypleus tridentatus* in Kinmen County, Taiwan	CHANG, Yi
1645 – 1700	**Coffee & Tea Break**	**West Lobby**
1700 – 1730	**KEYNOTE PRESENTATION**	**Aquarius Room 1**
	Keynote 5: Introduction to the Assess to Plan Conservation Planning Tool of the IUCN SSC Conservation Planning Specialist Group	Ms. RAGHAVAN, Roopali
	End of Day 2	

PROGRAMME

DAY 3: FRIDAY, 21 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
0830	**Registration**	**Corridor of Aquarius Room 4**
0845 – 1015	**SESSION 7: CONSERVATION III**	**Aquarius Room 3 & 4**
Session Chair	**Yumiko IWASAKI**	
0845 – 0900	Oral 34: Global Trade Data and Conservation Challenges for Asian Horseshoe Crabs	JOHN, Akbar
0900 – 0915	Oral 35: Utilization of Biologging Data for the Conservation and Management of Horseshoe Crabs	WATANABE, Shinichi
0915 – 0930	Oral 36: Conservation of Horseshoe Crabs in Bangladesh: Status, Challenges and Recommendations	UDDIN, Mohammad Muslem
0930 – 1000	Oral 37: Harvesting and Trafficking of Horseshoe Crabs in Indonesia	KLEIN, Joseph
1000 – 1015	Oral 38: Spawning Habitat Suitability Maps for the Conservation of *Tachypleus tridentatus* in Tsuyazaki Cove, Japan	ITAYA, Shinji
1015 – 1030	**Coffee & Tea Break**	**West Lobby**
1030 – 1150	**INTRODUCTION TO WORKSHOP THEMES:** ***T. gigas* Red Listing and Developing Conservation Action Plan for Asian Horseshoe Crabs**	**Aquarius Room 3 & 4**
Leads	**LAURIE, Kevin, SMITH, David, RAGHAVAN, Roopali**	
1150 – 1345	**Lunch & Poster Presentations**	**West Lobby / Aquarius Room 1**
1345 – 1515	**Conservation Planning for Asian Horseshoe Crabs Using the Assess to Plan Tool**	**Aquarius Room 3 & 4**
1345 – 1445	Participant Introductions – To Understand the Diversity of Knowledge on the Three Species amongst all Participants Contributing the Planning	**RAGHAVAN, Roopali**
1445 – 1515	Agreeing on the Scope of the Workshop	
1515 – 1530	**Coffee & Tea Break**	**West Lobby**
1530 – 1730	**Conservation Planning for Asian Horseshoe Crabs Using the Assess to Plan Tool**	**Aquarius Room 3 & 4**
	Threat Mapping for all Three Species. Identifying Commonalities and Differences. Prioritisation to Decide Breakout Working groups for Day 4 **Breakout Group Topics** 1. Species Protection (Population Management) 2. Habitat Protection 3. Education and Awareness 4. Research Priorities	**RAGHAVAN, Roopali**

PROGRAMME

DAY 3: FRIDAY, 21 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
1800	**Transfer to Workshop Dinner**	**RWS B1 Coach Bay**
1900 - 2100	**WORKSHOP DINNER**	**NUSS Kent Ridge Guild House**
	Recorded Presentation by Wildlife Photographer of the Year (2023)	**Laurent BALLISTA**
	International Horseshoe Crab Day Presentation	**Yumiko IWASAKI**
	NSS Horseshoe Crab Rescue and Research Initiative - 70th Anniversary Celebration Highlight	**Marine Conservation Group, NSS**
	End of Day 3	



PROGRAMME

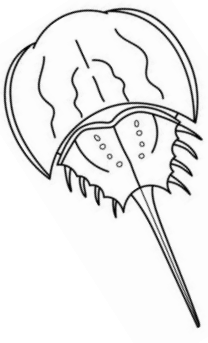
DAY 4: SATURDAY, 22 JUNE 2024		
TIME	**SESSIONS**	**VENUE & SPEAKER(S)**
0845	**Registration**	**Corridor of Aquarius Room 4**
0900 – 1230	**Conservation Planning for Asian Horseshoe Crabs Using the Assess to Plan Tool**	**Aquarius Room 3 & 4**
0900 – 1000	**Introduction to Breakout Group Discussions and Action Planning Outcomes Expected** **Breakout Group Topics** 1. Species Protection (Population Management) 2. Habitat Protection 3. Education and Awareness 4. Research Priorities	**RAGHAVAN, Roopali**
1000 – 1230	Break Out Working Groups to Identify Specific Actions, Intended Consequences (Measurable Outcomes), Timelines and responsible Stakeholders for each Topic	
1230 – 1330	**Lunch**	**West Lobby**
1330 – 1700	**Conservation Planning for Asian Horseshoe Crabs Using the Assess to Plan Tool**	**Aquarius Room 3 & 4**
1330 – 1530	Continuation of Break Out Working Group Discussions to Identify Specific Actions, Timelines and Responsible Stakeholders for Each Topic	**RAGHAVAN, Roopali**
1530 – 1800	Report back to Plenary and Agreement between all on Next Steps. (Remind About the Funding Support - Asian HSC Conservation Award - Call for Proposals for Two Pilot Projects within this year)	
1800	CLOSING CEREMONY	**Aquarius Room 3 & 4**
	Closing Remarks Dr Yeo Seng Beng, President, Nature Society Singapore Dr Mark Botton & Dr Paul Shin, Co-Chairmen, IUCN Horseshoe Crab Specialist Group	
	End of Day 4	

PROGRAMME

DAY 5: SUNDAY, 23 JUNE 2024

TIME	OPTIONAL FIELD TRIP ACTIVITIES (REGISTERED PARTICIPANTS ONLY)	VENUE
0730 – 1230	Activity 1: Visit to Sungei Buloh Wetland Reserve (SBWR) & Mudflats Viewing of Mangrove Horseshoe Crabs	Sungei Buloh Wetland Reserve
1000 – 1100	Activity 2: Behind-The-Scenes Tour Of The S.E.A. Aquarium	S.E.A. Aquarium
	End of Day 5	

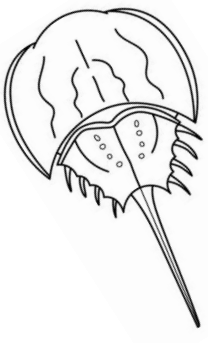
For more information, please refer to page 22.



YOUNG SCIENTISTS POSTER PRESENTATIONS

DAY 1: 19 JUNE 2024

Display	Code	Poster Session	Presenter
P	S 1	Pilot Study of Mangrove Horseshoe Crab Monitoring by Students	Hwa Chong Institution
P	S 2	Students in Citizen Science: Mangrove Horseshoe Crab Monitoring Project	Dunman Secondary School
P	S 3 - 8	Sustainable Futures: Integrating Mangroves into Urban Landscapes	S.E.A. Aquarium Youth Ocean Ambassadors



POSTER SESSIONS

**** Student Presentation***

DAY 2 & 3: 20 – 21 JUNE 2024

Display	Code	Poster Session	Presenter
E	P 1	Engaging the Public in Horseshoe Crab Conservation through Education	MAK, Kin Weng (Linus)
E	P 2*	Impact Assessment of Human Activities on Resources of Juvenile Horseshoe Crabs in Hainan Coastal Areas, China	CHEN, Xiao Hai
E	P 3*	Major Habitat of Juvenile *Tachypleus tridentatus* in Kinmen County, Taiwan.	JIN, Yi-hua
E	P 4	Effects of Polystyrene Microplastics on the Antioxidant System and the Microflora Composition of Intestine in *Tachypleus tridentatus* Juveniles	LI, Yu Hong
E	P 5	A Century of Horseshoe Crab Conservation Evolution in Japan – Expert Surveys, Citizen Science, School Education, Environmental Education, Multi-Generational Multi-Sector Surveys, Stewardship	SEINO, Satoquo
E	P 6	Community-Based Monitoring of American Horseshoe Crabs (*Limulus polyphemus*) in New York	SMITH, David
E	P 7	Study on the Community of Meiofauna in the Spring and Winter Seasons of Xiamen Jimei Chinese Horseshoe Crab Nursery	WENG, Zhao Hong
E	P 8*	Investigation on Ecosystem Health Status of Horseshoe Crab Habitat Under Anthropogenic Climate Processes - Applicability of Benthic Foraminifera Biofacies	MANDAL, Arkaprava
E	P 9	Carving a Future: Mah Meri Wood Carving as a Tool for Horseshoe Crab Conservation	MAT ZAUKI, Nurul Ashikin
E	P 10	Green Status Assessment for *Tachypleus tridentatus*	LAURIE, Kevin & SMITH, Dave
E	P 11	Expression of Perspectives Considering the Existence of Horseshoe Crabs on India's Northeast Coast	PATI, Siddhartha
P	P 12	International Horseshoe Crab Day: Four Years of Global Conservation Activities	KWAN, Kit Yue & IWASAKI, Yumiko
P	P 13	Preliminary Study of a Potential Nursery Ground for *Tachypleus tridentatus* and *Tachypleus gigas* Crab in Tanjung Batu, North Borneo, Indonesia	AINI, Naila Khuril
P	P 14*	The Microbiome on Lesioned and Non-Lesioned Shell of Captive Horseshoe Crabs (*Limulus polyphemus*)	CARMICHAEL, Thomas
P	P 15	Improving the Conservation Awareness on Asian Horseshoe Crabs through the Ecotourism at Kuala Sepetang, Perak, Malaysia	CHOONG, Pai Chee
P	P 16	Dietary Insights and Competition Between *Carcinoscorpius rotundicauda* and *Tachypleus gigas* Through DNA Metabarcoding Analysis	AINI, Naila Khuril

POSTER SESSIONS

**** Student Presentation***

DAY 2 & 3: 20 – 21 JUNE 2024			
Display	Code	Poster Session	Presenter
P	P 17	Standardized Monitoring of Juvenile Horseshoe Crabs in a Nursery Habitat in Palawan: A Comparison of Transect Orientations	KAISER, Dorkas
P	P 18	Integrated Analysis of mRNA-miRNA Expression Profiles in Three Continuous Embryonic Stages of *Tachypleus tridentatus*	MA, Xiaowan
P	P 19	Distribution Patterns and Conservation of Horseshoe Crabs in Indonesian Waters Under Climate Change	MEILANA, Lusita
P	P 20	Characterising Horseshoe Crab Bycatch in Balikpapan: Implications for Fisheries Management and Conservation	SUNDAH, Rafly Zhulkifly Karel
P	P 21*	Assessment of the Population Status of Horseshoe Crabs in Purba Medinipur Coast, Northeast Bay of Bengal - Evidence of Decline Due to Unsustainable Fishing Practices	PAL, Kangkana
P	P 22*	Application of Machine Learning Programme for Prediction of Morphometric Parameters of Indian Horseshoe Crab: *Tachypleus gigas*	DASH, Bhawna
P	P 23	Have the Indian Mass Medias Played Significant Role for Conservation of Horseshoe Crabs!	MISHRA, Sasmita
P	P 24	Horseshoe Crab Palace: Rebirth from Near Local Extinction – Survey and Restoration Actions by a Grassroots Organization for *Tachypleus tridentatus* in Chiayi County, Taiwan	SU, Yin-tien
P	P 25	Archipelago-Wide Population Survey and Multiple Conservation Strategies of *Tachypleus tridentatus* around Penghu Archipelago, Taiwan	YANG, Ming-Che
P	P 26	Horseshoe Crabs as Pets: The Marine Life Fishery	BROCKMANN, H. Jane
P	P 27*	Effects of Blood Extraction on *Tachypleus gigas* Spawning in Captivity	ABDUL HALIM, Anis Syahira
P	P 28	Public Awareness Programmes and the Release of Early-Hatched Horseshoe Crabs, *Tachypleus gigas*	MOHAMAD, Faridah
P	P 29	Artificial Breeding of *Carcinoscorpius rotundicauda* and *Tachypleus gigas*: First Attempt from Bangladesh	RAHMAN, Turabur

NON-SCIENTIFIC PROGRAMME

WORKSHOP DINNER

FRIDAY, 21 JUNE 2024
NUSS Kent Ridge Guild House, Level 2, 9 Kent Ridge Drive, Singapore 119241

About venue

Situated within the National University of Singapore campus, the Kent Ridge Guild House (KRGH) is the largest of the three guild houses managed by the National University of Singapore Society (NUSS). It offers a plethora of facilities including a fitness centre, a swimming pool, squash and tennis courts, restaurants, bars and function rooms.

About Presenter

Presentation by **Laurent Ballesta**, the Wildlife Photographer of the Year (WPY) 2023.

Laurent Ballesta is an Award-winning underwater photographer, co-founder of Andromède Océanologie and leader of the Gombessa project.

Laurent is a marine scientist, explorer, award-winning underwater photographer and pioneering deep diver. He also won the 2021 Wildlife Photographer of the Year award for his spawning grouper image and has captured stunning images of some of the rarest marine phenomena and never-before-seen underwater locations.

About International Horseshoe Crab Day

International Horseshoe Crab Day, observed on **June 20th**, is an annual observance dedicated to raising awareness of this "living fossil," a marine chelicerate arthropod living in shallow coastal waters on soft sandy or muddy bottoms. Its existence is critical to coastal biodiversity, as horseshoe crabs lay millions of eggs on beaches to feed shorebirds, fish, and other wildlife. Besides, their large hard shell serves as microhabitat for species such as sponges, mud crabs, mussels, and snails. Yet, their population is at risk due to overharvesting, and habitat loss, among other reasons.

This day highlights the significance of horseshoe crabs in various ecosystems, promote conservation efforts to protect their declining populations, and acknowledge their contributions to science and medicine.

OPTIONAL POST-WORKSHOP FIELDS ACTIVITIES

SUNDAY, 23 JUNE 2024

VISIT TO SUNGEI BULOH WETLAND RESERVE (SBWR) & MUDFLATS VIEWING OF MANGROVE HORSESHOE CRABS

Time: 7.15am - 12.30pm
Meeting Points: 7.15am @ RWS Casino Basement 1 East Coach Bay
7.25am @ Harbourfront Coach Bay

Direction to Harbourfront Coach Bay:

Take **North East Line (NEL)** & **Circle Line (CCL)** to **HarbourFront Station, Exit B**

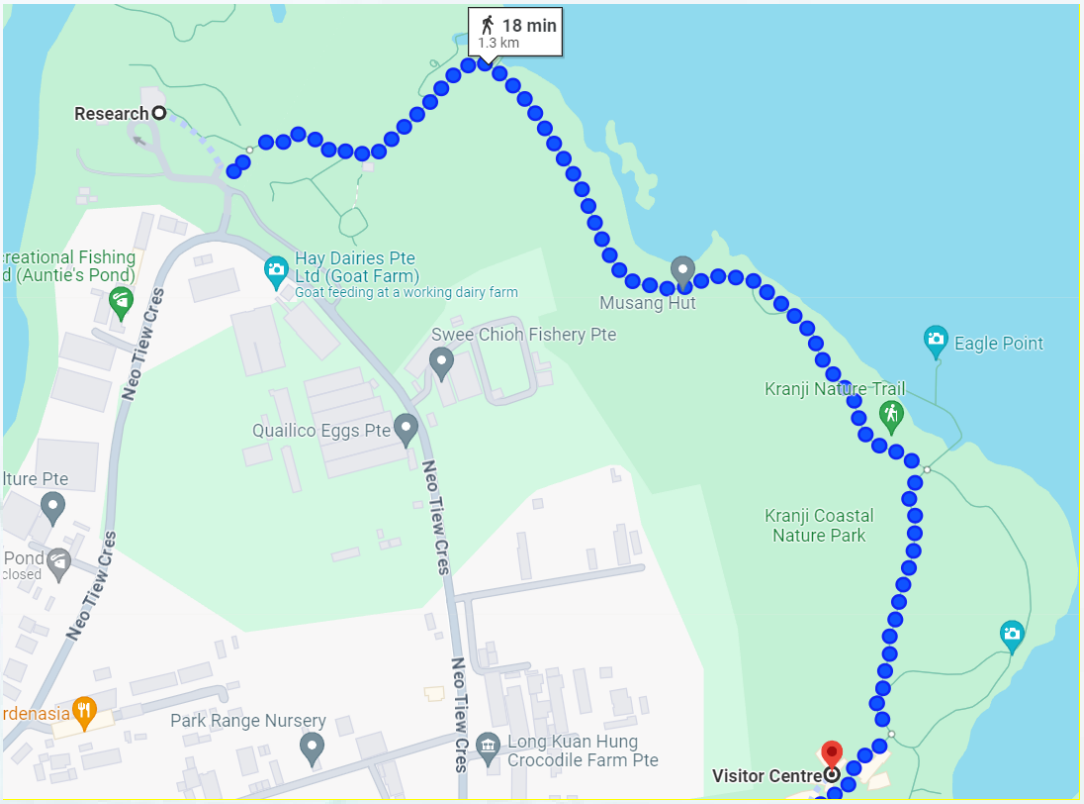
Via from HarbourFront Station Exit B through HarbourFront Shopping Centre

Via from HarbourFront Station Exit B, exit to 1 Maritime Square and walk along pathway.

Sungei Buloh Wetland Reserve is Singapore's first protected wetland reserve and covers an area of 130 hectares. The reserve consists of mudflats, mangroves and freshwater ponds, and is a site of international importance for migratory shorebirds. In 2003, Sungei Buloh Wetland Reserve was recognized as Singapore's first ASEAN Heritage Park (AHP).

Mangrove Boardwalk

Explore the beauty of the most extensive mangrove forest in Singapore and get close to its inhabitants without getting your feet muddy. This is an easy walk that introduces you to the mangrove forest and brings you close to the trees and wildlife, all without needing to get your feet wet or muddy. Look out for horseshoe crabs, mudskippers, monitor lizards, mud lobsters, crabs, spiders and more.



Suggested Attire:

- Covered walking shoes with good grip
- Long pants (avoid insect bites)
- Insect repellent
- Sunblock
- Wide brimmed hat
- Water bottle (refill points available)
- Poncho or raincoats

OPTIONAL POST-WORKSHOP FIELDS ACTIVITIES

SUNDAY, 23 JUNE 2024

BEHIND-THE-SCENES TOUR OF THE S.E.A. AQUARIUM

Time: 10am - 11am
Meeting Point: 9.55am, Entrance of the S.E.A Aquarium

S.E.A. Aquarium is one of the world's largest aquariums, home to more than 100,000 marine animals representing 1,000 species across more than 40 diverse habitats. The vast array of aquatic life is complemented by interactive programmes, up-close animal encounters and immersive learning journeys to inspire visitors to protect the world's oceans.

Behind-the-Scenes Tour of the S.E.A. Aquarium offers a unique opportunity to explore areas typically off-limits to the general public. This exclusive tour provides an insider's look at the operations, conservation efforts, and daily routines that keep the aquariums running smoothly.

DIRECTION TO VENUE

Getting to S.E.A Aquarium Singapore by Car

- Drive down Sentosa Gateway till you reach Resorts World Sentosa Car Park. You can park your car in 'B1 East'. Once inside, you will find Car Park Map Directories that will tell you how to reach S.E.A. Aquarium on Level 1.

Getting to S.E.A Aquarium Singapore by Sentosa Express

- Take the MRT to the nearest MRT station to S.E.A Aquarium Singapore: HarbourFront Station.
- From there, head to Level 3 of VivoCity Mall and board the Sentosa Express monorail to the S.E.A Aquarium Singapore.

GENERAL INFORMATION

ENTERING SINGAPORE

A) General Entry Requirements

1a) Immigration Requirements

To enter Singapore, travellers must meet the following immigration requirements:

i) Passport Validity

- Have minimum 6-month passport validity if you are not a Singapore passport holder

ii) Visa

- Short term travellers holding a passport or travel document from a visa-required country/region must apply for a Visa
- Visa-required travellers can use the Visa-Free Transit Facility for stay of less than 96 hours in Singapore, if eligible

iii) Security and Immigration Processes on Arrival

- Ensure that you do not bring prohibited items into Singapore.
- Familiarise yourself with immigration/customs clearance procedures, including whether you are eligible for automated clearance.
- Short-Term travellers should have sufficient cash and proof of onward travel (tickets, visas), and ensure that you do not stay beyond your visit pass validity. You may retrieve your e-Pass after arrival using the e-Pass Enquiry Portal or check your visit pass validity using the visit pass validity tool.

1b) SG Arrival Card (SGAC)

All travellers are required to submit the SG Arrival Card **within three (3) days** (including the day of arrival) **before arriving in Singapore,** except:

- Those transiting/transferring through Singapore without seeking immigration clearance; and
- Singapore citizens, Permanent Residents and Long-Term Pass Holders entering via land checkpoints.

Submission of SGAC is Free and can be done via the SGAC e-Service or MyICA Mobile app. Please refer to SGAC with Electronic Health Declaration for more information.

2) Public Health Requirements

To avoid tests and quarantine, travellers must fulfil the public health requirements below. Travellers who cannot meet the public health requirements and refuse any test(s) and/or quarantine may be turned away from Singapore.

2a) Yellow Fever Requirements

Produce an International Certificate of Vaccination for Yellow Fever, if you have visited any country at risk of Yellow Fever transmission in the six (6) days prior to arrival in Singapore.

Travellers must serve quarantine for six (6) days from date of departure from countries with risk of yellow fever transmission if they cannot meet the requirement. Quarantine also applies to those who are ineligible to receive the vaccination e.g., children aged one year and below and individuals with contraindications, and travellers whose yellow fever vaccination certificate has yet to become valid.

2b) COVID-19 Requirements

There are **no longer any COVID-19 measures** for travellers arriving in Singapore **from 13 Feb 2023**, regardless of vaccination status or traveller profile.

LEAVING THE AIRPORT

PUBLIC BUS

Terminals 1, 2 and 3: Bus stops are located at the basement bus bays. You can take buses 24, 27, 34, 36, 53, 110 and 858 from there.

Terminal 4: At the bus stop next to Car Park 4B, you can take buses 24, 34, 36 and 110. At the bus stop near the SATS Inflight Catering Centre 1, you can take buses 27, 53 and 858.

Payment options for public transport include contactless Mastercard/Visa/NETS bank cards, mobile wallets, stored-value EZ-Link/NETS FlashPay cards, and Singapore Tourist Pass. Do note that admin fees apply for payments with foreign-issued bank cards.

Stored-value EZ-Link cards can be purchased from any Changi Recommends store, and at the Passenger Service Centre or TransitLink Ticket Office at Changi MRT Airport Station. Click here for more information on the payment options for public transport.

Alternatively, you may use cash to pay for your bus fare. Please prepare the exact fare for your trip as no change will be given.

TRAIN

To get to the city, take the train from Changi Airport MRT Station (CG2) to Tanah Merah MRT Station (EW4), then transfer to the East West Line towards Tuas Link MRT Station (EW33).

Alternatively, take the train from Changi Airport MRT Station to Expo MRT Station (CG1/DT35), then transfer to the Downtown Line towards Bukit Panjang MRT Station (BP6/DT1).

To get to Pasir Ris, take the train from Changi Airport MRT Station to Tanah Merah MRT Station, then take the East West Line towards Pasir Ris MRT Station (EW1).

From Changi Airport MRT Station to Tanah Merah MRT Station:

First train	**Last train**
Monday to Saturday: 5:31 AM	Connecting to Tuas Link: 11:18 PM, daily
Sunday and public holidays: 5:59 AM	Connecting to Pasir Ris: 12:06 AM, daily

Get detailed train timings on the **SMRT Journey Planner**.

Payment options for public transport include contactless Mastercard/Visa/NETS bank cards, mobile wallets, stored-value EZ-Link/NETS FlashPay cards, and Singapore Tourist Pass. Do note that admin fees apply for payments with foreign-issued bank cards.

Stored-value EZ-Link cards can be purchased from any Changi Recommends store, and at the Passenger Service Centre or TransitLink Ticket Office at Changi Airport Station. Click here for more information on the payment options for public transport.

TAXI

Taxis are available for hire at the taxi stands in the Arrival areas of Terminals 1, 2, 3 and 4. A ride to the city takes about 30 minutes and costs between S$20 and S$40. All fares are metered.

There is an additional Airport Surcharge for all trips originating from the Airport:

- Mon–Sun (5:00PM–11:59PM): S$8 Airport Surcharge
- All other times: S$6 Airport Surcharge
- Midnight surcharge (12:00 AM–6:00 AM): 50% of final metered fare
- Peak-hour surcharge (6:00 AM–9:30 AM, Mon–Fri and 6:00 PM–12:00 AM, Mon–Sun): 25% of final metered fare

TYPE OF TAXI	PEAK HOURS / LATE NIGHT 6:00 AM–9:30 AM (MON–FRI) AND 6:00 PM–12:00 AM (MON–SUN)	OFF-PEAK HOURS / ALL OTHER TIMES
Regular Taxi	S$30–S$35	S$20–S$30
Premium Taxi	S$40–S$50	S$30–S$40

PRIVATE HIRE CAR

While Uber is no longer available in Singapore, passengers can also book private hire cars from Grab, Gojek, Tada Mobility or Ryde for a ride out of the airport. Make a booking via the respective transport providers' mobile applications (downloadable on Apple App Store and Google Play Store) and head to the Arrival pick-up points at Terminals 1, 2, 3 or 4.

Note: While it will no longer be mandatory for drivers and passengers to wear masks from 29 Aug 2022, the **Land Transport Authority encourages drivers and passengers to wear masks to reduce the risk of infection.*

CAR

For passengers who need to be picked up by car, please head to our Arrival ***pick-up points***.
You can also rent a car **here** or at any car rental counter at the Arrival Halls.

AIRPORT TRANSFER

Our 24-hour Ground Transport Concierges (GTC) offers convenient transfers from Changi Airport to your destination. There are two ways to make a booking:

1. Click **here** or download the iChangi app to book a ride in advanced
2. Approach our friendly customer service officers at the GTC counters at the following locations:

T1: Arrival Pick-up, Basement
T2: Arrival hall, level 1, door 5
T3: Arrival hall, level 1 (next to information counter)
T4: Arrival hall, level 1 (next to information counter)

Transportation options include:

- 4-seater vehicle (S$55.00 per trip to any destination in Singapore)
- 7-seater vehicle (S$60.00 per trip to any destination in Singapore)
- City Shuttle (S$10.00 per adult or S$7.00 per child below 12 years of age) to selected downtown areas. The City Shuttle departs every hour from 0700 - 2300hrs

WEATHER

Singapore is situated near the equator and has a typically tropical climate, with abundant rainfall, high and uniform temperatures, and high humidity all year round. Singapore, being an island, also has a coastal climate, the proximity of the sea has a moderating influence on its climate.

January lies in the middle of the rainy season, so the chances of rainfall increase more than in the previous months. The average temperature is generally 27°C, with the maximum being 34°C and the lowest 24°C. As January experiences moderate temperature in Singapore, the weather is relatively good as compared to the hottest months, May and June.

EXPLORING SINGAPORE

Please refer to www.visitsingapore.com/see-do-singapore for more information.

ESSENTIAL INFORMATION

Climate & Time Zone

GMT +8, UTC +08:00
Year-round Tropical, semi-dry sunny/rainy
Temperature range: 24 to 34°C
Humidity: 60-90%

Currency

Singapore Dollars (SGD)
Money-changing services and ATMs are widely available islandwide. **Bruneian Dollars (BND) is accepted on par in Singapore.**

Most places also accept VISA, MasterCard, American Express, & UnionPay. Some places accept Diners and JCB. Cashless payments are widely accepted (Apple Pay, Google Pay, Alipay, WeChat Pay, Grab Pay). Public Transport accepts credit cards with VISA payWave / MasterCard PayPass or Contactless, there is no need to purchase transit cards for using the subway system, taxis or public buses.

Languages

Main language: English (UK)
Most Singaporeans can converse in an additional language: Mandarin Chinese, Malay or Tamil

Tax Refunds

Tourists can claim a refund of the 8% Goods & Services Tax (GST) paid on goods purchased above $100. More GST refund information here.

Emergency Numbers

Emergency Ambulance and Fire: 995
Non-Emergency Ambulance: 1777
Police: 999

Electricity and Adapters

Singapore utilises power plugs with 3 square prongs (UK Type G).
Standard electrical current: 220 to 240V.

DIRECTION TO RESORTS WORLD CONVENTION CENTRE, SENTOSA, SINGAPORE

1. By Car

- On Sentosa Gateway, keep to left lane and drive down the slope leading to Resorts World Sentosa Car Park.
- Filter right and drive into tunnel for ""Cars/Taxis"".
- Follow signage to ""B1 West"" and park vehicle in the green zone.
- Resorts World Convention Centre is located on the left while driving in.
- After entering, take the escalator up (one flight), to the L1 Aquarius Room.

For entry to Resorts World Sentosa car park, only car park charges apply.
For entry (via Sentosa gantry) to other parts of Sentosa, Sentosa Island admission charges apply.

See Map of Sentosa Gateway:

Carpark Charges
Monday - Thursday (excludes Public Holidays)
SGD6.50 for 1st hour
SGD1.10 for half hour or part thereof
Capped at SGD13.10 per day (0000hrs to 2359hrs)

Friday/Saturday/Sunday/Public Holiday
SGD9.70 for 1st hour
SGD1.10 for half hour or part thereof
Capped at SGD16.30 per day (0000hrs to 2359hrs)
10 Minutes Grace Period (Exit to City)
No Grace Period (Exit to Sentosa)

Valet Service Charges
SGD3.00 service fee per vehicle (excludes prevailing parking charges)

See diagram of "B1 west" carpark, and other facilities at level B1

2. By Taxi and Ride-hailing Services

Alight at the Resorts World Sentosa Basement 1 Casino Drop-off point.
See walking route to Resort World Convention Centre - map/video guide.

For entry (via Sentosa gantry) to other parts of Sentosa, Sentosa Island admission charges apply.

List of Singapore taxi companies: www.ptc.gov.sg/fare-regulation/taxi-PHC/P2P-Transport-Services

Available ride-hailing services include **Grab** | **Gojek** | **Ryde** and **TADA**. There is no Uber in Singapore.

3. By Bus or MRT (Mass Rapid Transit)

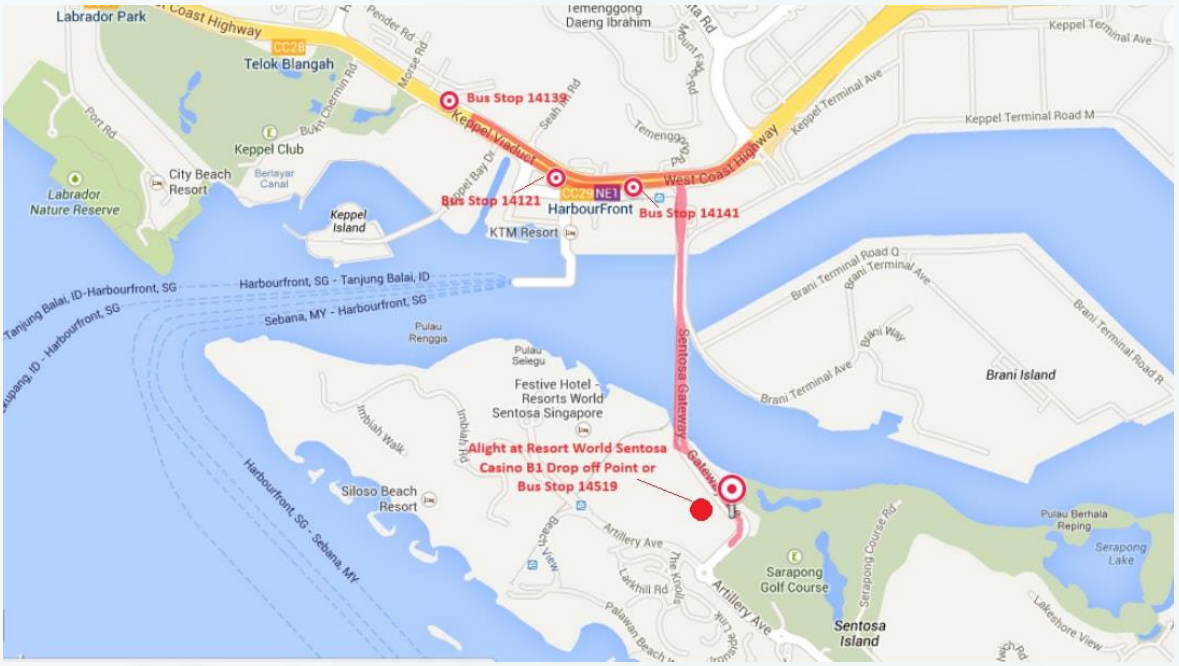
Bus option 1

- Take public buses 10, 30, 57, 61, 65, 80, 97, 100, 123M, 131, 143, 145, 166, 855 and alight at VivoCity.
- Alternatively, take MRT North-East Line (NEL) or Circle Line (CCL) and alight at HarbourFront Station (NE1 / CC29).
- Proceed to board Shuttle Bus RWS8 from bus stop 14141 at VivoCity , or bus stop 14121 at Merrill Lynch HarbourFront.
- Alight at Resorts World Sentosa Casino drop-off point, basement 1.
- See walking route to Resort World Convention Centre - map/video guide.

Bus option 2

- Take RWS8 shuttle bus from bus stop 14139 on Telok Blangah Road (before Seah Im Road).
- Alight at Resorts World Sentosa Casino drop-off point, basement 1.
- See walking route to Resort World Convention Centre - map/video guide.

See map of RWS8 shuttle bus route, and further information. (https://landtransportguru.net/busrws8/).



Bus option 3

- Take public bus 123 directly onto Sentosa Island.
- Alight at Resorts World Sentosa Casino bus stop 14519, located at basement 1.
- See walking route to Resort World Convention Centre - map/video guide.

Travel Guide via Buses and Train: www.transitlink.com.sg/travel-guide.

Click here for information on payment options for public transport.

4. By Sentosa Express Monorail

- Take MRT North-East line (NEL) or Circle line (CCL), and alight at HarbourFront station (NE1 / CC29).
- Take Exit E to VivoCity and proceed to level 3 to board the Sentosa Express.
- Alight 1 stop later at Resorts World Station
- After exiting the Monorail Station, walk towards Universal Studio until you reach the escalators on your left.
- Take the escalator down, turn left and head towards the Casino Entrance (Dragon Statue).
- See walking route to Resort World Convention Centre - map/video guide.

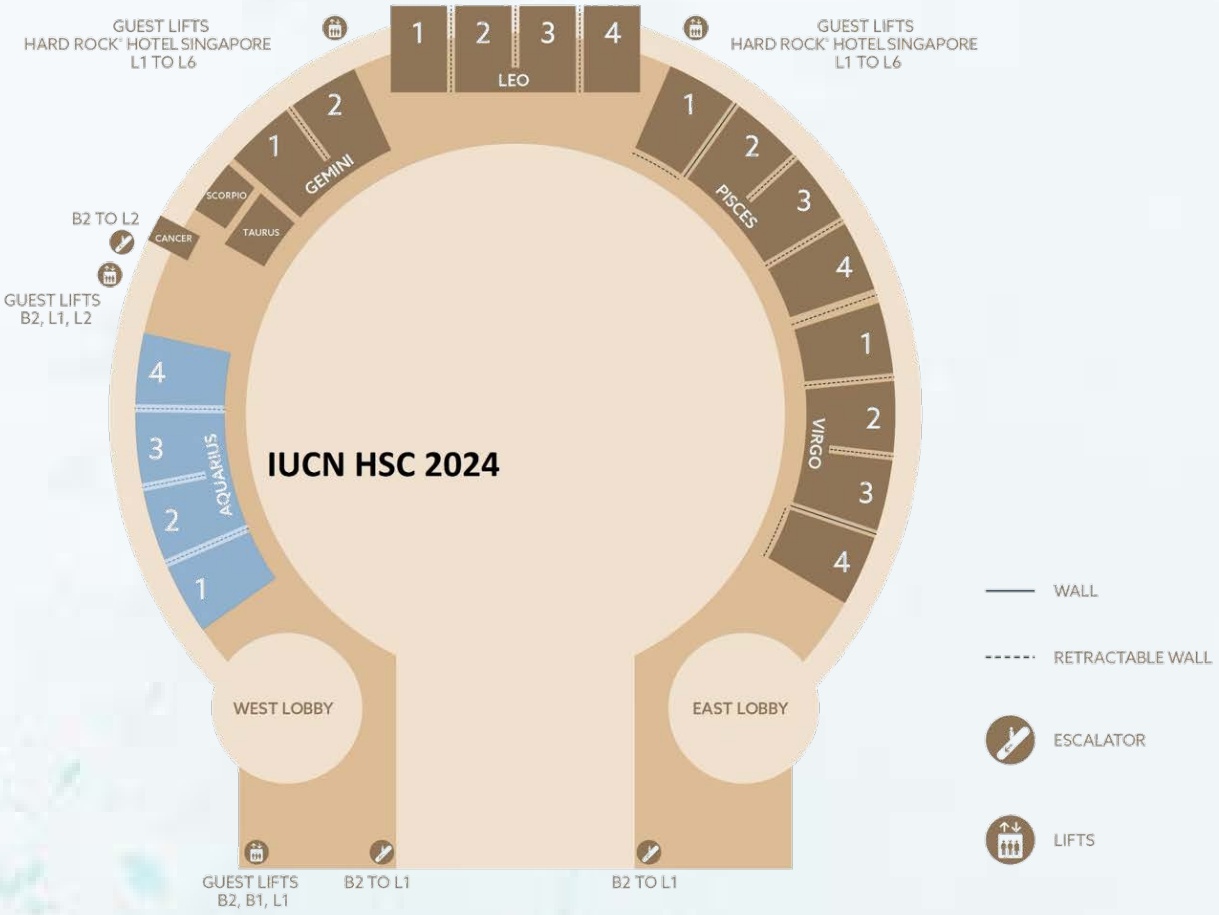
More information on the Sentosa Express, including Sentosa Island admission charges, refer to: www.sentosa.com.sg/en/things-to-do/attractions/sentosa-express/.

5. By Walking

- Take MRT North-East line (NEL) or Circle line (CCL), and alight at HarbourFront station (NE1 / CC29).
- Proceed to level 1 (ground level) of VivoCity and look for directions to the Boardwalk (700m in length), which parallels the Sentosa Gateway road and bridge.
- Cross the harbour on foot, and upon reaching Sentosa island, turn right and head towards Universal Studios Singapore.
- Continue to the end of the sheltered foot path, then turn left towards the Universal Studios Globe landmark.
- Walk past the Universal Studios Globe and take the escalators down to Resort World Sentosa Casino Dropoff Point at basement 1.
- See walking route to Resort World Convention Centre - map/video guide.

RESORTS WORLD CONVENTION CENTRE

Aquarius Rooms at Level 1 (Lobby West)
Resort World Convention Centre, Resorts World Sentosa
8 Sentosa Gateway, Sentosa Island, Singapore 098269



[K1] POPULATION STATUS AND RECOVERY OF THE AMERICAN HORSESHOE CRAB

SMITH, David R [1, 2]

1 – Eastern Ecological Science Center, U.S. Geological Survey, West Virginia;
2 – Environmental Biology Graduate Program, Hood College, Maryland, USA

OBJECTIVES

The range of the American horseshoe crab (*Limulus polyphemus*) extends from Maine, USA, to the Yucatán Peninsula, Mexico, encompassing over 52,000 km of shoreline with significant regional variation in ecology, abundance, threats, and management.

In this talk, I summarize:

- the advancement in management and monitoring over recent decades,
- the current population status throughout the species' range, and
- the potential future status and recovery.

MATERIALS AND METHODS

I review published literature and recent assessments on regional population status and trends. I highlight the Green Status Assessment (GSA) results regarding the species' future status and recovery potential. I also describe the role of citizen science and advocacy in horseshoe crab management.

RESULTS

Population monitoring surveys, including agency and citizen science, now occur in many key areas. The monitoring data feed into peer-reviewed assessments of Atlantic coast populations on a four-year cycle to regulate harvest. However, the populations of the Gulf of Mexico and Yucatán are not routinely assessed. The LAL industry has developed best practices to minimize mortality, but their adoption is voluntary, and the practices vary among states. In 2019, population status was assessed in the Atlantic coast regions as stable or increasing, except in the New York area. Recent trends from key areas confirm the current status. States continue to review and revise regulations. The GSA confirmed a heavy dependence on harvest management but revealed an inadequate focus on habitat protection.

CONCLUSION

In the late 1990s, conservation advocates sounded the alarm about overharvesting and raised the profile of horseshoe crab management. In response, science-based conservation of the American horseshoe crab has advanced remarkably over the past two decades. While near- term threats are increasingly understood and controllable, recovery potential is constrained by the long-term effects of coastal development and climate change, which are uncertain and difficult to mitigate at the spatial scale necessary to ensure ecologically functional populations throughout the species' range.

[K2] CONSERVATION OF HORSESHOE CRAB THROUGH GENETIC ENGINEERING OF rFC FOR BIOMEDICAL APPLICATIONS

DING, Jeak Ling [1]; HO, Bow [2]

1 – Department of Biological Sciences; 2 – Department of Microbiology and Immunology, National University of Singapore, Kent Ridge, Singapore

OBJECTIVES

During Gram-negative bacterial infection, endotoxin released from the bacteria interacts with human cell receptors to drive inflammation and fever. In severe persistent infections, excessive endotoxin induces septic shock and death. The ubiquity of endotoxin poses a threat to the pharmaceutical and healthcare industries. For the past 5 decades, quality assurance (QC) for endotoxin-free applications of injectable drugs and surgical implants has relied on the LAL (limulus amoebocyte lysate) test developed from horseshoe crab blood. However, LAL test requires harvesting, bleeding and loss of horseshoe crab. Problems with variations, sensitivity and specificity of LAL to endotoxin, and threats on horseshoe crab populations necessitated an alternative and more reliable endotoxin test. We aimed to genetically engineer Factor C (FC), the endotoxin-sensitive enzyme biosensor in LAL, to develop a synthetic test for endotoxin.

MATERIALS AND METHODS

By molecular recombinant technology, we reverse-transcribed isolated mRNA from *Carcinoscorpius rotundicauda* amoebocytes, into cDNA and cloned and screened for FC clones. Following selection and characterization of most robust clones, we expressed recombinant FC (rFC) in various host cells including different yeast strains, monkey, human and insect cells.

RESULTS AND CONCLUSION

rFC was optimally expressed via recombinant baculoviral system in insect cells. By up- scaling expression, the rFC produced was developed into a consistent, rapid, sensitive, and animal- free test for bacterial endotoxin, which is equal to or better than the LAL test. The rFC test is approved by US, EU, China and Japan Pharmacopoeias, and adopted worldwide as an alternate test for QC of parenteral drugs and vaccines.

[K3] NO INTACT EGGS IN AN UPTURNED NEST: POTENTIAL IMPACTS OF GLOBAL CHANGES IN COASTAL WETLANDS ON HORSESHOE CRAB CONSERVATION

LEE, Shing Yip [1, 2, 3]

1 – School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China; 2 – Australian Rivers Institute. Griffith University, Australia; 3 – IUCN Mangrove Specialist Group

OBJECTIVES

This presentation aims to [1] review the recent changes in coastal wetlands, particularly, urbanization, species invasion, and restoration, on the value of these habitats to horseshoe crab populations; and [2] discuss potential conservation measures to reduce the impact of these changes, with particular reference to tropical coastal wetlands.

MATERIALS AND METHODS

The trend of quantitative and qualitative changes in coastal wetlands is reviewed based on the latest global data. Particular attention is paid to the role of urbanization, species invasion, and restoration, in driving the changes. The potential impacts of these changes on the invertebrate fauna of coastal wetlands are explored based on current understanding of the interaction and mutual dependence between coastal wetlands and their associated fauna.

RESULTS

Coastal wetlands support highly diverse and abundant invertebrate faunas, with many species of conservation and/or commercial importance. Urbanization, species invasion, and recent large-scale restoration efforts all exert strong impacts on coastal wetland habitats, resulting in significant quantitative (e.g., areal cover) and qualitative (e.g., habitat complexity) changes with strong implications for the associated fauna. Horseshoe crabs demonstrate certain ecological and life-history traits that may increase their vulnerability to adverse habitat changes.

CONCLUSION

Globally, coastal wetlands are under immense pressure from urbanization and species invasion. While restoration efforts may increase wetland area, it is crucial that diverse, mature, functional coastal wetlands are protected from further loss and degradation, to promote the conservation of their associated invertebrate fauna, such as horseshoe crabs.

[K4] HOW SCIENCE CAN IMPROVE ASIAN HORSESHOE CRAB CONSERVATION MANAGEMENT: ATTEMPTS IN BEIBU GULF OF CHINA

KWAN, Kit Yue [1]; WANG, Chun-Chieh [2]; LU, Gang [3]; ZHOU, Zhiqin [3]; TAN, Kian Ann [1]

1 – Guangxi Key Laboratory of Beibu Gulf Marine Biodiversity Conservation, College of Marine Sciences, Beibu Gulf University, Guangxi, China; 2 – Guangxi Beibu Gulf Marine Research Center, Guangxi Academy of Marine Sciences, Nanning, China; 3 – Haikou Duotan Wetland Institute, Haikou, China

OBJECTIVES

The future priorities to the conservation of Asian horseshoe crabs, according to a questionnaire survey administered to 46 selected horseshoe crab experts in 2019, are baseline data collection and threat management. Over the past eight years, efforts have been devoted to better understanding the Asian horseshoe crab population and habitat distribution in Beibu Gulf of China. However, linking up science and management is difficult, particularly when Asian horseshoe crabs are not economically important species in China.

MATERIALS AND METHODS

The efforts to promote science-based management in various community service projects on Asian horseshoe crabs in Beibu Gulf of China were summarized.

RESULTS

(1) Identification of important spawning/nursery habitats is useful in various marine park/protected area management as well as environmental impact assessment projects. Standardized monitoring protocol adopted by the IUCN Asian Horseshoe Crab Observation Network can ensure data quality and allow yearly comparisons. (2) The peak season/month for spawning/nursery is important to design cost-effective monitoring activities and to implement precautionary measures to avoid massive loss during coastal constructions. (3) Movements of the spawning pairs between sea and land are crucial to assess any potential threats derived from human activities. (4) Engaging fisher communities in partnership with non-governmental organizations can maximize conservation impacts.

CONCLUSION

Enhanced understandings regarding the core habitats and their connectivity to support spawning, nursery and feeding of Asian horseshoe crabs are important to promote science- based decisions to further improve conservation management of remaining Asian horseshoe crab populations in Beibu Gulf of China.

[K5] INTRODUCTION TO THE ASSESS TO PLAN CONSERVATION PLANNING TOOL OF THE IUCN SSC CONSERVATION PLANNING SPECIALIST GROUP

RAGHAVAN, Roopali [1, 2]

1 – Head, Terrestrial Species and Conservation Planning, Mandai Nature, Singapore; 2 – Co-Convenor of the Southeast Asia Resource Centre of IUCN SSC Conservation Planning Specialist Group (CPSG)

ABSTRACT

The IUCN SSC Conservation Planning Specialist Group (CPSG) helps save threatened species by increasing the effectiveness of conservation efforts worldwide. The focus of CPSG is to scale up effective species conservation planning in the SSC in order to support efforts to conserve and restore populations of species under threat and ultimately to halt species extinctions. This has typically focused on single species or population planning; however, CPSG is now up-scaling this work to apply it to multi-species groups. Currently, two objectives of CPSG's work are i) to improve the connection between Red Listing and conservation planning and ii) to develop a tool for moving more species, more quickly, from assessing and into planning (in line with the SSC's ASSESS – PLAN – ACT model.

The Assess to Plan (A2P) tool of CPSG uses analyses of IUCN Red List data for multiple species and the input of local specialists, to identify next steps towards conservation action for these groups. It also identifies the individuals or agencies best placed to take these actions. It is designed to work either as an integral part of the IUCN's Red Listing framework — combining Red List workshops with the A2P process, where possible — or as a stand-alone process for groups of species with published Red Listassessments.

During this workshop we will utilise some of the CPSG A2P processes to identify conservation needs and actions for the three species of the Asian Horseshoe crabs Tri- spine Horseshoe Crab (*Tachypleus tridentatus*), Coastal Horseshoe Crab (*T. gigas*) and Mangrove Horseshoe Crab (*Carcinoscorpius rotundicauda*). We will also work on next steps for implementation and monitoring to ensure their safe future across their range.

[I1] PAST, PRESENT, AND FUTURE OF THE ASIAN HORSESHOE CRABS FROM THE PERSPECTIVE OF EVOLUTION

TANG, Qian [1]; JOHN, Akbar [2,3]; WARDIATNO, Yusli [4]; NISHIDA, Shin [5]; DO, Van Tu [6, 7]; XIE, Xiaoyong [8]; PATI, Siddhartha [9, 10]; SUSANTO, Handoko Adi [11]; HAJISAMAE, Sukree [12]; NELSON, Bryan Raveen [13]; MIN, Wah Wah [14]; HASAN, Mohammad Eusuf [15]; SALLES, Tristan [16]; CHEN, Yilin [17, 18]; QU, Yanhua [17, 18]; LEI, Fumin [17, 18, 19]; VENKATESH, Byrappa [20]; **RHEINDT, Frank E [1]**

1 – Department of Biological Sciences, National University of Singapore, Singapore; 2 – Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia, Penang, Malaysia; 3 – Renewable Biomass Transformation Cluster, School of Industrial Technology, Universiti Sains Malaysia, Penang, Malaysia; 4 – Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, IPB University, Indonesia; 5 – Biology, Science Education, Faculty of Education, University of Miyazaki, 1-1 Gakuen-Kibanadai-Nishi, Miyazaki, Japan; 6 – Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, Hanoi, Vietnam; 8 – Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Hanoi, Vietnam; 8 – Guangdong Provincial Key Laboratory of Fishery, Ecology and Environment; South China Sea Fisheries Research Institute, Chinese Academy of Fisheries Sciences, Guangzhou, China; 9
– Association for Biodiversity Conservation and Research (ABC), Odisha, India; 10 – NatNov Bioscience Pvt. Ltd., Odisha, India; 11 – Regional Office, Arafura and Timor Seas Ecosystem Action (ATSEA) Program, Bali, Indonesia; 12 – Faculty of Science and Technology, Prince of Songkla University, Pattani, Thailand; 13 – Institute of Tropical Biodiversity and Sustainable Development, Universiti Malaysia Terengganu, Kuala Nerus, Malaysia; 14 – Center of Excellence for Ecoinformatics and Marine Sciences, School of Life Sciences, Walailak University, Thailand; 15 – Marine Fisheries Survey Management Unit, Department of Fisheries, Chattogram, Bangladesh; 16 – School of Geosciences, University of Sydney, Australia; 17 – Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing, China; 18 – College of Life Sciences, University of Chinese Academy of Sciences, Beijing, China; 19 – Center for Excellence in Animal Evolution and Genetics, Chinese Academy of Sciences, Kunming 650223, China; 20 – Institute of Molecular and Cell Biology, A*STAR, Singapore

OBJECTIVES

Three of four extant horseshoe crab species in Asia share habitats across one of the world's largest and most dynamic shelf areas, the Sunda Shelf. By investigating the relationship between the Asian horseshoe crabs and the environment, our study aims to highlight important features for the long-term survivability of these coastal marine flagship species.

MATERIALS AND METHODS

With our comprehensive geographic and genomic sampling regime, for the three Asian horseshoe crab species, we reconstructed demographic histories, mapped population genetic structure, and estimated their vulnerabilities to future environmental changes.

RESULTS

Our study suggests that the current distribution and diversity of the Asian horseshoe crab can be attributed to the periodic submergence of the Sunda Shelf since 400 thousand years ago. Based on the population genetic analyses, we identified boundaries of populations and strongholds for evolutionary potentials of all three species. Moreover, with a novel eco- evolutionary analytical framework, we highlight key habitats that provide refugium conditions and connectivity to offset the advent effects from global warming by the end of the century.

CONCLUSION

Our work produced essential baseline information for the conservation of the Asian horseshoe crabs. Our work also highlights that the Sunda Shelf, as the sole repository for the diversity of the Asian horseshoe crabs, provides the complexity and connectivity for their long-term thrive.

[I2] BACTERIAL ENDOTOXINS TESTING – PROGRESSIVE SCIENCE AND SUSTAINABILITY

BOLDEN, Jay [1]

1 – Eli Lilly and Company, Indianapolis, United States of America

OBJECTIVES

The use of naturally-derived test reagents from horseshoe crabs (LAL/TAL) in tests for bacterial endotoxins have benefited human health for over 40 years. However, the use of LAL/TAL negatively impacts wild horseshoe crabs and associated imperiled species. Recombinant reagents derived from horseshoe crab DNA sequences are available and mitigate effects to all impacted species due to biomedical use of LAL/TAL. We report on our efforts to replace LAL with recombinant reagents.

MATERIALS AND METHODS

The Bacterial Endotoxins Test (BET) as described in the European Pharmacopoeia and as proposed by the United States Pharmacopoeia; using recombinant Factor C (rFC) and end- point fluorescence, or recombinant Cascade reagent (rCR) and kinetic chromogenic absorbance, in pharmaceutical medicines or related components.

RESULTS

We validated the BET using recombinant reagents in over 60 pharmaceutical medicines and related components. We observe comparability between recombinant reagents and LAL based on experience with over 150 different products and over 300,000 test samples. Over 65 health authorities have reviewed new Lilly marketing authorizations and 9 products are approved for release to market using rFC.

CONCLUSION

Current recombinant reagents are equivalent to LAL/TAL based on mechanism of action, and as supported by the literature and supplier validation. Our data further supports comparability and the successful replacement of LAL with rFC for over 80% of our medicine and related component bacterial endotoxins tests. Global transition to recombinant reagents will positively impact horseshoe crabs and associatedspecies.

[I3] RESEARCH AND CONSERVATION EFFORTS ON HORSESHOE CRABS IN INDIA: FROM 1909 TO 2023

DASH, Bisnu Prasad [1]

1. Adjunct Professor, Post Graduate Department of Zoology, Fakir Mohan University, Balasore, Odisha, India, Email Id: bisnu.bbs22@gmail.com

OBJECTIVES

To review the various research studies carried out on Indian horseshoe crabs and to know about the conservation status till date.

MATERIALS AND METHODS

Available published research articles on Indian Horseshoe crabs in different journals, books, Ph.D., M.Phil, and Masters Degree theses and monographs of national, state institutes were collected and reviewed. Information was also collected from several authors by personnel communications and discussions.

RESULTS

The occurrence of *Tachypleus gigas* and *Carcinoscorpius rotundicauda* has been known along the coasts of West Bengal and Odisha states since 1909. Studies about their distribution, habit and habitat, biology and biotechnological applications have been addressed. Much of the works were done during 1909-1930, 1980-1990 and again from 2006-2021. The Government of India has funded few studies on distribution, habitat mapping, in vitro conservational studies and exploring several biotechnological potentials. These animals have been included earlier in the Schedule IV and subsequently in Scheduled II of the Wildlife Protection Act 1972 which was revised in the year 2023. Few non-government organisations (NGO) are creating awareness among the population residing along the coastal districts of these two states about the importance of the horseshoe crabs and the role of community participation for conservation of the species in the country.

CONCLUSION

However research works on horseshoe crabs in India have been fragmented and sporadic in nature. Long term longitudinal studies on these important arthropods are very scarce in nature and a sustainable strategy for conservation of these species is yet to be initiated.

[O1] KEEPING UP OBSERVATION OF COASTAL HORSESHOE CRABS (*Tachypleus gigas*) ACROSS MAJOR HABITATS IN SUNDA SHELF, INDONESIA: HIGH GENETIC DIVERSITY AND MIXING POPULATION

AINI, Naila Khuril [1]; MASHAR, Ali [1]; WARDIATNO, Yusli [1,2]; EFFENDI, Hefni [1,2]; MADDUPPA, Hawis [3]

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OBJECTIVES

Horseshoe crab populations are increasingly threatened by over-exploitation, habitat destruction, consumption, and climate change. Species with limited dispersion capacities are frequently constituted of highly genetically organized populations over small geographic regions. Yet, there are limited studies on the population genetics of coastal horseshoe crabs (*Tachypleus gigas*) in Indonesia. This study aimed to identify the haplotype diversity and genetic connectivity of the coastal horseshoe crab observation in Sunda shelf, Indonesia.

MATERIALS AND METHODS

To achieve this, we collected a total of 136 samples from eight priority habitats: Bintan, Balikpapan, Demak, Madura, Subang, Ujung Kulon, Semarang and Lamongan. The samples were amplified using primers for mitochondrial (mt) AT-rich region DNA sequences.

RESULTS

The results showed 40 haplotypes, including nine shared across all localities. Haplotype diversity (*h*) was quite high, ranging from 0.783 to 0.945. In contrast, the nucleotide diversity obtained was relatively low at all locations, with values ranging from 0.003-0.009. Moreover, genetic differentiation (F_{ST}) value was relatively low (0 to 0.0340) and not significantly different ($p > 0.05$), except among samples from Ujung Kulon-Madura and Kulon-Subang ($p < 0.05$). The haplotype network revealed evidence of shared haplotypes among groups. Tajima's D and Fu's FS test results suggested population increase.

CONCLUSION

Our results revealed a limited level of differentiation, indicating a single stock with great connection. As a result, a regional conservation strategy is suggested for Indonesia's coastal horseshoe crabs.

[O2] GENETIC DIVERSITY ON HORSESHOE CRAB FROM SUMATRA AND JAVA, INDONESIA: A PRELIMINARY DATA

KURNIATAMI, Gabriella Tarida [1], KURNIASIH, Eka Maya [2], KHOLILAH, Nenik [3], NURSALIM, Nining [3], PUTRO, Sapto Purnomo [1], CAHYANI, Ni Kadek Dita [1,3]

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OBJECTIVES

There are three species of Horseshoe crabs (Order Xiphosura) present in Indonesian water, *Tachypleus tridentatus*, *Tachypleus gigas,* and *Carcinoscorpius rotundicauda*. The declining population of horseshoe crabs in Indonesia due to factors such as bycatch and mass consumption, despite their low economic value, is a pressing concern. This preliminary study aims to utilize the DNA Barcoding method to learn about the horseshoe crabs phylogenetics from Sumatra and Java, Indonesia.

MATERIALS AND METHODS

The research utilized Sanger sequencing targeting Cytochrome Oxidase Subunit I (COI) gene using jg-HCO and jg-LCO primers from mitochondrial DNA. MEGA11 program was used for both genetic distance and phylogenetic tree analysis.

RESULTS

A total of 22 samples of horseshoe crabs DNA from four different locations (Jambi, Bangka Belitung, Demak and Tuban) were amplified with Sanger sequencing and identified with MEGA 11. The phylogenetic tree analysis concluded that there are two different species, *T. gigas* and *C. rotundicauda.* Both species show differences in genetic variations. With a genetic distance within each species of 0-0.1% and between species of 0.1-0.9%.

CONCLUSION

There is a clear separation between species, shown by genetic distance. However, between *C. rotundicauda* species, there is not much difference in genetic variation between sampling locations with evidence that Java and Sumatra Island were showing the higher difference in genetic composition compared with location between Java or between Sumatra.

[O3] ADULT POPULATION ESTIMATE TO THE *Tachypleus tridentatus* ALONG KINMEN COUNTY, TAIWAN

SHIH, Yi-Jia [1, 2]; CHANG, Yi [2]; KIM, Yi-Hua [2]; CHEN, Yu-Ting [3]; CHEN, Yin-Ting [4]; WANG, Jia-Qiao [1]

1 – Fisheries college, Jimei University, China; 2 – Graduate Institute of Marine Affairs, National Sun Yat-sen University, Taiwan; 3 – Ocean Conservation Administration, Ocean Affairs Council, Taiwan; 4 – Fisheries Research Institute, Kinmen County, Taiwan.

OBJECTIVES

The tri-spine horseshoe crab (*Tachypleus tridentatus*) is a species of concern due to its unique economic and medical value. Although a global decline in the population of the tri- spine horseshoe crab is reported, the lack of data on population size hampers the development of conservation management measures. Hence, the objective of this study is to conduct the first evaluation of the adult population size along Kinmen County, where a relatively abundant population persists in Taiwan.

MATERIALS AND METHODS

Adult individuals of horseshoe crabs were collected from net bycatch between 2018 and 2023 (except in 2019). These collected individuals were marked with chips and/or color plastic tags worn at the base of the tail. The targeted individuals resided in the recovery pond for about a week before rewilding. Subsequently, the capture-mark-recapture method was employed to estimate the adult population size, and the recapture rate was also calculated.

RESULTS

A total of 2,641 adult horseshoe crabs were collected, with 2,236 individuals marked. Among them, 59 individuals were recaptured, resulting in a recapture rate of approximately 2.23%. The estimated adult population size for each year ranged from 1,888 to 107,623. Overall, the adult population is approximately 46,452 individuals. Within a 95% confidence interval, the highest estimated population is 64,423 individuals, while the lowest is 36,320 individuals.

CONCLUSION

This study reveals the estimated population size of adult *T. tridentatus,* which is one of the few works focusing on the adult populations. These results also contributed to crucial evidence for the long-term conservation strategies and effectiveness for tri-spine horseshoe crabs in Taiwan.

[O4] HABITAT AND POPULATION RECOVERY OF MANGROVE HORSESHOE CRAB AFTER A MAJOR CYCLONIC EVENT IN THE BAY OF BENGAL

BHADURY, Punyasloke [1]*; MANDAL, Arkaprava; YASH; KUMAR, Chakresh; SAINI, Nirupama; GHOSH, Anwesha

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OBJECTIVES

Sundarbans, the world's largest continuous mangrove forest formed at the Ganga Brahmaputra Meghna riverine system of the Bay of Bengal, is home to a large population of mangrove horseshoe crab, along with the Indo Pacific horseshoe crab (*Tachypleus gigas*). In 2020, a category 5 very severe cyclonic storm 'Amphan' hit and badly affected the mangrove horseshoe population in Sagar Island, an island within Sundarbans.

MATERIALS AND METHODS

Immediately following the cyclone, intense field work was initiated to determine population status of mangrove horseshoe crabs. The habitat assessment was undertaken during this period by assessing mangrove vegetation status as well as quantifying the nature of sediment grain size patterns. Besides, with the help of local fisherfolk communities, marine litter was removed systematically during the study period. Attempts were also undertaken to rescue and release mangrove horseshoe crab from other affected islands gradually into the restored habitat of Sagar Island.

RESULTS

Immediately following the cyclone, population status showed a sharp decline of 1-2 individuals per km (compared to 12-15 individuals per km) in Sagar Island and there was large-scale destruction of habitat attributes including that of mangrove vegetation. The silty- clay nature of sediment (35-40% of texture proportions) was replaced by coarse and fine sand particles across habitats of mangrove horseshoe crabs. Besides, marine litter dominated by plastics, ghost nets, among others were found across the habitats of mangrove horseshoe crabs. More than 500 kg of plastics and ghost nets were removed between June, 2020 and January, 2021 with the active involvement of local fisherfolk communities to restore the habitats of mangrove horseshoe crabs. The sediment texture analysis revealed gradual transition to silt-clay nature of sediment. However, microplastic abundance in sediment and surrounding the intertidal water column were found to be higher. During this period, there was occasional presence of adult mangrove horseshoe crabs; however juvenile forms were not encountered. From February, 2021 the occurrence of mangrove horseshoe crabs showed an increase (3-5 individuals per km).

CONCLUSION

The overall number of mangrove horseshoe crabs presently shows an increasing trend and restoration activities led by coastal fisher folk communities are showing gradual recovery in terms of population structure and habitat in Sundarbans.

[O5] MOLECULAR ECOLOGY OF THE MANGROVE HORSESHOE CRAB (*Carcinoscorpius rotundicauda*) IN INDONESIA: EVIDENCE FOR HIGH GENETIC DIVERSITY AND LIMITED GENE FLOW

KURNIASIH, Eka Maya [1]; CAHYANI, Ni Kadek Dita [2], IMAI, Hideyuki [3]

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OBJECTIVES

The population genetic studies of the mangrove horseshoe crab, *Carcinoscorpius rotundicauda* are still lacking, and its population decline is due to being frequently caught as by-catch in Indonesia. This study aims to assess the genetic diversity and population structure of *C. rotundicauda* for conservation collected from three sites in Indonesia: Jambi, Bangka Belitung, and East Java.

MATERIALS AND METHODS

A total of 150 samples of *C. rotundicauda* DNA from three locations were amplified using designed primers for mitochondrial control region (CR) sequences. The population structure was assessed using Wright's fixation index (F_{ST}) and analysis of molecular variance (AMOVA) using Arlequin v.3.5 program and genetic diversity values using DNASp v6.

RESULTS

The results revealed 81 haplotypes across all localities. Haplotype diversity (h) ranged relatively high from 0.873 to 0.988, while nucleotide diversity (π) ranged low from 0.5-0.6% compared to estimates from the same genetic marker in different horseshoe crab species. The high F_{ST} values ranging from 0.374 to 0.735 for pairs of genetic differentiation (after Bonferroni correction) indicated that each of the three sites was genetically independent. AMOVA demonstrated that the majority of the variation was among populations (61.61%) compared to within populations (38.39%). Both Tajima's D and Fu's Fs values from the neutrality tests were negative, suggesting population expansion.

CONCLUSION

We conclude that *C. rotundicauda* exhibits high genetic diversity and significant differentiation across various areas in Indonesia. Consequently, targeted conservation efforts should be directed towards specific regions to ensure the preservation of the mangrove horseshoe crabs in Indonesia.

[O6] MOLECULAR IDENTIFICATION OF HORSESHOE CRAB FROM BANGLADESHI COAST USING DNA BARCODING TECHNIQUE

RAHMAN, Shafiqur [1]; HAQUE, Md. Amdadul [2]; RAHMAN, Turabur [1]; ISLAM, Zahidul [1]; RABBY, Ahmad Fazley [1]; RASHID, Jonaira [2]; KARIM, Ehsanul [3]; ALI, Md Zulfikar [3]

1 – Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute, Cox's Bazar-4700; 2 – Fresh Water Station, Bangladesh Fisheries Research Institute, Mymensingh- 2201; 3 – Head Quarter, Bangladesh Fisheries Research Institute, Mymensingh-2201

OBJECTIVES

The horseshoe crab, an ancient marine arthropod, inhabits along the coast of Bangladesh. Molecular evidence and phylogenetic placement of these crabs are still undercover in this habitat. The rapid climate change impacts all terrestrial and marine creatures, including this ancient crab that has existed for millions of years.

The study aimed to identify the collected specimens and confer the phylogenetic position with other populations of the horseshoe crab species found in Southeast Asia.

MATERIALS AND METHODS

A combination of molecular and morphological approaches was employed which were collected from the coast of Bangladesh.

RESULTS

Regarding morphological analysis, *T. gigas* and *C. rotundicauda* differ externally. Two prominent distinctive characteristics are that *T. gigas* has a spine rack in the telson, but *C. rotundicauda* lacks one, and the spine of the abdominal segment is bigger and more robust in *T. gigas*. From a molecular perspective, *T. gigas* and *C. rotundicauda* are 11.24% genetically distinct, while their genetic diversity is 0.83% and 0.24%, respectively. According to the phylogenetic tree, *C. rotundicauda* from the coast of Bangladesh shares a close relationship with the Indian population but is distantly related to the population found in Malaysia and Indonesia. One specimen of *T. gigas* shows a cryptic placement in the phylogeny compared to other specimens.

CONCLUSION

This study uncovered two separate species. A comprehensive conservation effort off the coast of Bangladesh would be necessary to protect these two living fossils from extinction.

[O7] GENETIC DIFFERENCES OF MANGROVE HORSESHOE CRABS *Carcinoscorpius rotundicauda* ALONG THE BAY OF BENGAL COAST IN ODISHA, INDIA

TUDU, Sanatan [1,2,3]; GUPTA, Sandeep Kumar [2]; SHAIK, Rahimuddin [1,3]; PATTANAYAK, Upasana [3]; BISWAL, Gobinda Chandra [3] PATI, Siddhartha [3]; DASH, Bisnu Prasad [1]

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3 - Research Division, Association for Biodiversity Conservation and Research (ABC), Balasore-756020, Odisha, India

OBJECTIVES

Mangrove horseshoe crab (*Carcinoscorpius rotundicauda*) is an ecologically significant species inhabiting the coastal regions of the Bay of Bengal. Understanding its genetic diversity and population structure is crucial for effective conservation and management efforts. In this study, we investigated the genetic differences of *C. rotundicauda* populations along the Bay of Bengal coast using mitochondrial DNA cytochrome c oxidase subunit I (CO*I*) gene sequence.

MATERIALS AND METHODS

A total of 89 book gill tissue samples were collected from dead remains of mangrove horseshoe crab specimens on the coast of the Bay of Bengal, and total genomic DNA was extracted using a standardized method involving proteinase K digestion/phenol- chloroform extraction. The extracted DNA was then amplified via polymerase chain reaction (PCR) targeting the CO*I* gene and sequenced bidirectionally using the BigDye v3.1 Kit and 3500 XL Genetic Analyzer. The obtained sequences were aligned with NCBI available sequences.

RESULTS

Sequence analysis revealed significant genetic variation among populations of *C. rotundicauda* along the Bay of Bengal coast. Phylogenetic analysis and population genetic parameters were employed to elucidate the genetic structure and connectivity among populations. A total of 18 unique haplotypes were observed in three populations of *C. rotundicauda*. Pairwise F-statistic distance (F*ST*) between South China-India was 0.044; Malaysia-India was 0.008; and South China-Malaysia was 0.041. These values indicate varying degrees of genetic differentiation among the populations, with the Indian population being closely related to the Malaysian population. The migrant per generation (Nm) was calculated to be 0.15, signifying limited gene flow among the *C. rotundicauda* populations. The haplotype diversity (Hd) and nucleotide diversity (π) were 0.9176 and 0.02093, respectively.

CONCLUSION

Overall, these findings provide valuable insights into the genetic structure and diversity of *C. rotundicauda* populations along the Bay of Bengal coast. The low gene flow and high haplotype and nucleotide diversity highlight the importance of conservation efforts to maintain the genetic integrity of these populations.

[O8] HORSESHOE CRAB CONSERVATION REIMAGINED: THE PATH OF BALANCE AND MODERATION

GAUVRY, Glenn

Ecological Research & Development Group Inc. (ERDG), Little Creek, Delaware, USA

OBJECTIVES

The objective of this study is to explore innovative conservation strategies for the world's four horseshoe crab species that integrate scientific research with traditional ecological knowledge and non-scientific forms of understanding. This approach aims to foster a more inclusive, equitable, and effective conservation movement that respects both human and ecological well-being.

MATERIALS AND METHODS

This study synthesizes insights from a wide range of sources, including scientific literature, traditional ecological knowledge, and case studies on community engagement and socio- economic incentives. It adopts a holistic perspective that acknowledges the interconnectedness of ecological, cultural, and economic factors in conservation.

RESULTS

Findings highlight the importance of compassion, balance, and moderation in conservation efforts, demonstrating how these values can lead to innovative solutions that address both ecological imperatives and human needs. The study reveals the potential of integrating traditional wisdom with scientific research to enhance the resilience of conservation strategies.

CONCLUSION

Embracing a holistic and inclusive approach to horseshoe crab conservation not only enriches our strategies but also ensures their sustainability and effectiveness. This study calls for a shift towards conservation practices that honor the interconnectedness of all life, leveraging diversity, and fostering unity in our collective quest for a sustainable and just world.

[O9] A COMMUNITY-BASED HABITAT MANAGEMENT MODEL IN AN UNDER PROTECTED BIODIVERSITY HOTSPOT: THE INTERTIDAL SHORES OF PAK NAI OF HONG KONG

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1 – Community Conservation Manager, The Nature Conservancy Hong Kong, Hong Kong SAR; 2 – Assistant Conservation Manager, The Nature Conservancy Hong Kong, Hong Kong SAR; 3 – Senior Conservation Program Manager, The Nature Conservancy Hong Kong, Hong Kong SAR

OBJECTIVES

The mudflats of Pak Nai are widely recognized for their ecological importance. It houses Hong Kong's largest expanse of *Halophila beccarii*, nursing grounds for *Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*, foraging grounds for birds, including *Platalea minor*, and a large area of abandoned benthic oyster farms. However, these critical mudflats and the horseshoe crab populations receive limited statutory protection and are vulnerable to on-going threats that include the rapid spread of invasive *Spartina alterniflora* cordgrass, constant influx of marine plastic litter, aquaculture debris and unsustainable tourism. Hence, The Nature Conservancy (TNC) has implemented an integrated ecosystem management approach, since 2021, to preserve their wildlife.

MATERIALS AND METHODS

TNC and volunteers have been conducting on-site habitat management activities specifically targeting horseshoe crab habitat enhancement. This includes the reconfiguration of abandoned oyster farms into more naturally configured oyster beds, clearing of invasive cordgrass removal, marine plastic litter and oyster aquaculture debris. TNC also conducted scientific research, including horseshoe crab walk-through surveys, habitat mapping and sediment monitoring, to monitor the results.

RESULTS

Over the past 3 years, we have completed reconfiguring 7700 m^2 of abandoned oyster farms, removal of 462 m^2 of invasive cordgrass removal, clearing of 3 tons of marine plastic litter and oyster aquaculture debris.

From 2021 to 2023 summer, 56.1% increase of *Tachypleus tridentatus* population (from 126.8 to 198 individuals) was observed on-site.

CONCLUSION

These management activities have positively enhanced the sediment characteristics and environment of juvenile *Tachypleus tridentatus* and such integrated management approach should be replicated in other under-protected horseshoe crab hotspots.

[O10] THE BOYS OF SUMMER: A SHIFT IN GENDER RATIO OF AMERICAN HORSESHOE CRABS (*Limulus polyphemus*) DURING THE SPAWNING SEASON IN JAMAICA BAY, NEW YORK

COLON, Christina [1]; BOTTON, Mark [2]; SCLAFANI, Matthew [3]; CERRATO, Robert [4]; SCOTT, Christopher [5]; SELIGMAN, Ann [6]

1 – Kingsborough Community College, Brooklyn, New York, USA; 2 – Fordham University, New York, New York, USA; 3 – Cornell Cooperative Extension, New York, USA; 4 – Stony Brook University, New York, USA: 5 – New York State Department of Environmental Conservation, USA; 6 – New York City Audubon, USA

OBJECTIVES

The primary goal of the New York Horseshoe Crab Monitoring Network's ongoing monitoring program is to assess the health of the breeding population at key spawning beaches along the shores of Long Island, New York. We tested the hypothesis that the sex- ratio became more male biased as the spawning season progressed.

MATERIALS AND METHODS

Starting in 2011, annual spawning surveys have been conducted along several beaches in Jamaica Bay, New York, a federally protected urban estuary. Plumb Beach East and Big Egg Marsh were both surveyed using quadrat counts on three days around four Spring high tides from May through early July by trained citizen scientists as part of a region-wide survey program. Counts and gender ratios for each survey interval were averaged and values were clustered for each of four survey events for this analysis.

RESULTS

Preliminary data confirms that as the spawning season progresses, the relative frequency of males increases significantly. The total counts for both males and females decline as the season progresses. This trend is apparent at both Plumb Beach East and Big Egg.

CONCLUSION

The decline in the proportion of females at spawning beaches over the course of the summer could be due to a variety of factors including offshore migrations of females as their egg supply becomes depleted or higher mortality of females (Bopp, et al. 2019). Additional research is warranted to better understand these trends.

[O11] HUMAN EXPLOITATION SURVEY OF ADULT HORSESHOE CRAB AND PUBLIC AWARENESS CAMPAIGN IN HONG KONG SAR, CHINA

TANG, Pui Yi [1], PANG, Lee Yan [1], SO, Kelvin Jun Yin [1]

1- WWF - Hong Kong

OBJECTIVES

Human exploitation has been identified as one of the potential threats to the survival of adult horseshoe crabs. This study aims to investigate the extent of human exploitation affecting the population of adult horseshoe crab s and explore the possible conservation measures in Hong Kong.

MATERIALS AND METHODS

WWF- Hong Kong conducted a market survey and large-scale phone interviews to assess knowledge and consumption patterns of horseshoe crabs. Besides, in-depth interviews were conducted with representatives from fishermen and religious organizations respectively.

RESULTS

WWF identified 80 individual horseshoe crabs sold and displayed in 98 seafood restaurants or fish stalls. Besides, a total of 1,005 Hong Kong resident s were successfully interviewed. Over 53% (n = 536) of respondents reporting they have no prior knowledge and never heard of horseshoe crab before. However, almost all respondents showed a high willingness to pledge not to consume the animal for any purpose after being informed that horseshoe crabs were of conservation concern. Furthermore, fishermen and religious organizations provide valuable Local Ecological Knowledge (LEK) to the study such as the supply chain of horseshoe crabs in Hong Kong.

CONCLUSION

This study emphasized the importance of raising public awareness about the conservation of horseshoe crabs and the potential threat that human exploitation poses to the survival of adult horseshoe crabs. The "Horseshoe Crab-Friendly Campaign" could serve as an example of promoting sustainable behavioural change. Nevertheless, regulation and effectively managing marine protected areas is fundamental to conserving horseshoe crabs and their habitats.

[O12] FIELD OBSERVATIONS AND LABORATORY MANIPULATIONS REVEAL THE SIGNIFICANCE OF BEACH CLEANUP IN IMPROVING THE BODY CONDITION OF JUVENILE HORSESHOE CRABS

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1 – Department of Chemistry, City University of Hong Kong, Hong Kong, China; 2 – College of Marine Sciences, Beibu Gulf University, Qinzhou, China; 3 – Guangxi Key Laboratory of Beibu Gulf Marine Biodiversity Conservation, Qinzhou, China; 4 – State Key Laboratory of Marine Pollution, City University of Hong Kong, Hong Kong, China

OBJECTIVES

To investigate the impact of oyster rubbles from oyster farms on the body condition and foraging behaviour of juvenile horseshoe crabs through field and laboratory studies.

MATERIALS AND METHODS

The population abundance and the size and weight of juvenile horseshoe crabs in two neighbouring mudflats, Pak Nai and Ha Pak Nai, with a higher percentage cover of oyster rubbles for the former, were compared. A laboratory experiment simulating the effect of oyster rubbles was conducted by maintaining second instars of *T. tridentatus* under two densities of obstacles for 42 days. Another group without obstacles served as a control.

RESULTS

Ha Pak Nai is a more favourable habitat for horseshoe crabs, reflected by a higher population density, a larger prosomal width, and a higher body weight. Individuals of *T. tridentatus* in Hai Pak Nai were 20% heavier than those in Pak Nai. The total distance travelled, and displacement was positively correlated with the prosomal width in Ha Pak Nai but not in Pak Nai. In the laboratory experiment, the body weight increased with time, with a significantly higher value for the control than the high obstacle density treatment. Prosomal width increased with time, but the effect of obstacle density was insignificant.

CONCLUSION

The field observations and the laboratory experiment indicate the negative impact of debris on the juvenile horseshoe crabs. Regular beach cleanup, as shown in Ha Pak Nai, is an effective way to improve the habitat quality and should be promoted to conserve this “living fossil”.

[O13] EXPLORING LOCAL KNOWLEDGE INFORMATION OF HORSESHOE CRABS IN BANTEN AND CENTRAL JAVA

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1 – University of Sultan Ageng Tirtayasa, Serang Indonesia; 2 – Polytechnic of Agricultural Engineering Indonesia, Tangerang, Indonesia

OBJECTIVES

Horseshoe crabs, an ancient marine animal, play ecological, medical, and cultural roles, yet their populations face numerous threats. Despite this, their information from local knowledge remains underexplored. This study aims to inform the knowledge surrounding horseshoe crab among local government, coastal communities, fishermen, and crab mongers.

MATERIALS AND METHODS

This research was conducted from July - September 2023. The methods used in this study are semi-structured interviews and participatory observations with 20 respondents spread across Banten (subdistrict: Panimbang, Lontar, Kronjo, Mauk, Tanjung Pasir) and Central Java (subdistrict: Mangkang).

RESULTS

The findings highlight concerning trends: 85% reported a decline in horseshoe crab populations, with 95% caught as bycatch, averaging 1-16 individuals per trip. Among the identified species, 40% were *Tachypleus gigas*, 30% were *Carcinoscorpius rotundicauda*, 25% found both species, and 5% were unidentified. Additionally, 10% of respondents reported finding horseshoe crab eggs. Furthermore, 80% of respondents had never consumed horseshoe crab eggs, though 55% were aware of others consuming them. For fishermen who found gravid female horseshoe crabs, 60% of them chose to sell them to the crab mongers and 60% of respondents explained that they would be punished if they caught horseshoe crabs in their area.

CONCLUSION

This study provides information on incorporating local knowledge into marine conservation frameworks and fostering synergy between traditional wisdom and scientific understanding.

[O14] CONSERVATION NETWORK OF HORSESHOE CRAB IN TAIWAN: CONSERVATION PRACTICE FROM COMMUNITY-BASED CITIZEN SCIENCE TO NATIONAL POLICY

YANG, Ming-Che [1, 2, 3]; SU, Yin-tien [4]; HUANG, Hui-Ching [1]

1 – Taiwan Horseshoe crab Conservation Network; Taiwan; 2 – Department of Life Sciences, National Cheng Kung University, Taiwan; 3 – The IUCN SSC Horseshoe Crab Specialist Group; 4 – Chiayi Ecological Environment Conservation Association, Chiayi, Taiwan

OBJECTIVES

The loss or fragmentation of horseshoe crab, *Tachypleus tridentatus* habitat is a major threat, particularly on the main island of Taiwan. Presently, juvenile populations are only found in wetlands in Penghu and Kinmen Islands or within three protected areas on the main island of Taiwan. The strategy in a single direction is insufficient to provide comprehensive conservation for horseshoe crabs.

MATERIALS AND METHODS

We provide a review of the population status and multi-layered conservation practices of *Tachypleus tridentatus,* including both declining and relatively stable populations around Taiwan.

RESULTS

Scientific and community-based citizen science surveys on juvenile populations in nationally protected wetlands have been conducted for several years. Various conservation practices, such as public education and conservation policy, have been implemented based on different population statuses among Taiwan. Since 2022, the harvesting of horseshoe crabs has been banned throughout Penghu County. The construction of the fourth restoration center for horseshoe crabs in Chiayi is scheduled for completion in 2026 to fill the gap in southern Taiwan.

CONCLUSION

Efforts to establish a conservation network for horseshoe crabs in Taiwan also aim to foster collaboration among NGOs, research groups, and local and central governments.

[O15] A PROGRESS UPDATE OF THE IUCN HORSESHOE CRAB SPECIALIST GROUP

SHIN, Paul [1]; BOTTON, Mark [2]

1 – City University of Hong Kong, Hong Kong SAR, China; 2 – Fordham College at Lincoln Center, New York, NY, USA

OBJECTIVES

To review recent achievements of the IUCN Horseshoe Crab Specialist Group (HSC SG) and outline its future goals.

MATERIALS AND METHODS

The HSC SG was established in 2012 to advocate for science-based conservation of horseshoe crabs and their habitats. We review facets of our work under the general categories of ASSESS, NETWORK, and COMMUNICATE.

RESULTS

ASSESS: *Limulus polyphemus*: Red Listing published in 2016, formerly Least Concern, now Vulnerable; Green Status published in 2022 as Moderately Depleted. *Tachypleus tridentatus*: Red Listing published in 2018, formerly Data Deficient, now Endangered; Green Status in progress. *Carcinoscorpius rotundicauda* and *T. gigas*: Red List Data Deficient, updates inprogress.

NETWORK: Asian HSC Observation Network, in partnership with government, local NGOs and conservation organizations. Adopt a standardized set of survey methods and develop a field guide and data sheet for juvenile HSC monitoring across Asia. Collaboration with Nature Society (Singapore) and Mangrove Action Project at IUCN World Congress (2016).

COMMUNICATE: International HSC Day, established 2019; international and regional HSC conferences; publications (e.g. Tanacredi et al., 2022).

CONCLUSION

We are grateful to all the people that have contributed to the past success of the HSC SG and we look forward to continuing our productive interactions. Further targets include the development of a Conservation Action Plan for Asian HSC at the Singapore Workshop; implementing pilot projects based on the CAP; educating local fishermen on how to save HSC which are trapped as bycatch and/or in ghost nets; and engaging with local communities to restore degraded habitats.

[O16] STRATEGIES FOR BUILDING AND OPTIMISING A MARINE CONSERVATION

NETWORK FOR *Tachypleus tridentatus* IN BEIBU GULF

CHEN, Xiao Hai [1, 2]; XIE, Xiao Yong [1]; ZOU, Ji Xin [2], SHI, Jun [2]

1 – Guangdong Provincial Key Laboratory of Fishery Ecology and Environment; South China Sea Fisheries Research Institute, Chinese Academy of Fisheries Sciences, Guangzhou, China; 2 – College of Marine Sciences, South China Agricultural University, Guangzhou, China

OBJECTIVES

Emerging marine conservation network strategies adapted to the ecological habits of *T. tridentatus* can make a significant contribution to the survival potential of populations. Designing the network with good ecological connectivity and preserving spatial resources as much as possible has become a key research issue.

MATERIALS AND METHODS

Species and environmental data were collected by field sampling and remote sensing. Marine conservation networks were constructed using species distribution models, least- cost pathway models and circuit theory. Functional connectivity metrics were used to assess connectivity. The relationship between the number of reserves and network connectivity was simulated using numerical models.

RESULTS

We supplemented baseline data on adult and juvenile *T. tridentatus* populations in the Beibu Gulf and revealed the spatial heterogeneity of their potential habitat distribution. A marine conservation network was successfully established, including 43 priority areas for reserve establishment and several ecological corridors. The connectivity of the network shows a law of diminishing returns as the number of reserves increases. This suggests that simply increasing the number of reserves is not an optimal strategy.

CONCLUSION

The scarcity of *T. tridentatus* resources warrants immediate conservation action, including the development of methods suitable for surveying and assessing *T. tridentatus* populations, and the inclusion of *T. tridentatus* as a target species in emerging conservation networks. The framework developed in this study will provide decision support for establishing and optimising marine conservation networks. It is expected that maximum conservation benefit will be achieved with minimum spatial resources.

[O17] EXPLORING OF CONSERVATION MECHANISM OF CRITICAL HORSESHOE CRAB HABITAT OVERLAPPING WITH TOURIST HOTSPOTS

TAO, Jingru [1]; LIU, Chengshu [1]; WANG, Jinxiu [1]

1 – Guangxi Biodiversity Research and Conservation Association, Guangxi, China

OBJECTIVES

To implement the conservation of horseshoe crabs and their crucial habitats in the Beibu Gulf coastal wetlands, we advocate for an approach grounded in citizen science and collaborative efforts among multiple stakeholders.

MATERIALS AND METHODS

By monitoring the horseshoe crabs, macrobenthos and waterbirds in coastal wetlands through citizen science monitoring, the Guangxi Biodiversity Research and Conservation Association (BRC) conducted a rapid survey of the environmental impact of massive influx of tourists post- pandemic in the beach of Beihai, Guangxi during peak summer season with the assistance of volunteers and local guides. The Ecological Beachcombing Initiative, a conservation guideline for recreational beachcombing, is jointly published by BRC, local community and relevant government agencies.

RESULTS

The rapid survey results indicated that the highest concentration of tourists is in the mid- tidal area, where tourists collect shellfish, sandworms, fiddler crabs, and other species, often discarding them in large quantities on the beach. Many domestic tourists are unfamiliar with horseshoe crabs, and even local visitors are unaware of their conservation status, making horseshoe crabs a target as well. In response to this issue, BRC cooperates with relevant government agencies, local fishing communities and NGOs to jointly launch an ecological beachcombing initiative. Combining results from other surveys focusing on the same area, BRC initially understood the tourist-intensive areas and activity routes, and set up the 4 publicity points, 11 community guides and 30 volunteers were organized and trained to give public explanations, directly or indirectly affecting more than 5,000 tourists in 5 days.

CONCLUSION

The reckless beachcombing and other recreational activities reflect the lack of management and public awareness of coastal wetlands conservation in tourist hotspots. BRC is committed to fostering the sustainable development of coastal wetlands, with a particular emphasis on horseshoe crab conservation. This will be achieved through ongoing citizen science monitoring efforts and the promotion of ecological beachcombing practices.

[O18-19] THE IUCN GREEN STATUS ASSESSMENT FOR *Tachypleus tridentatus*

LAURIE, Kevin [1]; CHEUNG, S.G. [2]; DO, Van Tu [3]; FUNCH, Peter [4]; IWASAKI, Yumiko [5]; KAISER, Dorkas [6]; KWAN, Kit Yue [7]; MEILANA, Lusita [8]; MOHAMAD, Faridah [9]; SEINO, Satoquo [10]; YANG, Ming-Che [11];ˀBOTTON, Mark [12]; SHIN, Paul [13]; SMITH, Dave [14]

1 - Hong Kong Coast Watch, China; 2 – City University of Hong Kong, China;i3 – Vietnam Academy of Science and Technology, Viet Nam; 4 – Aarhus University, Denmark; 5 – Hiroshima University, Japan; 6 – Katala Foundation, Philippines; 7 – Beibu Gulf University, China; 8 – IBP University, Indonesia; 9 – Universiti Malaysia Terengganu, Malaysia; 10 – Kyushu University, Japan; 11 – National Cheng Kung University, Taiwan; 12 – Fordham University, USA; 13 – City University of Hong Kong, China; 14 – U.S. Geological Survey and Hood College, USA

OBJECTIVES

The IUCN developed the Green Status Assessment (GSA) process to aid species recovery. This talk will present the main results of applying the GSA to *Tachypleus tridentatus* and highlight insights gained for improving the conservation of this and other Asian horseshoe crab species.

MATERIALS AND METHODS

The IUCN Horseshoe Crab Specialist Group convened an expert team with geographic and topical representation to apply the GSA to *T. tridentatus*, identifying and communicating conservation and information needs. Over five months, the team met virtually bi-weekly to draft the GSA. They assessed threats, identified conservation actions, and assessed historical and current population status within spatial units. The team projected future status under conservation scenarios to evaluate recovery potential.

RESULTS

The team defined 14 spatial units to account for the range-wide variation in genetic structure, ecology, and threats. The ongoing threat assessment identified the major threats, with various degrees of uncertainty, as 1) harvest for consumption, TAL, and bycatch, 2) habitat loss resulting from coastal development, reclamation, near-shore activities, and aquaculture, 3) invasive alien species, including macrophyte encroachment on spawning and nursery habitat, 4) pollution effects, and 5) direct and indirect impacts of climate change. Although the status assessment is in process, a widespread absence of viable populations and significant challenges to recovery were revealed.

CONCLUSION

The GSA framework's application will help the conservation community understand and communicate the actions needed to improve the status of *T. tridentatus* range-wide. However, critical knowledge gaps were identified through the GSA. Ultimately, the species' recovery will depend on combined action across and within countries prioritized where conservation and research can benefit most.

[O20] LIMB DEVELOPMENT IN THE ASIA PACIFIC HORSESHOE CRAB *Tachypleus gigas* MÜLLER

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1 – ViStA Lab, Birla Institute of Technology and Science (BITS), Pilani-KK Birla Goa Campus, Goa, India

OBJECTIVES

Though there has been significant studies regarding the development of eggs in the three other living species, very little is known about the data deficient species, *Tachypleus gigas*, leaving behind a lacuna in the general understanding of development. Though the large yolk- filled yolk poses problems, the early development and the changes in the limb in *Tachypleus gigas* has been studied using various microscopic techniques.

MATERIALS AND METHODS

Eggs grown in the laboratory at optimized conditions were fixed at different stages and were observed in the stereozoom microscope. Subsequent imaging of the fixed eggs using a modified protocol in the Scanning Electron Microscope was also undertaken. The images were validated using nuclear staining with an inverted fluorescence microscope aswell.

RESULTS

The progressive development from the initial limb buds at the germ disc originating at stage 11, leading to the formation of the fully developed limbs in the second instar was mapped and documented.

CONCLUSION

The development of limbs in the *Tachypleus gigas* embryo correlated to the development of the limbs in *Limulus polyphemus* and Tachypleus *tridentatus*. This is the first report of its kind in the data deficient species of *T. gigas*.

[O21] PROMISING ANTIBACTERIAL ACTIVITY OF NANO CHITOSAN PREPARED FROM DEAD HORSESHOE CRAB (*Tachypleus gigas*) BROKEN CARAPACE IN COMPARISON TO NANO CHITOSAN OF OTHER SOURCES

PRADHAN, Jyotirmayee [1], BAISAKHI, Barsha [1, 2], DAS, Basanta Kumar [2], MOHANTY, Debasmita [2], DASH, Bishnu Prasad [3]

1 - P.G. Department of Zoology, Kuntala Kumari Sabat Women's College, Affiliated to Fakir Mohan University, Balasore, Odisha, India; 2 - ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata, India; 3 - P.G. Department of Zoology, Fakir Mohan University, Balasore, Odisha, India

OBJECTIVES

The study aimed to produce and analyze chitosan nanoparticles (HCNPs) derived from the broken carapace of deceased horseshoe crabs (*Tachypleus gigas*). The study also assessed the antibacterial effects of HCNPs against selected bacterial fish pathogens, and compared with chitosan and nano chitosan of alternative sources.

MATERIALS AND METHODS

HCNPs were prepared using sodium tripolyphosphate anions. Characterization of the nanoparticles was done using FTIR, zeta potential and particle size distribution analysis. The antibacterial activity of both commercial nano chitosan (CNPs) and HCNPs against *Aeromonas hydrophila* (ATCC-7966), *Escherichia coli* (ATCC-25922), and *Staphylococcus aureus* (ATCC-25923), was evaluated by disc diffusion method.

RESULTS

Zeta potential and particle size distribution analysis for HCNPs was 55.8 mV and 105.7 nm respectively while in comparison to CNPs it was 36.2 mV and 32.40 nm respectively. Results show that HCNPs exhibit maximum zones of inhibition (12, 16 and 16 mm) against *E. coli*, *S. aureus* and *A. hydrophila* in comparison to other chitosan and nano chitosan.

CONCLUSION

The findings suggest that chitosan extracted from the dead carapace of horseshoe crabs demonstrates enhanced qualities comparable to those of chitosan and nano-chitosan from alternative sources. Structural analysis contributes to understanding the antibacterial properties of both chitosan and nano-chitosan at a mechanistic level.

[O22] SILENCING OF NOVEL *TTVTG6-LIKE* INDUCED OVARIAN CELL APOPTOSIS IN ANCIENT CHELICERATE *Tachypleus tridentatus*

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OBJECTIVES

Vitellogenin (Vtg) serves as the precursor of yolk protein and exhibits widespread distribution in the ovary of both vertebrates and invertebrates. *Vtg* plays a critical role in facilitating oocyte maturation and embryonic development following oviposition. To comprehensively unravel the regulatory mechanisms governing vitellogenesis in *T. tridentatus*, a synergistic integration of histological, molecular biological, and genetic research is necessary.

MATERIALS AND METHODS

Real-time quantitative PCR, fluorescent in situ hybridization, primary cell culture, siRNA silencing method, TUNEL, ROS, Flow cytometric analysis.

RESULTS

TtVtg6-like transcript encompassed a length of 4,887 bp and encoded 1,629 amino acid residues. Notably, *TtVtg6-like* was found to contain 25 exons. Furthermore, the molecular weight and isoelectric point of *TtVtg6-like* were determined to be 191.6 KDa and 6.73, respectively. Subsequent mRNA expression analysis demonstrated the specific expression of *TtVtg6-like* in ovary and yellow connective tissue. In addition, *TtVtg6-like* was located and distributed in both ovary and yellow connective tissue. Intriguingly, employing an siRNA approach to silence *TtVtg6-like* resulted in a decrease in *TtVtg6-like* transcription levels. Concomitantly, *TtVtg6-like* silencing led to increased production of ROS, resulting in DNA damage and cell apoptosis within the ovarian primary cell. The induction of apoptosis ovarian primary cells due to *TtVtg6- like* silencing was further corroborated through TUNEL assay and flow cytometry analysis.

CONCLUSION

Overall, our findings underscore the significance of *TtVtg6-like* in ovarian cell development. Consequently, the insights gained from this study contribute to the future exploration of vitellogenesis and ovarian development in *T. tridentatus*.

[O23] A NOVEL SYSTEM TO MONITOR THE GROWTH OF EGGS IN HORSESHOE CRAB SPECIES *Tachypleus gigas*

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1 – ViStA Lab, Birla Institute of Technology and Science (BITS), Pilani-KK Birla Goa Campus, Goa, India

OBJECTIVES

The development of eggs in horseshoe crabs occurs over several weeks after fertilization. There have been studies associated with the study of various developmental stages. However, a continuous monitoring system is still not available. Our objective was to make a system that could monitor continuous changes occurring within and on the surface of the eggs.

MATERIALS AND METHODS

For designing the egg housing chamber, we used Free CAD version 0.20. After designing, it was 3D printed using PLA filament. We used Raspberry Pi V3 connected with a 5MP camera sensor for the continuous monitoring system. Custom Python code was used for automatic data storage. A fertilized, developing egg of horseshoe crab species *T. gigas* was used to monitor the development.

RESULTS

The 3D-printed egg housing chamber provided conditions for the *T. gigas* eggs to grow. We observed the development of eggs for more than 7 weeks. The system captured and recorded the continuous growth of eggs throughout the entire duration. We observed changes in the due course of development.

CONCLUSION

Although this is the first study of its kind, the system was able to continuously monitor the development of eggs in horseshoe crab species *T. gigas.* The system has several advantages and can be used for tracking the development of other species as well. The system can be improved further and give us insight into the development of horseshoe crabs with more accuracy.

[O24] HORSESHOE CRAB MORTALITY AT POWER PLANTS AND A SOLUTION

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OBJECTIVES

Hundreds of electricity generating power plants (nuclear, gas and coal) are located along the coastlines of North America and Asia within the range of horseshoe crabs. All use water from the local environment. Aquatic organisms including fish and horseshoe crabs can be trapped on the water intake structures of these plants, sometimes in very large numbers. Here we describe the magnitude of this impingement at one power plant in Florida, USA and a successful approach to greatly reducing horseshoe crab mortality at this plant.

MATERIALS AND METHODS

In 2015, Cape Canaveral Energy Corporation (CCEC) collaborated with horseshoe crab experts to monitor the number of horseshoe crabs trapped on the intake structures of the power plant. Living individuals were separated from dead, tagged, and relocated. Initially a fence and two years later a wall was constructed across the intake basin. CCEC has continued to monitor horseshoe crab impingement at this power plant.

RESULTS

Large numbers of adult horseshoe crabs (84,028 per year with 100% mortality) were trapped annually at the CCEC intake structures prior to mitigation. The initial deterrent fence was ineffective at preventing impingement (46,848 trapped per year with 12% mortality). After the wall was constructed, the numbers of horseshoe crabs on the intake structures dropped by 98% (647 per year with 49% mortality).

CONCLUSION

This study illustrates the importance of monitoring for horseshoe crab impingement at power plants. A well-designed barrier at power plant intake structures can be highly effective in reducing horseshoe crab mortality.

[O25] ARTISANAL FISHING IN THE CORE NURSERY HABITATS OF ASIAN HORSESHOE CRABS IN GUANGXI, CHINA: SUGGESTIONS FOR CONSERVATION MANAGEMENT

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OBJECTIVES

Habitat loss is one of the major threats for Asian horseshoe crabs. Conservation attention is largely focused on the development associated activities, i.e. land reclamation which causes explicit, significant, and permanent change of habitats. Far less attention is paid to small-scale activities, such as artisanal fishing that is generally believed to have temporary and minor disturbance on habitats with implicit impacts on horseshoe crab populations.

MATERIALS AND METHODS

Beachcombing, one type of artisanal fishing in the intertidal zones of China for harvesting sipunculid worms and bivalves, was quantified in the three core nursery habitats of tri-spine horseshoe crabs *Tachypleus tridentatus* in Beihai, Guangxi. A drone based line transect survey was implemented once per month in each habitat across the whole intertidal zone over a year to explore the spatiotemporal pattern of beachcombing intensity.

RESULTS

A higher intensity of beachcombing from October to March, the inactive season for juvenile *T. tridentatus*, than the active season (April to September), was noted for fishermen. But for tourists, beachcombing intensities did not differ between the seasons. Two hot zones of beachcombing, one near the mangrove fringes and the other close to the lower intertidal zones, were identified. Fishermen mainly beachcombed in the middle and lower parts of intertidal zones, while tourists frequented the area near the fringes of mangroves.

CONCLUSION

We suggest controlling the number of tourists and guiding them to beachcomb away from the mangrove fringes to reduce potential disturbance on juvenile *T. tridentatus*, which tends to aggregate near the fringes of mangroves.

[O26] MICROPLASTICS IN AMERICAN HORSESHOE CRAB EGGS, JUVENILES, AND ADULTS FROM AN URBAN ESTUARY IN NEW YORK CITY

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OBJECTIVES

To investigate the presence of microplastics (MPs) in eggs and digestive systems of adult and juvenile horseshoe crabs (HSCs) from Jamaica Bay, New York.

MATERIALS AND METHODS

Ten batches of fertilized eggs were extracted from Jamaica Bay sediments, and 10 batches of unfertilized eggs were obtained from gravid females. Digestive tracts (esophagus, gizzard, and intestine) were obtained from 16 recently deceased adult HSCs. Six juvenile HSCs were kept in aquaria and the fecal material was then obtained. All samples were stained with Nile Red (NR) and examined under 40x magnification with a fluorescence microscope. Prior to NR application, samples were digested using 30% H_2O_2 to minimize false positives. Digital images were processed using ImageJ.

RESULTS

MPs were found in all fertilized and unfertilized eggs. 1 g of HSC eggs was estimated to contain approximately 426-840 MPs. Shorebirds migrating through Jamaica Bay in the spring concentrate their feeding on HSC eggs, and could thus be ingesting numerous MPs. MPs were also found in each of the adult and juvenile digestive systems. The number of MPs in juvenile HSCs was more than twice the number in adults, which may be related to the greater ingestion of sediment particles by the juveniles.

CONCLUSION

MPs were present in all samples of HSC eggs and digestive systems, but whether they are linked to any adverse effects is uncertain. The high prevalence of MPs in HSC eggs is a potential concern for migratory shorebirds whose feeding is concentrated on the abundant HSC eggs.

[O27] DEVELOPING CADMIUM DETOXIFICATION STRATEGIES IN THE TRI-SPINE HORSESHOE CRAB (*Tachypleus tridentatus*): INSIGHTS FROM A 430 -MILLION- YEAR-OLD SPECIES

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OBJECTIVES

This research seeks to explore and characterize the novel cadmium detoxification pathway in *Tachypleus tridentatus* and aims to reveal how this ancient species has adapted to survive in heavy metal-polluted environments. Understand these biochemical mechanisms underlying, contributing to the conservation of *T. tridentatus* and offering insights into potential cellular repair mechanisms that could mitigate heavy metal impacts on marine ecosystems.

MATERIALS AND METHODS

To study the novel cadmium detoxification in *T. tridentatus*, we collected specimens for antioxidant index analysis. Transcriptomic analysis and Illumina sequencing were performed to select and validate RGs for qRT-PCR. And analyze the expression stability analysis of the potential RGs DEGs expression validation by qRT-PCR.

RESULTS

Our study unveiled a unique cadmium detoxification pathway in juvenile *Tri-spine horseshoe crab (Tachypleus tridentatus)*. For the first time, ARP5 was the optimal reference gene under metal stress. Cadmium stress induces oxidative stress in juvenile *T. tridentatus*. Transcriptomic and metabolomic analysis shows high cadmium stress disrupts glycerophospholipid metabolism in juvenile *T. tridentatus* to mitigate toxicity.

CONCLUSION

The novel cadmium detoxification pathway discovered in *T. tridentatus* highlights its resilience and the urgent need for its conservation. This research not only underscores the species' evolutionary significance but also suggests methods for its monitoring and preservation. By leveraging these findings, conservation efforts can be enhanced, ensuring the survival of this ancient species and contributing to environmental remediation strategies. Emphasizing the conservation of *T. tridentatus* is crucial for maintaining marine biodiversity.

[O28] THE NURSING GROUND OF CHINESE HORSESHOE CRAB (*Tachypleus tridentatus*) IN FUJIAN: THE PRESENT SITUATION, THREATS AND CONSERVATION

WENG, Zhao Hong [1]; CHEN, Tian Sheng [1]; XIE, Yang Jie [1]; CHEN, Zhi [2]; WANG, Jia Qiao [1]; CHEN, Bo Cheng [1]; GUO, Yu Qing [1]; ZHONG, Yun Min [1]; GAO, Rui [1];
HE, Ze Ji [1]; PAN, Jing Xuan [1]; WANG, Zhi Ting [1]; TAN, Shu Qian [1]; NIE, Xu Long [1]; CHEN, Xu Nuo [1]; LIU, Tao [1]; KOU, Yi Xiu [1]; LI, Kun Yue [1]; YE, Kun [1]; LI, Yu Hong [3]; CAI, Li Zhe [4]

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OBJECTIVES

The coast of Fujian was once an important distribution area for Chinese horseshoe crabs (*Tachypleus tridentatus*). With the rapid development of the coastal economy and the increasing demand for land, a large number of coastal tidal flats have been reclaimed. The nursery grounds of *T. tridentatus* were seriously damaged. In this study, we investigated the distribution of nursery sites and the population of juveniles in Fujian coast, so as to provide a theoretical basis for the protection of *T. tridentatus*.

MATERIALS AND METHODS

The investigations were carried out during 1-2h before and after the lowest tidal in the summer of 2021-2023. A cross-sectional scanning search method was used. Every visible juvenile was searched for, the number was recorded, the prosomal width was measured.

RESULTS

A total of 16 breeding sites were found in 2021. The number of the juvenile in these sites ranged from 1 to 151, with a density varying between 0.001 and 0.3356 individuals per 100 square meters. However, in 2023, the beach of Jimei Nandi Park in Xiamen was transformed into a tourist spot through sand filling, resulting in the disappearance of this crucial nursing ground along with the destruction of four other sites. Meanwhile, the juvenile populations at four sites have vanished, and their density has been declining, ranging from 0 to 0.1578 individuals per 100 square meters in 2022 and from 0 to 0.0910 individuals per100 square meters in 2023.

CONCLUSION

The juvenile populations and their nursing grounds were destroyed seriously in the coast of Fujian. It is suggested to establish the reserve in the existing breeding habitats, strengthen the efforts of artificial proliferation and release, and conduct ecological remediation in some silted tidal flats.

[O29] A PRELIMINARY INVESTIGATION OF EPIBIOTIC MACROFAUNA ON THE MANGROVE HORSESHOE CRAB *Carcinoscorpius rotundicauda* (LATREILLE, 1802) IN SINGAPORE

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OBJECTIVES

This study aims to investigate the epibiotic community living on *C. rotundicauda* in the northern coast of Singapore and investigate the extent of infestation by a recent invasive American mussel, *Mytella strigata* (Lim et al. 2018) on the resident *C. rotundicauda* populations.

MATERIALS AND METHODS

The mangrove horseshoe crabs (HSCs) were collected at four sites: 1) Kranji mudflats, 2) Kranji Reservoir Park, 3) Sungei Buloh Wetlands Reserve and 4) Lim Chu Kang mudflats to examine the epibiont diversity, as well as the extent of epibiotic attachment onto the host's body.

RESULTS

A total of 481 HSCs were collected from the four sites over four survey dates. The overall surveys found only four types of organisms in the epibiotic communities on the mangrove horseshoe crabs across all sites. Results showed that the overall occurrence of epibionts on *C. rotundicauda* was significantly influenced by Life Stage and Size, but not Site.

CONCLUSION

The study found a limited diversity of epibiont organisms on the mangrove horseshoe crabs, *C. rotundicauda*. The American mussel, *M. strigata, is* mostly found on the ventral planes. These suggest preferential distributions of epibiotic species over the body planes of *C. rotundicauda*, which could be driven by the epibiotic species' needs. Notably, the non-native and highly invasive species, *M. strigata* is among the diversity of epibionts, and its impact on *C. rotundicauda* remains poorly understood. The potential risks exist, as this study showed that the ventral regions of *C. rotundicauda* are susceptible to mussel *M. strigata* attachment.

[O30] PROGRESS AND CHALLENGES IN HORSESHOE CRAB CONSERVATION IN CHINA

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OBJECTIVES

Field investigation data show that the horseshoe crab population has seriously declined in China. Natural distribution of tri-spine horseshoe crab *Tachypleus tridentatus* populations has recently disappeared in some places, posing a regional extinction risk. All horseshoe crab species in China were officially listed as the national second level key protected wildlife in 2021, and the problem of overfishing was reversed through strict measures. Currently, it is urgent to take multiple measures and work together to improve horseshoe crab resource recovery.

MATERIALS AND METHODS

Evidences of human disturbance towards *T. tridentatus* habitats were collected in terms of their habitats, animal physiology and behaviour. The roles of media coverage and public participation, and their way to affect conservation management in China were considered.

RESULTS

In terms of scientific investigations, in addition to animal physiology and behaviour research, our study on assessment of *T. tridentatus* habitat shows a significant negative correlation between human disturbance index and the abundance of juvenile horseshoe crabs in the intertidal zone in the Beibu Gulf. Factors such as breeding areas, residential areas, ports and docks are priority considerations for horseshoe crab habitat protection. Public participation and widespread media promotion are required in attracting public attention and participation in horseshoe crab conservation activities. Attracting media coverage of horseshoe crab conservation work with Chinese characteristics is an additional task worth attempting by scientific researchers.

CONCLUSIONS

Human disturbances towards *T. tridentatus* habitats are evident. How scientific theories can effectively guide the practice of horseshoe crab conservation, and how scientific theories can be transformed into conservation actions are demanding in China. Attracting media coverage is important in connecting research and local management.

[O31] EXPLORATION AND PRACTICE OFSUSTAINABLE DEVELOPMENT MODEL OF CHINESE HORSESHOE CRAB (*Tachypleus tridentatus*) CONSERVATION COMMUNITY IN FUJIAN, CHINA

LI, Yu Hong [1,2]; WENG, Zhao Hong [3]; CAI, Li Zhe [4]; CAI, Jing Xiang [2,5]; Sun, Ming Yue [1]; CHEN, Yu Lin [1]; LIU, Zhen Qi [1]; ZHAN, Wen Lu [1]; QU, Zhen Yi [1];
CHEN, Hong Kai [1]; QIN, Ding Yang [1]; WU, Yi Xing [1]; LIU, Jing [1]; ZHU, Ze Heng [1]; MEI, Yi Jie [1]

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OBJECTIVES

The Horseshoe crab conservation community in China was established by people who love and protect horseshoe crabs along the coast, aiming to gather the resources of all parties to build a joint platform and explore a horseshoe crab conservation model which is mainly based on the people from coastal fishing villages. On Chinese Valentine's Day in 2022, with the support of the civil environmental protection fund "Action for the Sea" project, the first horseshoe crab conservation community (horseshoe crab community for short) was established in Fujian Province, which is located in Tangdong Village, Jinjing Town, Jinjiang City. Tangdong Village is rich in juvenile horseshoe crab resources and is a valuable habitat for juvenile Chinese horseshoe crabs in the Asia-Pacific region. The objective of this research is to explore the sustainable development model of "Horseshoe Crab Conservation Community" along the coast of Fujian, that is, based on the concept of ecological civilization construction, how to protect the habitat ecological environment and juvenile horseshoe crab resources in the distribution area of Chinese horseshoe crabs, and at the same time, promote the development of marine culture research and tourism in fishing villages where horseshoe crabs are present to facilitate the revitalization of the countryside.

MATERIALS AND METHODS

Literature review, personal interviews and investigations being carried out on the tidal flat during 2h before and after the lowest tide.

RESULTS

1) A new development model of "horseshoe crab conservation community" along the coast of Fujian was explored under the parallelism of coastal biodiversity conservation and the dissemination of overseas Chinese culture in fishing villages. We grasp the current problems and difficulties in the construction of the horseshoe crab community in Tangdong Village, and propose corresponding solutions and suggestions for the development model of the horseshoe crab community. 2) Effectively promote the horseshoe crab community - Tangdong Village through new media means, increase the visibility and influence of Tangdong Village, attracting more tourists, and then promote the development of the local economy and achieve rural revitalization. 3) To give full play to the advantages of overseas Chinese culture and the marine culture of the fishing villages in southern Fujian, creating a feasible programme about a study and research base for local primary and secondary school students as well as overseas Chinese students while exploring, constructing and developing the horseshoe crab conservation community. 4) Combining horseshoe crab conservation activities with the traditional Chinese festivals, examples for Chinese Valentine's Day, and conducting cultural activities related to horseshoe crabs with

traditional Chinese characteristics, etc. The 2023 Chinese Valentine's Day Horseshoe Crab Conservation Science Campaign won the Outstanding Activity Reward for the National Science Popularization Day by the China Association for Science and Technology.

CONCLUSION

Taking into account both protection and development, we explore the possibility of paralleling the protection of China's coastal biodiversity with the spread of overseas Chinese culture in fishing villages and the promotion of a new model of eco-tourism economic development, so as to promote rural revitalization and development and achieve a win-win situation for ecology, economy and culture.

[O32] HORSESHOE CRAB HABITAT DEVELOPMENT AND CONSERVATION/ RESTORATION – LESSONS FROM JAPAN

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ABSTRACT

Horseshoe crab habitat is a coastal area.

After modernization and rapid economic growth, environmental problems arose.

Excessive coastal development was warned against because of frequent disasters such as land subsidence, flooding, and tsunami disasters. Reflecting on this situation, we are moving toward disaster prevention using ecosystems.

Geomorphologically, tidal flat reclamation, seabed excavation, and beach loss have occurred. Problems of water pollution, marine debris, and material circulation have occurred.

In regional management, it was important to integrate the originally existing and introduced institutions.

The actual examples of coastal and watershed development and policies in the region will be discussed in a bird's eye view for the Seto Inland Sea and Kyushu coast.

[O33] JUVENILE POPULATION AND CONSERVATION STRATEGIES of *Tachypleus tridentatus* IN KINMEN COUNTY, TAIWAN

CHANG, Yi [1]; KIM, Yi-hua [1]; SHIH, Yi-jia [1]; CHEN, Yung-sheng [2]; CHEN, Yu-ting [3]

1–Graduate Institute of Marine Affairs, National Sun Yat-sen University, Taiwan; 2–Fisheries Research Institute, Kinmen County; 3–Ocean Conservation Administration, Ocean Affairs Council, Taiwan

OBJECTIVES

Conservation measures for tri-spine horseshoe crab (*Tachypleus tridentatus*) have been applied in Taiwan for decades, but the population status and conservation outcome are still not clear. This study therefore investigated the juvenile population and spatial distribution of *T. tridentatus* along the tidal flat of Kinmen County, Taiwan, where the population of juvenile *T. tridentatus* has yet to be studied.

MATERIALS AND METHODS

The mark-recapture approach was used to estimate the juvenile population of *T. tridentatus*, while the instar distribution of every individual was identified by prosomal width.

RESULTS

The study revealed that the estimated juvenile population was 91,101, while individuals peaked at 5th and 7th instars with survival rate about 2%. Moreover, the spatial distribution of juveniles showed that 4,373 individuals were found along the tidal flat of west Kinmen, whereas only 732 individuals were found in the protected area, indicating that the major habitat of *T. tridentatus* is not well protected. Therefore, it is suggested that planning a new protected area to preserve spawning grounds and habitat along the natural coast is needed, and stakeholder engagement may accelerate the planning process.

CONCLUSION

Considering co-management with local communities and fishermen to establish new protected areas can enhance the management effectiveness, and the licensing of limited fishing activities should be applied to prevent fishing pressure increased in the ecosystem around the habitat of *T. tridentatus*.

[O34] GLOBAL TRADE DATA AND CONSERVATION CHALLENGES FOR ASIAN HORSESHOE CRABS

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OBJECTIVES

This study aims to analyze global trade data to assess the extent of exploitation and identify conservation challenges associated with unsustainable harvesting of Asian horseshoe crabs driven by global trade demands.

MATERIALS AND METHODS

Global trade data from 10 Asian countries is analyzed comprehensively to discern patterns and trends in the trade of horseshoe crabs and their derivatives. Key trading regions are identified, and data spanning these regions are scrutinized to determine the scale of demand for horseshoe crabs and the impacts of harvesting practices.

RESULTS

The analysis reveals a concerning trend of escalating demand for Asian horseshoe crabs and their derivatives in global trade. Particularly, there is a growing market for horseshoe crab meat, with certain regions considering it a delicacy. However, unsustainable harvesting practices associated with this trade pose significant threats to horseshoe crab populations, leading to declines and ecological imbalances. Conservation challenges identified include habitat degradation, overexploitation, bycatch mortality, and inadequate regulatory frameworks.

CONCLUSION

This research underscores the urgent need for proactive conservation measures to safeguard the ecological integrity and ensure the sustainable use of Asian horseshoe crab populations. Collaboration among stakeholders is essential to address the conservation challenges posed by unsustainable harvesting driven by global trade demands. Effective management strategies, including quota regulations and habitat protection measures, are imperative to mitigate the adverse impacts of trade and ensure the long-term survival of Asian horseshoe crab populations.

[O35] UTILIZATION OF BIOLOGGING DATA FOR THE CONSERVATION AND MANAGEMENT OF HORSESHOE CRABS

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OBJECTIVES

Biologging, a method involving the attachment of miniaturized data loggers to animals to measure their behavior, ecology, and surrounding environment, is increasingly used across various species. Recent initiatives have aimed to share and utilize collected data to conserve endangered species. We developed Biologging intelligent Platform (BiP), which allows for the registration of data from various measuring devices targeting all four species of horseshoe crabs. This presentation introduces Biologging data obtained from *Tachypleus tridentatus,* highlighting the benefits of sharing and analyzing such data.

MATERIALS AND METHODS

The research was conducted in the eastern Seto Inland Sea, Japan, and in the eastern Sabah, Malaysian Borneo, where horseshoe crabs were equipped with accelerometers and depth/temperature loggers. Data recovery was facilitated through local fishing activities. In the Seto Inland Sea, information on activity cycles in captivity and wintering behavior in the wild was obtained, while in Sabah, data on activity cycles and depth utilization were collected in the wild.

RESULTS

Depth data provided insights into depth utilization, activity periods, spawning periods, and the frequency and timing of bycatch incidents. Although tracking horizontal movements underwater is challenging, depth data allows for tidal variation measurements, offering a potential method to approximate locations by comparing with tidal models.

CONCLUSION

Utilizing biologging data for horseshoe crab conservation and management is promising. The information gained provides essential insights into the ecological characteristics of species, such as distribution and activity patterns. Data sharing is expected to aid in visualizing fishing and bycatch data, contributing to establishing marine protected areas and conservation policies.

[O36] CONSERVATION OFHORSESHOE CRABS IN BANGLADESH: STATUS, CHALLENGES AND RECOMMENDATIONS

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1 – Department of Oceanography, University of Chittagong, Chattogram, Bangladesh

OBJECTIVES

The objective of this presentation is to share the status of horseshoe crab populations in Bangladesh and identify key conservation challenges and opportunities for sustainable management.

MATERIALS AND METHODS

To achieve this objective, we conducted field surveys along the coastal areas of Bangladesh to assess horseshoe crab populations and their habitats. We collected data on population densities, distribution patterns, and habitat characteristics. Additionally, we reviewed existing literature on horseshoe crab biology, ecology, and conservation in both local and global contexts.

RESULTS

Our findings reveal a significant decline in horseshoe crab populations in Bangladesh, primarily due to habitat loss caused by coastal development, pollution, and unsustainable harvesting practices. Climate change impacts, including sea-level rise, further threaten their survival. Local exploitation for bait and traditional uses also contributes to population decline.

CONCLUSION

Conservation efforts for horseshoe crabs in Bangladesh face several challenges, including inadequate legal protection, limited stakeholder awareness, and the absence of comprehensive management plans. Addressing these challenges requires collaborative efforts involving government agencies, non-governmental organizations, research institutions, and local communities. By implementing habitat restoration measures, sustainable harvesting regulations, public education initiatives, and research collaborations, we can ensure the long- term viability of horseshoe crab populations and preserve the ecological integrity of Bangladesh's coastal ecosystems.

[O37] HARVESTING AND TRAFFICKING OF HORSESHOE CRABS IN INDONESIA

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1 - University of California, Santa Cruz, United States; 2 - Aarhus University, Denmark

OBJECTIVES

All three species of Asian horseshoe crabs (*Tachypleus gigas*, *T. tridentatus*, and *Carcinoscorpius rotundicauda*) are harvested and traded across their ranges for a variety of purposes including for use as food and for biomedical bleeding. However, little is known about the scale, scope, geographic extent, or operations of this trade, at either national, regional, or international scales. Given Indonesia's status as a host to all three species, and as a source country for global illicit wildlife trading, the case of horseshoe crab exploitation in Indonesia is particularly important to understand.

MATERIALS AND METHODS

To synthesize current knowledge about horseshoe crab harvesting and exploitation in Indonesia, we analyzed publicly available data including news reports of illicit horseshoe crab trading, reports of cultural and ceremonial use, as well as conducting interviews and ethnographic research with experts, fishers, and coastal communities near horseshoe crab habitats.

RESULTS AND CONCLUSION

Our research indicates multiple sites of horseshoe crab harvesting and trading in Indonesia, including sites in Sumatra, Java, and Sulawesi. We highlight cases of harvest for local consumption and for illicit international trade. We also include a recent report of direct observations indicating the presence of a reproductive population of *T. tridentatus* in northern Sulawesi, along with reports of trading activity in the area — significant for a region where direct observations have been rare. We also discuss issues of enforcement capacity, public awareness of the legally-protected status of horseshoe crabs among the general public, and suggest priorities for future research.

[O38] SPAWNING HABITAT SUITABILITY MAPS FOR THE CONSERVATION OF *Tachypleus tridentatus* IN TSUYAZAKI COVE, JAPAN

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OBJECTIVES AND METHODS

The suitable spawning habitat of *Tachypleus tridentatus* was estimated and mapped for the first time using scientific modelling in Tsuyazaki, Japan. A total of 43 nests were found at five sites from 2018 to 2019. Of these 43 nests, the location information of nine nests at one of the sites was used as "Training data" for constructing models. A series of procedures were employed to determine the relationship between the biological data and their physical parameters to estimate the suitable spawning habitat. First, the contribution rates of the physical parameters to nest locations were evaluated. Second, physical parameters that showed significant contribution rates were chosen to estimate suitable spawning habitats.

RESULTS AND CONCLUSION

It was found that the beach elevation (tidal level) was the most significant parameter for estimating suitable spawning habitats. Mean High Water Neap to Mean Higher High Water was estimated as a suitable spawning habitat, and 74% of the nests were fitted in an area that was assessed as suitable. The result was consistent with previous studies. The area of suitable spawning habitat was estimated to be only 476 m^2, comprising 24% of the sandy beach in the study site. Therefore, it was concluded that the conservation and restoration of spawning grounds is a high-priority and urgent issue at the site. It is proposed that scientific models for nest/egg occurrence and beach elevation can effectively determine suitable spawning habitats and be useful for establishing MPAs for this globally endangered species.

[P1] ENGAGING THE PUBLIC IN HORSESHOE CRAB CONSERVATION THROUGH EDUCATION

MAK, Kin Weng, Linus [1]; YAP, Yen Ling Laura-Marie [1]

1 – School of Applied Science, Republic Polytechnic, Singapore

OBJECTIVES

The Diploma in Environmental & Marine Science (DEMS) at Republic Polytechnic (RP) has been engaged in horseshoe crab conservation for over a decade. This study aims to outline the conservation efforts and educational initiatives undertaken by DEMS.

MATERIALS AND METHODS

DEMS employs a three-pronged approach to horseshoe crab conservation: field surveys, ex- situ conservation in RP's aquaculture facility, and outreach programmes. Students and interns contribute by designing educational materials and participating in outreachactivities.

RESULTS

Programmes such as school talks and booths at outreach events target primary and secondary school students, as well as families to raise awareness about horseshoe crab conservation. Educational materials, including brochures, videos, and interactive activities, enhance public understanding of horseshoe crabs and their habitats. Partnerships with organizations like the National Library Board facilitate storytelling sessions for children, promoting familial bonding and conservation education.

CONCLUSION

DEMS' multifaceted approach to horseshoe crab conservation has effectively engaged both students and the public. By combining field research, educational initiatives, and partnerships, DEMS contributes to the conservation of these unique marine species while fostering environmental stewardship among future generations.

[P2] IMPACT ASSESSMENT OF HUMAN ACTIVITIES ON RESOURCES OF JUVENILE HORSESHOE CRABS IN HAINAN COASTAL AREAS, CHINA

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OBJECTIVES

The booming coastal zone economy poses increasing anthropogenic threats to marine life and habitats. Focusing on horseshoe crabs (HSCs), we constructed a practical decision- making tool for better conservation.

MATERIALS AND METHODS

Firstly, the intertidal zone of HSCs was extracted by remote sensing interpretation, and the human pressure around the intertidal zone was classified. Subsequently, the surrogates - based spatial geographic model was extended to quantify the human pressures on HSCs. Based on the species data from field surveys and the total pressure variables, the overall threat status of species in different habitats were assessed. The random forest regression model was used to understand the relationship between anthropogenic pressure and distribution of the HSCs.

RESULTS

The results indicate that Aquaculture and Harbor have a dramatic impact on the abundance of the HSCs and need to be prioritized. The threshold effect providing an opportunity to find a balance between development and protection was found in Total pressure, Coastal residence and commercial Beach pressures. Finally, we find a suitable location to establish a marine protected area based on the change point model.

CONCLUSION

Our spatial modelling effectively quantifies the impacts of anthropogenic disturbance on horseshoe crabs and their habitats. This information on stress intensity and the relationship between stress and species distribution will assist in the management of horseshoe crab habitats and anthropogenic disturbances in protected areas.

[P3] MAJOR HABITAT of JUVENILE *Tachypleus tridentatus* in KINMEN COUNTY, TAIWAN

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OBJECTIVES

Spatial distribution of juveniles in nursery habitats is needed for *Tachypleus tridentatus* conservation, which can provide better understanding of juvenile major habitats for protection measures. This study thus conducted comprehensive field observations around the intertidal flat of Wujiang River Estuary (WRE) and Guningtou Horseshoe Crab Conservation Zone (GCZ) in Kinmen, Taiwan.

MATERIALS AND METHODS

Using fixed-point sampling method with the area 2 square meters for 30 points in the two study areas (WRE and GCZ), the juveniles were searched on the surface during low tides, while the spatial distribution of the juvenile *T. tridentatus* density was illustrated by the Nature Neighbor interpolation approach in geographic information systems.

RESULTS

The result revealed that the most juveniles were found in high tide regions at WRE with density about 3.8 inds./m^2. However, juveniles are abundant in the region at GCZ with densities about 2 inds./m^2 which was significantly lower than that at WRE. It is also noticed that there were not any juveniles found at most of the sampling points at GCZ, which suggested that WRE is good habitat for juveniles that more conservation measures should beconducted.

CONCLUSION

WRE is not only the habitat for juveniles, but many subadult individuals were also found near low tide zones. It is suggested that WRE provides a better juvenile population and nursery habitat for *T. tridentatus* rather than that in GCZ. We therefore suggested that tidal flats at WRE should be further protected by appropriate measures, such as new planning marine protected areas or prohibition of fishing/exploitation activities by existing laws.

[P4] EFFECTS OF POLYSTYRENE MICROPLASTICS ON THE ANTIOXIDANT SYSTEM AND THE MICROFLORA COMPOSITION OF INTESTINE IN *Tachypleus tridentatus* JUVENILES

LI, Yu Hong [1,3]; BO, Jun [2]; TAN, Yi Ran [1]; LIU, Ming Xiao [1]; QIU, Meng Yuan [1]; WENG, Zhao Hong [3]; CHAO, Fang [2]; LI, San Su [4]; MEI, Yi Jie [1]; ZHU, Ze Heng [1]

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OBJECTIVES

This study aimed to investigate the toxic effects of PS-MPs on the gastrointestinal tract of juvenile *Tachypleus tridentatus* and explore its effect mechanism, for a better understanding of the impact mechanisms of microplastics on the gastrointestinal tract of crustaceans.

MATERIALS AND METHODS

In this study, juvenile *Tachypleus tridentatus* of different ages (5th and 6th instar) were directly exposed to PS-MPs of the same particle size (6 μm) but different concentrations (0, 10^2 particles/L, 10^4 particles/L). Three different concentration groups of PS-MPs were set up: blank control group (no addition of PS-MPs), low concentration group (10^2 particles/L), and high concentration group (10^4 particles/L). 5th and 6th instar *Tachypleus tridentatus* were exposed separately, and two exposure times, 7 days and 21 days, were established. Conventional methods were used to study the indicators here, and a T-test was used to analyze whether there were significant differences in species between groups.

RESULTS

Comparing the accumulation levels of PS-MPs in the foregut and midgut, it was found that PS-MPs were preferentially distributed in the midgut. In addition, the accumulation level of PS-MPs in the intestines containing more contents which was significantly higher than that in the intestines contained no or small amounts of contents. The results also showed the relationship between oxidative stress kinase activity and PS- MPs concentration and exposure time, proving that PS-MPs can cause oxidative damage to the intestinal tissue of *Tachypleus tridentatus*. Against the damaging effects of ROS, the main protective antioxidant enzymes include SOD and CAT. In addition, analysis of the intestinal microbiota showed that the proportions of the two bacterial phyla Firmicutes and Proteobacteria in the intestine changed, and the abundance of *Pseudomonas* among the dominant bacterial genus. There was a significant decrease, while the content of potential pathogenic bacteria Campilobacterota and *Desulfovibrio* increased.

CONCLUSION

PS-MPs are preferentially distributed in the midgut of juvenile *Tachypleus tridentatus*. PS- MPs can cause oxidative damage to their intestinal tissues. PS-MPs stress not only causes oxidative damage to intestinal tissue and reduces the function of the intestinal immune system, but also causes intestinal flora imbalance in *Tachypleus tridentatus.*

[P5] A CENTURY OF HORSESHOE CRAB CONSERVATION EVOLUTION IN JAPAN – EXPERT SURVEYS, CITIZEN SCIENCE, SCHOOL EDUCATION, ENVIRONMENTAL EDUCATION, MULTI-GENERATIONAL MULTI-SECTOR SURVEYS, STEWARDSHIP

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ABSTRACT

Horseshoe crab conservation efforts in Japan began in the early 20th century and spanned a century.

Expert surveys were conducted based on a foundation of natural history up to the Edo period, with the introduction of modern biology. Citizen surveys of spawning numbers and ecology in habitats began, and were further introduced into school education. Later, the perspective of environmental education was introduced, which further developed into multi- generational and multi-sectoral surveys in the region. In addition, an understanding of the physical environment of the habitat was necessary. This required a multi-generational, multi-sectoral survey to understand changes in horseshoe crab populations and beaches. Stewardship of the site for responsible and systematic work and monitoring of the site was considered important for community-based management to understand its environmental history.

Cases in Kasaoka, Okayama Prefecture; Kitsuki, Oita Prefecture; Sone Tideland, Kitakyushu City; Imazu, Fukuoka City; and Imar, Saga Prefecture will be discussed.

[P6] COMMUNITY-BASED MONITORING OF AMERICAN HORSESHOE CRABS (*Limulus polyphemus*) IN NEW YORK

SCLAFANI, Matthew [1]: SMITH, D.R. [2]; BOPP, J.J. [3]; McKOWN, K.M. [3;, SCOTT, C.R. [4]; FEDE, C. [4]; LANDER, J.N. [4]; CERRATO, R.M. [5]

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OBJECTIVES

The New York Horseshoe Crab Monitoring Network, initiated in 2008, has grown to 30 sites surveyed annually by 800 volunteers. The Network's extensive spatial coverage and consistent tagging efforts support regular assessments of spawning activity, movement, and survival at different spatial scales.

In this poster, we summarize:

- the successful implementation of a scientifically rigorous large-scale community- based monitoring program,
- scientific products, including spawning trends and tagging-based survival and movement,
- the use of the monitoring data in conservation.

MATERIALS AND METHODS

Standardized protocols were used to count spawning horseshoe crabs in the intertidal and submerged zones, measure their size, sex, and stage (epiphyte coverage), and apply tags over 12 nights around the new and full moons in May and June. Staff managed data with quality controls before analysis and developed a website to help coordinate volunteers and distribute educational material.

RESULTS

Spawning activity varied among beaches, but general patterns emerged at the estuary level. For instance, spawning in the Long Island Sound and Peconic Estuaries was much lower than in the South Shore Estuary/Jamaica Bay and followed different trends. Survival varied among estuaries, reflecting different harvest pressures and habitat quality. Tag returns indicated a net eastward movement and low exchange between the estuaries.

CONCLUSION

Community-based monitoring can inform conservation, but program sustainability requires dedicated coordination and data management, public interest, and scientifically valid survey design. New York State funds the monitoring network coordination, implementation, and data management. Local organizations (government and non-government), private businesses, and interested private community members adopt and monitor local sites. Key long-term reference sites provide a central core, supplemented by ephemeral sites. Training and support (technical and logistic) ensure consistency. Data have directly informed management, allowing New York to advance the conservation of horseshoe crabs, including estuarine-level management to account for spatial variation in harvest pressure and survivorship.

[P7] STUDY ON THE COMMUNITY OF MEIOFAUNA IN THE SPRING AND WINTER SEASONS OF XIAMEN JIMEI CHINESE HORSESHOE CRAB NURSERY

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OBJECTIVES

The beaches around Xiamen Island, along the coast of Jimei and Tong'an Bay are muddy and sandy, suitable for the breeding and habitat of Chinese horseshoe crabs. Chinese horseshoe crabs can be seen on the Aoyuan Beach in Jimei. The Chinese horseshoe crab (*Tachleus tridentatus)* was listed as a national second level protected animal in February 2021. The food source for Chinese horseshoe crab larvae may mainly be meiofauna in sediments. This study investigated the population, composition, distribution, and biomass of meiofauna different tidal zones of Jimei Aoyuan, providing data support for the relationship between the distribution of Chinese horseshoe crab larvae and feeding groups.

MATERIALS AND METHODS

In the winter of 2021 and spring of 2022, sediment samples were collected at different tide levels to study the group composition, abundance, biomass, and dominant genera of marine nematodes.

RESULTS

In the winter of 2021, more than 5 meiofauna were identified, namely marine nematodes, polychaetes, oligotrichs, copepods, planarians, and other unidentified groups. Among them, marine nematodes are the most dominant group, accounting for 70.96% of the abundance of meiofauna, with an average abundance of (89.35 ± 20.39) ind · 10 cm^{-2}. The abundance of copepods accounts for 20.86% of the abundance of meiofauna, with an average abundance of (26.27 ± 14.75) ind · 10 cm^{-2}. The average biomass of meiofauna at high tide is (269.07 ± 95.16) μg· 10 cm^{-2}, the average biomass of meiofauna at low tide levels is (251.86 ± 77.39) μg · 10 cm^{-2}. The total average biomass of meiofauna is (260.46 ± 84.6) μg · 10 cm^{-2}. The dominant genera of marine nematodes that appear at high tide are *Terschellingia*, *Dorylaimopsis*, *Sabatieria*, *Daptonema*, and *Stylothersis*, with dominance rates of 28.33%, 19.44%, 13.61%, 9.05%, and 8.19%, respectively. The genera that appeared at low tide levels were *Terschellingia*, *Daptonema*, *Sabatieria*, *Dorylaimopsis*, and *Hypodontolaimus*, with dominance rates of 29.07%, 23.47%, 12.67%, 10.27%, and 7.73%, respectively.

In the spring of 2022, Chinese horseshoe crab larvae appeared in the tidal ditch after the ebb tide. Research has found that the meiofauna are marine nematodes, polychaetes, oligotrichs, copepods, and other unidentified groups. The abundance of marine nematodes accounts for 54.92% of the total abundance of meiofauna, with an average abundance of (107.24 ± 51.13) ind · 10 cm^{-2}; The abundance of copepods accounts for 28.64% of the total abundance of meiofauna, with an average abundance of (55.93 ± 38.65) ind · 10 cm^{-2}. The total average biomass of meiofauna in tidal creeks is (359.59 ± 95.43) μg · 10 cm^{-2}, with the maximum biomass of copepods being (136.40 ± 19.22) μg · 10 cm^{-2}; Biomass of meiofauna in bare sediment (741.99 ± 425.61) μg · 10 cm^{-2}, the maximum biomass of oligotrichs is (596.48 ± 360.02) μg · 10 cm^{-2}. The dominant genera of marine nematodes that appear at high tide are *Terschellingia*, *Daptonema*, *Halaponolaimus*, *Sabatieria*, and *Leptolaimus*, with dominance rates of 16.35%, 15.38%, 14.42%, 10.58%, and 8.65%, respectively. The dominant genera marine nematodes at low tide were *Terschellingia*, *Dorylaimopsis*, *Sabatieria*, *Daptonema*, and *Halaponolaimus*, with

dominance levels of 55.15%, 16.06%, 10.3%, 8.48%, and 2.12%, respectively. The statistical analysis result P=0.581 (P>0.05) indicates that there is no significant difference in the abundance of meiofauna in spring and winter seasons.

CONCLUSION

Marine nematodes are the most dominant group of meiofauna in Jimei Aoyuan Beach. The meiofauna average biomass is 260.46 ± 84.60 μg·10 cm^{-2}. There are four dominant genera of marine nematodes shared by different tide levels in two seasons, namely *Terschellingia*, *Dorylaimopsis*, *Sabatieria* and *Daptonema*.

[P8] INVESTIGATION ON ECOSYSTEM HEALTH STATUS OF HORSESHOE CRAB HABITAT UNDER ANTHROPOGENIC CLIMATE PROCESSES – APPLICABILITY OF BENTHIC FORAMINIFERA BIO FACIES

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OBJECTIVES

Coastal mangroves offer multifaceted ecosystem-level services, including some offer habitat for horseshoe crabs; hence, they are crucial towards achieving UN SDG goals including SDG13 and SDG14. The Sundarbans world's largest contiguous mangrove wetland, a RAMSAR site and an UNESCO World Heritage Site, is the preferred habitat of mangrove horseshoe crabs. Over the last three decades, Sundarbans has been increasingly reeling from several natural and anthropogenic disturbances. The objective of the study is to understand the scales of disturbances through benthic foraminifera profiling along with robust measurement of sedimentary organic carbon on a seasonal basis for the sedimentary habitats which are home to the population of mangrove horseshoe crabs.

MATERIALS AND METHODS

During seasonal intense sampling, sediment samples were collected using a hand-held corer during low tide conditions across the studied period.

RESULTS

The benthic foraminifera profiling exhibited low taxon level diversity with an overwhelming abundance of *Ammonia* spp. and *Quinqueloculina* spp. (calcareous taxa) signalling the influence of forms of nitrogen. The notably high abundance of dead and degraded foraminiferal tests indicates potential taphonomic alteration influenced by lowering pore water oxygen content and possible changes in N:P stoichiometry and freshwater flow. The sedimentary total organic carbon values showed a wide range of variability and influence of anthropogenic forcings highlighting the changing habitat quality which are home to mangrove horseshoe crab. There was evidence of anaerobic degradation of sediment organic matter, which resulted in changes in sediment pH and taphonomic alteration of benthic foraminifera tests.

CONCLUSION

The study based on spatio-temporal mapping of the habitats of mangrove horseshoe crab revealed increasing nitrogen, shifting sedimentary chemistry and possible influences on resources that could have long-term negative impacts on this sentinel species from Sundarbans.

[P9] CARVING A FUTURE: MAH MERI WOOD CARVING AS A TOOL FOR HORSESHOE CRAB CONSERVATION

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OBJECTIVES

To explore how the cultural and traditional practices, particularly the wood carving skills, of the Mah Meri community can be utilized as a conservation strategy for the local horseshoe crab population.

MATERIALS AND METHODS

The methodology included searching through existing literature to learn about the Mah Meri people's history and wood carving traditions. The published materials and books are examined to gain a deep understanding of their cultural heritage and artistic practices. Unfortunately, due to budget constraints, the site visit cannot be conducted for firsthand observation. Therefore, the data collection focused mainly on analyzing published literature.

RESULTS

The Mah Meri community, residing in the coastal area of Pulau Carey in Selangor, is renowned globally for their exceptional wood carvings. These carvings, often in the form of statues or masks, play integral roles in their rituals, prayers, cultural ceremonies, and storytelling, symbolizing myths and curing sickness. Inspired by the belief in spirits residing in all living and non-living entities, these carvings depict various deities and folklore. Notably, one such carving is the Moyang Belangkas, representing the spirit of the horseshoe crab, carved differently to depict both male and female forms. This illustrates the cultural significance of horseshoe crabs within the community, a tradition passed down through generations. However, the Mah Meri face threats from nearby oil palm plantations encroaching upon the mangrove forests, which serve as a primary source of wood for their carvings, indirectly impacting the habitat of horseshoe crabs in the area.

CONCLUSION

The incorporation of horseshoe crabs into their culture and traditions could serve as a valuable tool for conserving the local horseshoe crab population while also safeguarding their cultural and traditional significance for future generations.

[P10] GREEN STATUS ASSESSMENT FOR *Tachypleus tridentatus*

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OBJECTIVES

The IUCN developed the Green Status Assessment (GSA) process to aid species recovery. This poster presents the draft results of applying the GSA to *Tachypleus tridentatus* and invites review and comment.

MATERIALS AND METHODS

The IUCN Horseshoe Crab Specialist Group convened an expert team with geographic and topical representation to apply the GSA to *T. tridentatus*, identifying and communicating conservation and information needs. Over five months, the team met virtually bi-weekly to draft the GSA. They assessed threats, identified conservation actions, and assessed historical and current population status within spatial units. The team projected future status under conservation scenarios to evaluate recovery potential.

RESULTS

The team defined 14 spatial units to account for the range-wide variation in genetic structure, ecology, and threats. The ongoing threat assessment identified the major threats, with various degrees of uncertainty, as 1) harvest for consumption, TAL, and bycatch, 2) habitat loss resulting from coastal development, reclamation, near-shore activities, and aquaculture, 3) invasive alien species, including macrophyte encroachment on spawning and nursery habitat, 4) pollution effects, and 5) direct and indirect impacts of climate change. Although the status assessment is in process, a widespread absence of viable populations and significant challenges to recovery were revealed.

CONCLUSION

The GSA framework's application will help the conservation community understand and communicate the actions needed to improve the status of *T. tridentatus* range-wide. However, critical knowledge gaps were identified through the GSA. Ultimately, the species' recovery will depend on combined action across and within countries prioritized where conservation and research can benefit most.

[P11] EXPRESSION OF PERSPECTIVES CONSIDERING THE EXISTENCE OF HORSESHOE CRABS ON INDIA'S NORTHEAST COAST

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OBJECTIVES

To document community perceptions toward horseshoe crabs after a series of conservation- leadership programs, we design our instrument (questionnaire) using layman's terms so that community members can freely express their opinions without a scientific stigma.

MATERIALS AND METHODS

In particular, for conservation-neglected species like *Tachypleus gigas*, sensitive conservation planning and management decisions depend on an understanding of local population attitudes towards animals and their environment. Between September 2018 and February 2019, 388 local households in 12 separate villages in Balasore, Odisha, participated in a questionnaire-based interview that used a theoretical mapping on attitudes towards horseshoe crabs.

RESULTS

We discovered that 27% of respondents had repressive attitudes, 20% had mixed feelings, and 53% of interviewees tolerated the existence of horseshoe crabs in their location. The majority of responders (>60%) said that horseshoe crabs had practical advantages like aesthetic, financial, and cultural value. Nevertheless, a small percentage of respondents (<20%) said they had repressive views because horseshoe crabs broke their fishing nets. Age, gender, and education are demographic factors that are closely related to local community opinions of the conservation- neglected horseshoe crabs that are still in danger due to by-catch, according to both principal component and stepwise analyses.

CONCLUSION

Overall, this community perception survey enables us to understand community values and their attitudes toward horseshoe crabs in India.

[P12] INTERNATIONAL HORSESHOE CRAB DAY: FOUR YEARS OF GLOBAL CONSERVATION ACTIVITIES

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OBJECTIVES

During the 4th International Workshop on Horseshoe Crabs in Guangxi, China, the International Union for Conservation of Nature (IUCN) Horseshoe Crab Specialist Group designated June 20th as the first annual International Horseshoe Crab Day (IHSCD) to encourage and showcase conservation efforts for the four horseshoe crab species. Here, we assess the reach of IHSCD and highlight activities across years.

MATERIALS AND METHODS

From 2020 – 2023, participants in IHSCD shared descriptions of activities with the IUCN Specialist Group. Activities were compiled and categorized by the country where the activity took place, the type of organizer, and the type of event. We then compared these metrics across years to examine overall trends and changes among years.

RESULTS

A total of 91 activities took place across all years in 12 participating countries. Mainland China hosted the highest number of events per year and across years. Activities were organized by various groups and individuals, with most activities led by universities or schools, followed by non- governmental organizations (NGOs). Online talks were the most common type of event, while other common event types included in-person talks, exhibitions, and horseshoe crab releases.

CONCLUSION

IHSCD had broad participation during its first four years, which included unexpected challenges due to the COVID-19 pandemic. The types of activities and organizers varied across years and locations, highlighting the importance of local communities customizing events to best meet their goals. Assessing activities from previous years will be important to learn best practices and guide the future of IHSCD.

[P13] PRELIMINARY STUDY OF A POTENTIAL NURSERY GROUND FOR *Tachypleus tridentatus* AND *Tachypleus gigas* CRAB IN TANJUNG BATU, NORTH BORNEO, INDONESIA

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OBJECTIVES

This study aimed to investigate the potential nursery ground occurrence for Asian horseshoe crab including tri-spine horseshoe crab (*Tachypleus tridentatus*), coastal horseshoe crab (*Tachypleus gigas*) and mangrove horseshoe crab (*Carcinoscorpius rotundicauda*) to understand their ecological roles and recommendation for conservation management.

MATERIALS AND METHODS

Samples were collected from Tanjung Batu, North Borneo, Indonesia from Mei April to December 2024. Actually, this research is still running. Pre-ecological survey was conducted in the mudflat area based on a random survey in 3 days with 2 surveyors. The juveniles were explored, counted and measured.

RESULTS

The analysis revealed a potential nursery ground for *Tachypleus tridentatus* and *Tachypleus gigas*. Almost 100 juveniles, both of them were located around the mudflat area during our pre- survey in 3 days. Most of them were in early instar stages. However, only a juvenile of *Carcinoscorpius rotundicauda* was found around.

CONCLUSION

Juvenile's presence is a crucial part for establishing that protected areas can support the population of horseshoe crabs. Finding other locations as a potential nursery ground for *Tachypleus tridentatus* and *Tachypleus gigas* is a great insight. These findings highlight the importance of nursery ground protection and the need for further research to understand about the critical habitat in Tanjung Batu area. Basic data of this study offer insights into the nursery ground characteristics of horseshoe crabs and their role in coastal ecosystems.

[P14] THE MICROBIOME ON LESIONED AND NON-LESIONED SHELL OF CAPTIVE HORSESHOE CRABS (*Limulus polyphemus*)

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OBJECTIVES

The objective of this study was to identify bacteria associated with potentially deadly shell lesions that are common to horseshoe crabs held in captivity and provide information to support treatment.

MATERIALS AND METHODS

We swabbed lesioned and non-lesioned regions of the external surfaces of five animals held long- term in an outdoor mesocosm and one held in an indoor touch tank at the Alabama Aquarium, USA. The sampled animals represented a range of shell conditions from recently molted to heavily lesioned on dorsal and ventral surfaces. DNA from the swabs and holding tank water was extracted, amplified, sequenced, and analyzed using bioinformatics to characterize the microbiomes on the horseshoe crab shells and in water.

RESULTS

Differences in the prevalence and community composition of taxa comprising the microbiome between lesioned and non-lesioned shell regions and among animals will help identify bacteria associated with and potentially causing the lesions.

CONCLUSION

The development of shell lesions makes animals held in captivity vulnerable to premature mortality and negatively impacts the success of research, education and aquaculture activities globally. Determining the microbes that cause these lesions will help develop treatment or prevention methods against the lesions and increase survivability and scope for long-term conservation efforts that rely on captive-rearing and public displays of horseshoe crabs.

[P15] IMPROVING THE CONSERVATION AWARENESS ON ASIAN HORSESHOE CRABS THROUGH THE ECOTOURISM AT KUALA SEPETANG, PERAK, MALAYSIA

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1 – The Project Director, Look Port Weld Kuala Sepetang Community Committee, Malaysia

OBJECTIVES

Kuala Sepetang fishing village is blessed by the mangrove forest which acts as a natural barrier to tsunamis. The 40,000 hectares Matang Mangrove Forest Reserve is the largest mangrove wetlands in West Malaysia and recognized as the best managed sustainable mangrove ecosystem in Malaysia. This reserve is regarded as a breeding ground for numerous marine creatures, including Asian horseshoe crabs.

As Kuala Sepetang becomes a well-known tourist spot since 2014, fishers and farm keepers harvest horseshoe crabs, including the immature adults and juveniles in the wild, and keep them in their fish farms for exhibitions. Because of the low conservation awareness of the fishers, they tend to display the horseshoe crabs by wrongly holding their telson, making them into specimens, and many of them died entangled on the fish farms during low tides.

MATERIALS AND METHODS

By organizing Eco Ranger Kids Camp for Kuala Sepetang primary students, they start to learn about horseshoe crabs. The fishers and tourist guides were also approached and provided more knowledge of horseshoe crabs so that they could correctly deliver the message to the tourists.

RESULTS

Several conservation education efforts have been implemented, including:

(1) setting up a horseshoe crab educational board at Sepetang Fishing Village, sponsored by a local tourist corporate;
(2) organizing talks and sharing which covered the information about biology and ecology of horseshoe crabs;
(3) organizing field observation activities, and encouraged kids to report the occurrence of juvenile horseshoe crabs; and
(4) connecting with local fishers and tourist boat operators, to collect more baseline information on horseshoe crab trading.

CONCLUSION

The conservation effort in Kuala Sepetang is at the preliminary stage. More field observation activities for local kids will be organized to record the status of mangrove ecology, horseshoe crab occurrence and their spawning habitats. Besides that, baseline information regarding the fishers' conservation attitudes, especially the conservation awareness of fish keepers will be collected. These works will hopefully improve horseshoe crab conservation in Kuala Sepetang, Malaysia.

[P16] DIETARY INSIGHTS AND COMPETITION BETWEEN *Carcinoscorpius rotundicauda* AND *Tachypleus tridentatus* THROUGH DNA METABARCODING ANALYSIS

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OBJECTIVES

This study aimed to investigate the food composition and potential interspecific competition between mangrove horseshoe crab (*Carcinoscorpius rotundicauda*) and coastal horseshoe crab (*Tachypleus gigas*) using DNA metabarcoding, to understand their ecological roles and inform conservation efforts.

MATERIALS AND METHODS

Specimens were collected from three Indonesian locations (Balikpapan, Demak, and Sumenep) from April to November 2019. Stomach contents were extracted for DNA metabarcoding analysis, involving DNA extraction, amplification using universal primers, and sequencing to identify dietary components.

RESULTS

The analysis revealed a diverse diet composed primarily of bivalves, gastropods, crustaceans, echinoderms, polychaetes, and macrophytes, with significant dietary overlap between the two species. *C. rotundicauda* showed a wider range of prey items, suggesting a more versatile feeding strategy.

CONCLUSION

The significant dietary overlap between *C. rotundicauda* and *T. gigas* highlights the potential for interspecific competition for food resources. The broader diet of *C. rotundicauda* may reflect its adaptability to various habitats. These findings underscore the importance of habitat conservation and the need for further research to fully understand the ecological dynamics of these ancient marine species. DNA metabarcoding has proven to be a valuable tool for detailed dietary analysis, offering insights into the trophic interactions of horseshoe crabs and their role in coastal ecosystems.

[P17] STANDARDIZED MONITORING OF JUVENILE HORSESHOE CRABS IN A NURSERY HABITAT IN PALAWAN: A COMPARISON OF TRANSECT ORIENTATIONS

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OBJECTIVES

This poster presents the findings of an ongoing study to assess juveniles in a population of *Tachypleus tridentatus* occupying a nursery habitat in Palawan, Philippines. Survey results from transects oriented parallel (standard) versus perpendicular (adjusted) to the shoreline are compared. The annual monitoring in Palawan is part of the "Asian Horseshoe Crab Observation Network" program, established in 2021. The program aims to systematically monitor Asian horseshoe crabs throughout their range and address knowledge gaps in population and habitat characteristics.

MATERIAL AND METHODS

Following the protocol, surveyors search for juveniles at low tide in 8 x 8 m quadrats systematically distributed on four parallel transects, evenly spaced to cover the entire intertidal area. The length of the transects and the number of quadrats are determined in the first year and remain unchanged thereafter.

RESULTS

During the 2023 survey using transects parallel to the coastline, many juveniles were sighted between the first and second transect and were, therefore, not counted. Except for this approximately 200 m wide zone, the intertidal area is densely overgrown with seagrass, which hinders juvenile movement. Therefore, the population in this habitat type would presumably be more effectively sampled using perpendicular transects.

CONCLUSION

This study demonstrates the importance of sampling across an existing environmental gradient. It highlights the need to evaluate protocol adjustments to sample representative habitat conditions and accurately gather data on population density, age structure, sex ratio, and spatial distribution. Sustained monitoring helps provide the basis for effective conservation measures to protect these iconic and endangered species.

[P18] INTEGRATED ANALYSIS OF MIRNA AND MRNA EXPRESSION PROFILES IN THREE CONTINUOUS EMBRYONIC STAGES OF *Tachypleus tridentatus*

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OBJECTIVES

To elaborate the molecular mechanism underlying the embryonic developmental stages of *T. tridentatus* by integrated analysis of mRNA-miRNA interaction at three embryonic molt stages.

MATERIALS AND METHODS

We used the Illumina Navoseq platform (San Diego, CA, USA) to perform transcriptome and miRNA sequencing on samples from three embryonic molt stages of *T. tridentatus*, analyzed the data using bioinformatics tools, and validated the expression of miRNA and mRNA by qPCR.

RESULTS

Herein, we present the first large-scale transcriptome and microRNA (miRNA) dataset of embryonic stages of the horseshoe crab *Tachypleus tridentatus* and provide a general overview of the dynamics of global gene expression changes during early development. We identified 138,260 unigenes, including 34 immune-related gene families such as pattern recognition receptors, signaling and transduction pathway genes, antimicrobial peptides, and coagulation cascade genes. Additionally, 1522 miRNAs (1046 known miRNAs and 476 novel miRNAs) targeting 29,584 genes were predicted to be present. We also identified numerous mRNA-miRNA interactions, which provide insight into the immune reactions that occur during the antimicrobial process in early developmental stages of *T. tridentatus*. Quantitative PCR analysis revealed that the immune-related genes (Spaetzle, ankyrin-3, peptidoglycan- recognition protein, coagulogen, TNF-receptor-associated factor, and CD-9 antigen were negatively regulated by miRNAs miR-5735, miR-200, miR-145, miR-199, miR- 144, and miR-322, respectively.

CONCLUSION

The analysis of time-course gene expression data is a first step toward understanding the complex developmental gene regulatory networks in *T. tridentatus*. Our results are a valuable resource for analyzing the functions of gene repertoires in various developmental phases of horseshoe crabs.

[P19] DISTRIBUTION PATTERNS AND CONSERVATION OF HORSESHOE CRABS IN INDONESIAN WATERS UNDER CLIMATE CHANGE

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OBJECTIVES

Horseshoe crabs are an ancient lineage, which is pivotal to marine biodiversity and ecological health. Despite their ecological importance, horseshoe crabs face threats from habitat loss, climate change, and exploitation for their blue blood. Understanding the distribution pattern is very important for the effective conservation of species.

MATERIALS AND METHODS

We applied an ecological niche model to predict the distribution of three Asian horseshoe crab species (*Tachypleus gigas*, *T. tridentatus*, and *Carcinoscorpius rotundicauda*) in Indonesian waters,to reveal the protection gap for future conservation.

RESULTS

Firstly, the ecological niche divergence showed that three species have similar habitats in coastal regions. Moreover, the main habitats for the three species are distributed around Kalimantan island, along the north coastal region in both Java and Sumatra islands, only in the gulf of Boni in Sulawesi island. Additionally, most of the important habitats of horseshoe crabs are not included in the existing marine protected areas, revealing obvious protection gaps. Under climate change, three species will face habitat loss and fragmentation, especially for *T. tridentatus.*

CONCLUSION

Our findings underscore the urgent need for a comprehensive, climate-informed conservation strategy to safeguard these ancient species. This strategy should include the establishment of marine protected areas, community-based conservation initiatives, and adaptive management practices to mitigate the adverse effects of climate change on horseshoe crab populations.

[P20] CHARACTERIZING HORSESHOE CRAB BYCATCH IN BALIKPAPAN: IMPLICATIONS FOR FISHERIES MANAGEMENT AND CONSERVATION

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OBJECTIVES

Bycatch has been identified as an emerging threat towards horseshoe crab populations, including in Indonesia. Despite their status as a fully protected species in Indonesia, enabling their protection is especially challenging due to a lack of information and understanding. As such, this study aims to characterize horseshoe crab bycatch in Balikpapan to better understand the current status of horseshoe crab presence in Balikpapan's fisheries and subsequently the urgency for regulations or management to reduce fisheries pressure.

MATERIALS AND METHODS

During the period of January to June 2022, this study collected data to obtain morphological characteristics, spatio-temporal distribution, bycatch ratio and fishing practices associated with horseshoe crab bycatch in the region through a combination of Local Ecological Knowledge (LEK) Interviews and On-Board Observation.

RESULTS

A total of 629 Horseshoe crabs were encountered during the study, encompassing all three species (*T. gigas, T.tridentatus, C.rotundicauda)*. Horseshoe crabs are bycaught by artisanal, gillnet fishers with a ratio of 0.21 kg horseshoe crabs caught for every 1 kg of main catch. Horseshoe crab catch per trip averaged to 3.46 kg per trip or equivalent to 5-6 Individuals per trip. Although they are not exploited, habitat loss and bycatch-induced mortality are amongst the key threats identified from fishers' interviews.

CONCLUSION

The study reveals significant horseshoe crab presence in Balikpapan, highlighting the need for immediate regulatory action and management. Information illuminated through the study is key for informed conservation strategies that can significantly reduce bycatch and ensure their survival.

[P21] ASSESSMENT OF THE POPULATION STATUS OF HORSESHOE CRABS IN PURBA MEDINIPUR COAST, NORTHEAST BAY OF BENGAL – EVIDENCE OF DECLINE DUE TO UNSUSTAINABLE FISHING PRACTICES

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OBJECTIVES

In the northeast coastal Bay of Bengal, biotopes such as intertidal mudflats interspersed with patches of mangroves are home to *Tachypleus gigas* and occasionally *Carcinoscorpius rotundicauda*. The coast of Purba Medinipur located along the northeast Bay of Bengal is reeling from natural and anthropogenic forcings. The broad purpose was to assess the population status of these two species of horseshoe crabs and gather information about horseshoe crabs from coastal communities.

MATERIALS AND METHODS

The primary method included line transects based survey along the 3 km coastal stretch between June to July (2022) to record the occurrence of both species of horseshoe crabs. Questionnaire surveys were conducted on a weekly basis with resident coastal communities (predominantly fishermen and fisherwomen representing different age groups) to understand observed changes of population of horseshoe crabs and their habitats. In addition, sediment cores were collected to assess the nature of habitat quality.

RESULTS

During the surveys only dead males and females belonging to *Tachypleus gigas* were encountered. The inspection of the carapace revealed possible entanglement in fishing nets. In the survey only a single individual of *Carcinoscorpius rotundicauda* was recorded. During the survey juvenile males of *Tachypleus gigas* were rescued and released. Also during the survey, red ghost crabs (*Ocypode macrocera*) were found to eat the dead horseshoe crabs. The crabs predated on the ventral part of the gill region of dead horseshoe crabs. The coastal communities highlighted a fall in the occurrence of horseshoe crabs in the region and linked the decrease in number with use of unsustainable and cheap fishing nets as well as sharp decline of artisanal fishery practices. The sediment granulometry revealed a shifting pattern from sand to clay like particles in parts of the studied region.

CONCLUSION

The survey revealed only dead carapace of both horseshoe crabs and provided evidence of the possible uncontrolled use of fishing nets that may be leading to a decline in the population of horseshoe crabs. The gradual loss of artisanal fishing practices coincided with the observed decrease of horseshoe crab in coastal areas of Bay of Bengal.

[P22] APPLICATION OF MACHINE LEARNING PROGRAMME FOR PREDICTION OF MORPHOMETRIC PARAMETERS OF INDIAN HORSESHOE CRAB: *Tachypleus gigas*

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OBJECTIVES

During the field study along the coastal beaches for the enumeration of the horseshoe crabs, lots of individual body parts (Telson, Prosoma, or Opisthosoma) of dead horseshoe crabs have been found besides the live animals. Keeping in view of that, a machine learning programme was applied to predict the different morphological parameters of both the sexes based on the available body parts of horseshoe crabs found along the coastal regions of Balasore district of Odisha, India.

MATERIALS AND METHODS

The different morphological parameters such as: Total body length (TL), Prosomal length (PL), Prosomal width (PW), Opisthosomal length (OL), Opisthosomal width (OW), Telson length (TEL) of both male (81) female (107) *Tachypleus gigas* were measured and taken for analysis and used for machine learning applications. Statistical analysis was also performed and the test of significance between the means was derived by using Student's T test.

RESULTS

The mean TL, PL, PW, OL, OW, TEL of male horseshoe crabs were 28.63±2.44, 8.28±0.62, 16.28±0.83, 5.95±0.63, 8.77±0.64, 14.28±1.63 cm, and for female horseshoe crabs were 36.90±3.10, 11.90±0.80, 21.31±1.23, 7.75±0.75, 11.07±0.70, 17.31±2.10 cm respectively. Using the raw data and applying the machine learning programme, several equations were derived which may help to calculate and predict the different morphological variables.

CONCLUSION

The mean morphological parameters of female horseshoe crabs were statistically different from the male. Based on the derived equations if one morphological parameter is known then the other parameters can be predicted.

[P23] HAVE THE INDIAN MASS MEDIAS PLAYED SIGNIFICANT ROLE FOR CONSERVATION OF HORSESHOE CRABS?

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OBJECTIVES

To know whether the Indian Mass Medias (both print and electronics) have given adequate coverage for spreading awareness among the public for conservation of horseshoe crabs in the country.

MATERIALS AND METHODS

A search was conducted using Google platform and other publications in different national and regional newspapers for a period of last ten years. Different news articles, TV clippings and photographs published by various print and electronic media were collected and analysed for the purpose.

RESULTS

A total of 20,821 newspapers have been registered with the office of registrar of newspapers for India, Government of India as on March 2022. However, only countable national English daily newspapers and few digital news platforms have published several articles about the Indian Horseshoe crabs during the studied period. Few regional newspapers of West Bengal and Odisha state have also published articles on biomedical and ecological importance of horseshoe crabs. Similarly few TV channels of both the states have telecasted educational videos and news coverage regarding the significance of horseshoe crabs and their conservation efforts.

CONCLUSION

Keeping in view of the vast geographic areas and diversities among the population groups (based on languages) the efforts taken by the Indian Mass Medias are very limited in nature. There is an urgent need to enhance the activities of the different print and electronic media houses to educate and motivate the public, government and non government organisations to give emphasis for conservation of the horseshoe crabs in the country.

[P24] HORSESHOE CRAB PALACE: REBIRTH FROM NEAR LOCAL EXTINCTION – RESTORATION ACTIONS BY A GRASSROOTS ORGANIZATION FOR *Tachypleus tridentatus* IN CHIAYI COUNTY, TAIWAN

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OBJECTIVES

Only a few juveniles of *Tachypleus tridentatus* were found at several sites along the west coast of Taiwan's main island due to habitat loss or fragmentation. It is important to conduct population surveys and restoration efforts at Haomeiliao Wetland in Chiayi County.

MATERIALS AND METHODS

Surveys of *T. tridentatus* juveniles at Haomeiliao Wetland were conducted using zigzag survey design for continuous transect in 2005, 2019, 2021 and 2023. The restoration works based on local bycatch adults also began.

RESULTS

Population surveys revealed a density of only 0.013-0.03 individuals per 100 m^2 in 2021 and 2023 (with only one juvenile observed in four surveys), down from 0.8-9.2 individuals per 100 m^2 in 2005. The population of *T. tridentatus* was on the verge of local extinction. Since 2021, a grassroots initiative has recruited 20 volunteers to care for adult horseshoe crabs, housing three pairs, with two pairs producing over 20,000 eggs. Volunteers on daily rotation successfully removed fungus-infected eggs, reducing the infection rate, and hatching over 600 juveniles.

CONCLUSION

With effort, this marks the first successful egg-laying and hatching of juvenile crabs from bycatch adults in over a decade at the "Horseshoe Crab Palace", as well as the first successful breeding of juveniles by a grassroots organization in Taiwan. Furthermore, construction of a new restoration center in Chiayi aims to further support conservation efforts for horseshoe crab in southern Taiwan, slated for completion in 2026

[P25] ARCHIPELAGO-WIDE POPULATION SURVEY AND MULTIPLE CONSERVATION STRATEGIES OF *Tachypleus tridentatus* AROUND PENGHU ARCHIPELAGO, TAIWAN

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OBJECTIVES

The Penghu Archipelago, with a coastline spanning 448 kilometers, harbors the second most abundant population of *Tachypleus tridentatus* in Taiwan. Archipelago- wide population surveys and conservation efforts have been conducted in recent years.

MATERIALS AND METHODS

From 2019 to 2022, surveys of *T. tridentatus* juveniles were conducted at 17 sites, with detailed investigations carried out at 4 sites using zigzag lines, including Qingluo Wetland, a nationally important site protected under the Wetland Conservation Act, across three seasons. Population estimates were derived using the mark-recapture method, accounting for molting ratios. Adults were surveyed by bottom gillnet among 7 sites from 2015 to 2017.

RESULTS

Results show juveniles were observed at 10 sites between 2019 and 2022, with 35 adults recorded from 2015 to 2017. For example, surveys in Qingluo Wetland conducted from 2020 to 2021 found 119 and 331 juveniles, instar 5 to 12, respectively. Mark-recapture methods estimated approximately 401-403 individuals in July 2021. Juvenile distribution correlates with intertidal topography, with hotspots in shallow tidal pools. Lack of juveniles under instar 5 in some areas may be attributed to sediment size, distant spawning sites, and reduced spawning events.

CONCLUSION

Continued protection is warranted, with spawning adults observed during surveys. Conservation measures include enhancing protection of juvenile hotspots, continuous population monitoring, year-round bans on horseshoe crab capture (implemented in 2022), and community collaboration for marine education and conservation patrols.

[P26] HORSESHOE CRABS AS PETS: THE MARINE LIFE FISHERY

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OBJECTIVES

Collecting horseshoe crabs as specimens or for the aquarium trade, known as the Marine Life Fishery (MLF), is largely ignored by fisheries biologists, but in Florida it is an important source of horseshoe crab mortality. Most individuals collected in the MLF are 3-5 year-old juveniles that are sent around the world as specimens or pets for salt water aquaria. Here we describe the MLF in Florida and discuss its effects.

MATERIALS AND METHODS

In Florida, collecting horseshoe crabs requires a Marine Life permit from FWC/FWRI. This permit requires the holder to report the number of horseshoe crabs collected on each fishing trip. We used the data obtained from the FWC/FWRI Marine Resources Information System, Marine Fisheries Trip Ticket Program to determine harvest levels and CPUE (catch per unit effort).

RESULTS

24,760 horseshoe crabs were collected annually in the MLF of Florida (average/year from 1998 to 2022). Most were taken from Florida's west coast. CPUE remained steady on the west coast but declined on the east coast.

CONCLUSION

There are three concerns with the MLF. First, the numbers collected and the fact that most are juveniles means that the MLF could affect horseshoe crab populations in Florida, which are small and stressed from the effects of development, climate change and sea level rise. Second, aquarium pets may be released into waters that contain other species or populations of horseshoe crabs. Finally, we suspect that marine life collecting elsewhere may be overlooked as an important source of horseshoe crab mortality.

[P27] EFFECTS OF BLOOD EXTRACTION ON *Tachypleus gigas* SPAWNING IN CAPTIVITY

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OBJECTIVES

To determine the effects of blood extraction on *Tachypleus gigas* pairing and spawning in captivity.

MATERIALS AND METHODS

A *T. gigas* that had undergone blood extraction was transferred into a holding tank alongside unbled individuals of the opposite sexes that were similar in size. The pairing was observed twice daily. Once paired, they were carefully transferred into the spawning tank for further observation. After three hours of spawning activity, we recorded the number of nests and the number of eggs per nest of *T. gigas* after blood extraction.

RESULTS

Blood extraction shows an effect on the pairing activities of female *T. gigas* compared to males (Kruskal-Wallis, $P < 0.05$). Four of the six bled males were able to form pairings with the available females, whereas none of the bled females were chosen by the males. A total of 30 nests (7.5 ± 1.85 nests) were produced by four bled male pairs with an unbled female, with a mean of 238.63 ± 68.11 eggs per nest.

CONCLUSION

The impact of blood extraction on *T. gigas* mating behaviour may vary between sexes, with females experiencing more significant effects compared to males.

[P28] PUBLIC AWARENESS PROGRAMMES AND THE RELEASE OF EARLY-HATCHED HORSESHOE CRABS, *Tachypleus gigas*

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OBJECTIVES

To increase public awareness and to increase the *Tachypleus gigas* population in Terengganu waters.

MATERIALS AND METHODS

Public awareness programs were conducted through school engagement initiatives facilitated by funding from the government. The horseshoe crab rearing kit (JOJOLab) was developed and distributed to educational institutions in Terengganu. The rearing of *T. gigas* eggs until hatching was conducted in school with the help of students, teachers and monitored by our facilitators. A release event was organized to help the students release their early-hatched *T. gigas* to selected nursing grounds.

RESULTS

The rearing kit was distributed to two high schools, five primary schools, and eight preschools. A total of 210 eggs were distributed to high and primary schools. 95% of the eggs hatched successfully. Whereas approximately 1000 instar 1 juveniles were distributed to preschools for observation. In 2023, three release events were conducted to release 3000 instars 1 and instars 2 into selected nursing grounds.

CONCLUSION

The public's knowledge of *T. gigas* in Terengganu was observed to improve greatly, and the release of early-hatched *T. gigas* to natural habitat was expected to aid in boosting their number in the future.

[P29] ARTIFICIAL BREEDING OF *Carcinoscorpius rotundicauda* AND T*achypleus gigas*: FIRST ATTEMPT FROM BANGLADESH

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OBJECTIVES

To conserve the natural stock of two species of horseshoe crabs *C. rotundicauda* and *T. gigas* in Bangladesh, artificial breeding was experimented.

MATERIALS AND METHODS

For artificial breeding, horseshoe crabs of three individuals (one female and two male) of *T. gigas* and five pairs of *C. rotundicauda* had been collected from the wild and conditioned in hatchery for one month. After conditioning during the full moon of the following month, the first breeding trial was performed for both species. Electric simulation was provided for sperm and egg collection using Comfy Tens physiotherapy machine (made in Taiwan). Released eggs were washed with treated seawater and eggs and sperm were mixed together in a petri-dish for several hours (2 h). After mixing of sperm and eggs, these were transferred to four different systems for incubation. These systems for incubation of the eggs were S1 - petri dish with sea water, S2 - bowl with sand mud substrate, S3 - wet tissue in glass bowl and S4 - re-circulatory system in glass jar. Eggs were equally distributed in these systems for incubation where the seven eggs from *T. gigas* were transferred in S4. Daily water exchange was maintained in all systems for once and wet tissue was changed in S3 daily. Eggs were monitored if any form of life can be detected.

RESULTS

T. gigas only produced seven eggs and an average of 13±2 eggs were released from each female individual of *C. rotundicauda.* However, all the eggs were deformed in every system and then fungal attack was observed after fifteen days.

CONCLUSION

Though the trail did not succeed, hopefully it will help researchers better understand and make certain changes for successful breeding of horseshoe crabs in Bangladesh.

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