

# 國際海洋資訊

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海洋科技在海域遊憩活動的創新服務試驗

Innovative Trials of Information Service for Marine Recreation

馬來西亞海洋資訊

Malaysia Ocean Information



海洋委員會  
Ocean Affairs Council

發行



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主任委員：李仲威

## 牛轉乾坤 持續推動向海致敬

如何平衡環境與經濟，永續經營海洋，是全球都需要面對的議題。位處東南亞的馬來西亞海洋資源豐富，在海洋策略與產業方面皆有可供參考之處，因此本期以馬國為例，「國際議題」介紹馬國提出的《生物多樣性國家政策（2016～2025）》，宣示政府保護陸域和海洋生物多樣性的決心與行動；而「產業動態」則分享馬來西亞的藍色經濟案例，「資訊新知」介紹馬來西亞積極發展的海洋溫差發電，可作為我國海洋資源開發策略之借鏡。海洋治理有賴完善的法規制度規劃，本期亦從海洋政策與海域執法之方向出發，分享馬國的多元海洋發展與海域執法能量。

我國於2020年著手推動「向海致敬」政策，開始規劃積極開放、有效管理與多元利用海洋資源的施政作為，在開放海洋的同時，如何兼顧海域遊憩與安全就是首要之務。本期「專題報導」以金樽臺灣國際衝浪公開賽為例，介紹以海洋環境監測科技來支援海域遊憩活動的各項動態資訊服務，展現海洋科學資訊如何應用與創新，以利海域遊憩活動的蓬勃發展，更能促進我國海域遊憩活動的正向循環。

展望2021年，海洋委員會將持續落實執行2020年《國家海洋政策白皮書》6大政策目標，並廣續推動海洋法制等9大面向工作，積極辦理「向海致敬」政策重要工作，期望能在「生態永續」、「海域安全」、「產業繁榮」的願景下，讓臺灣的海洋事務蒸蒸日上，早日實踐永續海洋國家之目標！



圖說／馬來西亞彈丸礁（馬來文稱為 Pulau Layang-Layang）海中的獅子魚

圖片來源／Arhnue Tan from Pixabay  
<https://pixabay.com/photos/lionfish-scuba-diving-underwater-1430225/>

# 海洋科技在海域遊憩活動的創新服務試驗 ～以金樽臺灣國際衝浪公開賽為例

撰文／賴堅戊（國家海洋研究院海洋產業及工程研究中心研究員）  
廖建明（國家海洋研究院海洋產業及工程研究中心研究員兼主任）  
陳沛宏（國家海洋研究院海洋產業及工程研究中心助理研究員）  
關鍵字／海洋資訊服務、海域遊憩活動、風險海域劃設、向海致敬

本文旨在報導國家海洋研究院在2020年11月間配合臺東縣政府所舉辦之臺灣國際衝浪公開賽，於金樽海岸嘗試性地以海洋環境監測科技支援海域遊憩活動的破壞式創新服務試驗，為向海致敬中「海域遊憩活動安全動態資訊系統建置」計畫拉開序幕，期望能用科技拉近我們與海洋的距離。

我國行政院廣續「向山致敬」的成功經驗，在2020年起著手規劃推動「向海致敬」，鼓勵人民「知海」、「近海」及「進海」，讓民衆能夠暢遊山海間，盡情享受蓊鬱山林和婆娑海洋的美麗。另為落實「向海致敬」政策，依行政院所揭示「開放、透明、服務、教育及責任」5項原則，海洋委員會統合相關涉海部會，共同規劃各項施政作為，積極開放、有效管理、多元利用海洋資源，以確保海洋永續發展。

又科技部於2020年12月間舉辦「第11次全國科學技術會議」，擬定未來的科技研發布局藍圖，期望發展「以人為本」的科學技術，透過開放式創新及結盟與合作，強化探索性科學研究並布局新興科技發展，培育優質高階人才，強化科研創新生態系。

開放海洋首先引起普遍關切的即是安全議題，在海洋委員會於各縣市所舉辦的座談紀錄中，可以發現海域遊憩活動的管制以及海域空間利用的衝突往往成為討論最激烈的議題，因此如何在向海致敬政策的5項原則及其策略指導下，擬訂具體行動方案，來改善我們與海洋的關係，成為重要的課題。



圖1／向海致敬政策的5項原則及其具體策略  
圖片提供／改編自海委會政策說明簡報



在「資訊透明」和「風險明確」方面，為增進遊客的海域安全知識，同時有助於因應可能的海灘危險，如陳等人（2020）[1]所報導現代化海洋國家近年在海灘危險分級和海灘安全資訊網等兩項對於水域安全非常重要的資訊整合積極投注的功夫。海洋委員會及其所屬國家海洋研究院近兩年為明確我國海域遊憩風險，改善海岸管理策略，也積極透過整合海洋環境資訊、跨領域資料收集及訪談等方法，探討我國海域各類遊憩活動之風險環境因子。

## 近年海域遊憩風險劃設的進展

海洋委員會在2019年訂定低、中、高3種風險等級之環境臨界值[2]，將各類遊憩活動與海洋環境因子建立連結，進行風險評估；以此為基礎，並進而於2020年評估全國57處海域從事各類遊憩活動之風險分級，如表1中以臺東卑南、東河、成功、長濱等4個鄉鎮海域所評估的風險分級結果，在每年東北季風興盛期間（10月至翌年3月）即被評估為衝浪、風浪板等活動之高度風險海域[3]。這樣的分級結果即與每年11月在臺東金樽舉行國際衝浪賽的實況顯得微妙，也突顯了此類工作成果，雖然為海域遊憩活動及安全管理措施提供較具學理的分析準則，但是由於相關工作是為了訂定一體適用的海岸管理策略而進行，因此其條件假設在1.對多數人（或是初級海域遊憩活動參與者）適用的風險承受能力進行評估，而暫不考慮個體差異；2.以月為單位進行歷史數據的統計，而暫不考慮海洋及大氣環境的動態變化。因此，如何在以人為本且考量海洋動態變化的情境下，為海域遊憩活動參與者及海域管理單位提供所需之破壞式創新海洋資訊服務，即是國家海洋研究院在向海致敬以「海域遊憩活動安全動態資訊系統建置」計畫的核心精神，期望將海洋觀測先端科技所產出的資訊，轉譯成支持民衆迎向海洋的海洋環境及風險資訊服務。

## 新型態的衝浪浪點動態海域資訊服務

近年來隨著政府大力推廣海洋運動，使得海洋運動發展如雨後春筍般蓬勃發展。然而這些海洋運動通常是透過海洋水體、環境或氣候因子產生行為，因此過去有許多研究已探討其因果關係和相互影響情形[4][5][6][7][8][9][10][11][12]。

表1／臺東縣北海域從事各類海域遊憩活動之風險分級結果

項目 \ 月份	一	二	三	四	五	六	七	八	九	十	十一	十二
游泳	紅	紅	紅	黃	黃	黃	黃	黃	黃	紅	紅	紅
衝浪	紅	紅	紅	黃	黃	黃	黃	黃	黃	紅	紅	紅
潛水	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
風浪板	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
滑水板	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
拖曳傘	黃	黃	黃	綠	綠	綠	綠	綠	綠	黃	黃	黃
水上摩托車	黃	黃	黃	綠	綠	綠	綠	綠	綠	黃	黃	黃
獨木舟	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
香蕉船	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
橡皮艇	黃	黃	黃	綠	綠	綠	綠	綠	綠	黃	黃	黃
拖曳浮胎	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
風箏衝浪	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
立式划槳	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅
釣魚	紅	紅	紅	綠	綠	綠	綠	綠	綠	紅	紅	紅

紅色：高風險  
黃色：中風險  
綠色：低風險

資料來源／國家海洋研究院（2020）[3]

以衝浪活動為例，Walker早在1974年時提出休閒衝浪參數（Recreational surf parameters）[4]，而Jackson等人（2001）[8]瞭解衝浪者的技術水準和所有衝浪消費者的安全需求也對衝浪體驗有很大影響，因此進一步提出衝浪能力分級與波浪浪高（Hb）、波向角（ $\alpha$ ）及衝浪移動速（Vs）之關係，如表2所示。爾後，Scarfe等人（2003）[11]更進一步以「衝浪科學（The Science of Surfing Waves and Surfing Breaks）」為題，希望向衝浪者和非衝浪的海岸規劃者、科學家和工程師傳達衝浪科學的基本知識。

在臺灣，海域遊憩活動除了釣魚、游泳，就以投入衝浪的人口最為蓬勃興盛，近10年間，更因臺東縣政府常年在東河鄉金樽漁港舉辦國際級衝浪賽事（Taiwan Open of Surfing），更將我國的衝浪風氣及國際知名度帶到新的境界。

表2／衝浪者技術等級與波浪參數關係

衝浪技術	波浪參數	Hb (m)	$\alpha$ (deg)	Vs (m/s)
初學		<1.2	60~90	<3.0
中級		<2.5	60	<7.5
熟手		<8.0	>30	<12.0

資料來源／改編自Jackson等人（2001）[8]



圖2／金樽海灘架設臨時波流遙測系統  
圖片提供／賴堅成

2020年之衝浪賽於11月18日至22日舉辦，國家海洋研究院與臺東縣政府合作，於比賽期間在金樽海岸開設高解析X-Band波流遙測系統（圖2），並整合中央氣象局及國家海洋研究院的海氣象數值預測資訊，以容易理解的圖表資訊展示介面（圖3），提供衝浪選手及主辦單位在衝浪競賽期間海域環境資訊。此次在參考衝浪專家及社群對衝浪浪況的描述，將傳統海洋科學對海洋環境的描述方法轉譯成動態資訊服務之內容分述如下：

### 一、海象資訊

衝浪者趴在浪板上等待一個合適、可挑戰的浪，根據衝浪社群所提供對衝浪的海洋環境資訊需求，工作團隊從海洋科學的角度找出相應的資訊，這包括有長浪的浪高、週期、方向、能量、均勻性，以及潮汐、海溫、海底地形、底質特性等。由於適合衝浪的浪通常是週期較長的長浪，因此本次活動的海象資訊主要來自金樽臨時測站的X-Band波流遙測資訊及國家海洋研究院的WaveWatch風浪模式，個別海象資訊與衝浪的關聯說明如下：





### 三、資訊簡化與轉譯

金樽浪點資訊服務活動期間，我們進行了資訊內容的解說並向來到金樽的觀賽者、選手及活動承辦人等進行問卷調查，最終得到252份有效問卷，並對海氣象環境資訊需求得到充分回饋。我們可以發現直接提供海洋觀測數據的方式，對於非海洋科學領域的資訊使用者存在著認知上的隔閡，特別是對初學者而言。未來將根據波浪能量大小、波浪的頻率和方向的紛紜和集中程度來進行分類，並提供不同運動能力的衝浪者以綠、黃、紅等燈號的資訊供其參考，相信未來能為衝浪活動的趣味及安全提供更符合期待的資訊，為打造海域遊憩聖地做出貢獻。

### 結論

行政院推動向海致敬政策，相關部門為提升我國海灘遊憩安全刻正整合我國所有海灘資訊，建立風險分級，並建置海域遊憩活動一站式服務資訊平臺。將可增進遊客瞭解海域潛在風險，同時有助於遇到危險情況時，採取適當措施。

在鼓勵民衆親近海洋之際，筆者認為除了改善海岸管理策略，在海洋科學資訊的活用上，應更積極朝向協助民衆及相關產業，認識海洋、瞭解海洋，並強化創新服務，以利海域遊憩活動的蓬勃發展，提升我國在國際運動賽事實力，進而帶動運動旅遊、服務業及相關周邊產業的發展，促進我國海域遊憩活動的正向循環。

※致謝：感謝浪點資訊觀測期間，臺東縣政府交通及觀光發展處、海巡署東部分署、成功大學近海水文中心、高雄科技大學海洋事務與產業管理研究所及五方科技公司的各項協助。

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# 邁向生物多樣性的新時代：馬來西亞生物多樣性國家政策（2016-2025）

撰文／陳璋玲（國立成功大學海洋科技與事務研究所教授）

劉健合（國立成功大學海洋科技與事務研究所博士候選人）

關鍵字／馬來西亞、生物多樣性、海洋生態保護

生物多樣性國家政策（2016-2025）是馬來西亞致力保護陸域和海洋生態的國家發展政策。該政策的中央主管機關是自然資源暨環境部（Ministry of Natural Resources and Environment, NRE），明訂生物多樣性的5大原則、5大目標、17項標的，以及多項行動和措施。該政策亦明訂執行架構，包括設立中央單位和州政府層級多個整合平臺。另為確保該政策有效執行，自然資源暨環境部定期檢視執行進度，並發表報告。

## 前言

馬來西亞位於東南亞，赤道以北，分成半島馬來西亞（又稱西馬）和東馬（位於婆羅州）。馬來西亞之氣候屬熱帶型雨林氣候，全國陸地面積共330,345平方公里，包括879個島嶼面積，海岸線長達4,809公里，海域面積達453,186平方公里。馬國有豐富的陸域和海洋生態系，估計有15,000種維管植物、307種哺乳動物（其中30種是馬國特有種）、785種鳥類、242種兩棲類動物、567種爬蟲類，以及2,068種淡水和海水魚類。豐富的生物多樣性是馬國特有的自然資產，提供人民食物、水和多種經濟價值。

馬國1998年訂定第1版生物多樣性國家政策（National Policy on Biological Diversity）。自此，馬國歷經人口大量成長和重大社經改變，包括1998年2,300萬人增加至2015年的3,000萬人、人均國民生產總值和國家出口值分別成長3倍和7倍。隨著住宅和工業區域、城鎮和基礎建設興建，馬國轉型成為已開發、高所得的國家。這些發展對生物多樣性產生巨大壓力，使得許多物種變得脆弱，甚至有些面臨滅絕的威脅。



圖說／豐富多元的海洋生態系是馬來西亞重要的自然資產  
圖片提供／陳璋玲

棲地破碎化、外來物種入侵、污染、偷獵、土地競爭使用，以及氣候變遷等都是生物多樣性的威脅。人們普遍缺乏對生物多樣性重要的認知，以及存在著巨大的知識落差。此外，管理能量不強，用於生物多樣性的資金亦不足，這兩者對於維持生物多樣性非常重要。因此，延續1998年之政策，生物多樣性國家政策（2016-2025）進一步提供馬國在面臨增加且複雜的挑戰中，保護生物多樣性和永續使用的方向和架構。（本文介紹馬國生物多樣性國家政策，內容主要節錄自[1]。）

## 原則、目標和標的

生物多樣性國家政策宣示馬國致力於保護生物多樣性，促進生物多樣性的永續利用，以及確保來自生物多樣性利用所獲得的利益公平且平等地分配。該政策訂有5大原則、5大目標和17項標的，每項標的有對應的行動和具體措施。預計2025年達成標的。

### 一、原則

#### 原則一：遺產

- 生物多樣性是國家遺產，為了未來世代，必須永續管理，明智使用和保育。

#### 原則二：預警的

- 缺乏科學確定，不應作為延遲採取措施，減少生物多樣性損失的理由。

#### 原則三：分擔責任

- 生物多樣性保育和永續利用是社會各部門共同分擔的責任。

#### 原則四：參與式的

- 生物多樣性的規劃和管理須以參與式的方法實踐。

#### 原則五：良好治理

- 良好治理，包括可究責和透明化，對於生物多樣性保護非常重要。

### 二、目標與標的

#### 目標一：所有利益關係人有能力和承諾保護生物多樣性

- 標的1：更多的馬國人民意識到生物多樣性的價值和可以採取的步驟，以致力於保護和永續使用生物多樣性。
- 標的2：原住民、地方社區、民間協會和私人部門對生物多樣性保護和永續使用的貢獻大幅增加。

#### 目標二：減少生物多樣性面臨的直接和間接壓力

- 標的3：生物多樣性保護已成為國家發展規劃和部門政策和計畫的主流議題。
- 標的4：永續管理和使用森林、農業生產和漁業。
- 標的5：永續管理旅遊業且旅遊業促進生物多樣性保護。

#### 目標三：保護所有關鍵的生態系、物種和基因多樣性

- 標的6：建立代表性的保護區系統和採取以區域為基礎的保育措施，達到至少20%陸域區域和內陸水域，以及10%海岸和海洋區域受到保護。
- 標的7：合宜地保護和復育脆弱生態系和棲地，尤其是石灰山坡、濕地、珊瑚礁和海藻床。



- 標的8：確認、復育和保護重要的陸域和海域生態廊道。
- 標的9：確保已知的瀕危物種不會消失，且保育狀態維持和改善。
- 標的10：控制且減少偷獵、非法捕獲和非法貿易野生生物、魚類和植物。
- 標的11：確認侵入外來種和入侵途徑，控制優先處理的物種，以及採取措施，避免引入和建立。
- 標的12：設立全面的生物安全系統，以管理生物科技用於生物多樣性和人體健康可能產生的負面影響。
- 標的13：合宜保存栽種植物、人工豢養／養殖動物，以及其野生物種的基因多樣性。

#### 目標四：確保公平分享利用生物多樣性所得的利益

- 標的14：建置和名古屋議定書（Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization）一致的取得和分享利益的架構。

#### 目標五：改善利益關係人保護生物多樣性的能力、知識和技能

- 標的15：增強執行國家生物多樣性策略、生物多樣性公約，以及千禧年生態系統評估的能量。
- 標的16：增進有關生物多樣性價值、功能、現況、趨勢和其損失所造成後果的知識和科學基礎常識。
- 標的17：增加政府和非政府單位的資金和資源，運用於生物多樣性保護。

## 海洋生態保護措施

生物多樣性國家政策訂定17項標的。每項標的下有對應的行動和措施。本節摘錄和海洋生態保護有關的措施。

- 研擬和執行社區參與計畫，使居住於海洋／陸地保護區，以及緩衝區的原住民和地方社區參與生物多樣性保護。
- 透過新科技、整合執法，和遏阻性處罰，減少各種水污染來源。
- 促進和提供誘因予漁業認證，如海洋管理委員會標章（Marine Stewardship Council）。
- 研擬計畫，控制非法、未報告及不受規範漁撈行為（illegal, unreported and unregulated fishing）。
- 消除破壞性漁具的使用，加強使用海龜脫逃器（Turtle Exclusion Device）。
- 研擬計畫，加強海洋保護區國家網路之建立。
- 與印尼、汶萊和菲律賓建立跨界海洋保護區合作，優先處理有助珊瑚大三角行動（Coral Triangle Initiative）成功的事項。
- 制定和執行所有海洋保護區和禁止捕魚區的管理計畫，確保目標物種族群再建立。
- 建立完整的陸地和海洋保護區空間資料庫，資訊包括依法保護狀態、生物相威脅、生物多樣性和生態系統服務等。

- 確認、繪圖和保護海洋生物遷移路徑。
- 執行《船舶壓艙水及沉積物管理國際公約》，防止外來種入侵。
- 全面檢視中央和州政府有關漁業、海洋公園和海洋生物多樣性的法律文件，查看有否管理漏缺或重疊之處，並評估擴大海洋公園局（Department of Marine Park）職權之可能性。
- 執行國家海洋和淡水生物資源盤點調查，包括詳實的資源量評估。

## 執行架構

自然資源暨環境部（NRE）是執行生物多樣性政策的聯邦政府單位，包括提供政策整體方向、整合利益關係人行動、建立合適的體制平臺、促進資源就位，以及啟動政策評估等。州政府就所轄土地、水和森林資源的管理，負責採取行動。民間協會、原住民和地方社區，以及私人部門在政策執行上有很多機會可成為積極的參與者。

自然資源暨環境部設有國家生物多樣性委員會（National Biodiversity Council），是最高的決策單位，下設有整合平臺，包括國家指導次委員會（National Steering Committee）、州指導次委員會（State Steering Committee）、環境部長會議（Meeting of Ministers of the Environment）、國家生物多樣性圓桌（National Biodiversity Roundtable）。這些平臺各有不同功能，共同協助政策執行和監測，使合作協力最大化，並減少衝突。

國家指導次委員會是生物多樣性國家政策的主要整合平臺，其設有多個工作小組，協助政策執行，如社區為基礎的自然資源管理工作小組、生物多樣性研究工作小組。州指導次委員會是州級的執行生物多樣性政策的主要整合平臺。環境部長會議提供各州環境部長，以及環境和生物多樣性執行委員會人員的資訊整合和分享的平臺。國家生物多樣性圓桌由民間協會和私人部門主導，提供技術意見和協助予自然資源暨環境部和國家指導次委員會。

監測政策的執行是非常重要的工作。自然資源暨環境部主司該業務，國家生物多樣性委員會和國家指導次委員會則負責細節。每一執行階段的末期，自然資源暨環境部將檢視政策的執行情形，並發表報告。

## 海洋生態系

馬國專屬經濟海域和被公認為全球生物多樣性最高的珊瑚大三角重疊。因此馬國海洋及海岸地區的生物多樣性豐富，包括紅樹林、珊瑚和海藻床等。紅樹林遍布馬國海岸線，面積544,032公頃，是許多魚類哺育和攝食的場所，和重要經濟魚類和蝦類的棲息地。馬國有5處紅樹林被列為拉姆薩爾濕地（Ramsar sites），包括全世界公認管理最佳的Matang Mangrove Forest Reserve。

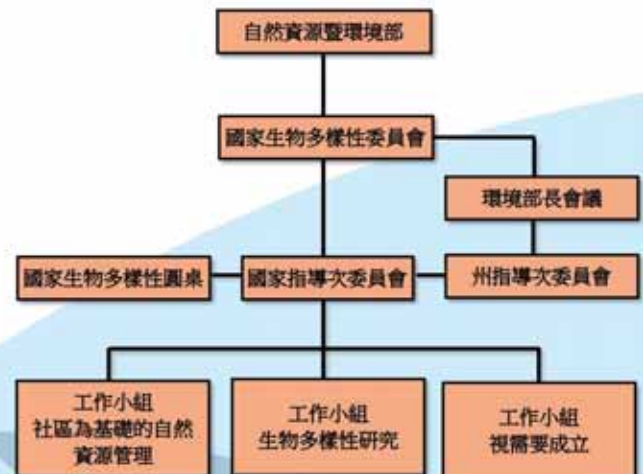


圖1/生物多樣性國家政策執行架構圖

資料來源/陳璋玲重製於生物多樣性國家政策 2016-2025 [1]



珊瑚礁主要分布在沙巴（Sabah）和馬來西亞半島東部的淺水區域。在沙巴和砂拉越（Sarawak）的珊瑚生物多樣性最高，估計約有550種珊瑚，而馬國半島則約有480種珊瑚。珊瑚礁生態系統服務價值估計每年達450億美元。海藻床是重要的海洋棲息地，估計約100種魚類和20種蝦類生活於此，為哺育、攝食和生產的場所，對於已瀕臨危險的儒艮和海龜的生存更是重要。

此外，馬國是4種海龜的築巢地，包括綠蠵龜（Green）、玳瑁（Hawksbill）、橄欖蠵龜（Olive Ridley）和棱皮龜（Leatherback）。棱皮龜曾是旅遊的吸引焦點，但因人民過度取獲龜卵，使得該物種數量大量減少，已被認為滅絕。目前保育工作主要致力於其他3個物種海龜能成功築巢。

## 海洋保護區

馬國海域面積453,186平方公里，其中1.4%為海洋保護區，包括海洋公園（marine parks）、海龜庇護區（turtle sanctuaries）、禁止捕魚區（fisheries prohibited areas）。目前有47座海洋公園，合計總面積為456,336公頃；14個海龜庇護區和禁止捕魚區，合計面積為207,723公頃。其中，西巴丹海洋公園（Pulau Sipadan Park）是世界最佳潛水地點之一。

西巴丹位於沙巴東部外海，面積只12公頃，是馬國唯一的大洋性島嶼，從海底上升約600公尺。該島嶼海洋生態豐富，有70多類的硬珊瑚和軟珊瑚，以及3,000多種魚類，生物多樣和澳洲大堡礁相似[2]。每年吸引許多潛水客。由於遊客造成陸域和海域生態破壞，馬國於2004年關閉島上所有渡假村，將其移至鄰近的馬布島（Mabul），2008年實施潛水許可制，一天只允許120名潛水客，2019年4月起增加至每天176名。另自2020年起，每年11月期間禁止所有遊客[3]。



圖說／西巴丹島潛水地點

圖片來源／<http://www.sabahparks.org.my/index.php/the-parks/sipadan-island-park> [4]

## 結論

生物多樣性國家政策（2016-2025）彰顯馬國保護陸域和海洋生物多樣性的決心與行動。馬國訂定許多有關漁業、水污染、保護區、壓艙水等管理措施，顯示海洋生態多樣性保護係跨部門合作，可作為我國推動海洋生態保育之參考。

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# 從馬來西亞案例省思臺灣藍色經濟之路

編撰／鍾政棋（國立臺灣海洋大學航運管理學系特聘教授兼任海洋觀光管理學士學位學程主任）  
 廖于晴、劉孟潔、黃琪涵、邱俊堯、許照雋（國立臺灣海洋大學航運管理研究所碩士生）  
 關鍵字／永續性、藍色經濟、海洋政策、海上運輸

全球人口不斷增加，面臨資源逐漸短缺、環境污染以及氣候變遷等危機，如何創造永續資源實須超前思考的重要議題。全球經貿及科技發展之推動，海洋資源成為公私部門利益關係人的優先考量。追求產業發展之同時，如何兼顧環境保護與永續資源，確實不容吾人忽視。藍色經濟（Blue economy）概念係指永續經營的海洋經濟，以經濟收益最大化及環境負擔最小化，並強調人類活動和海洋的調和與共生[1]。

## 藍色經濟的定義及課題

藍色經濟係循環經濟模式，不僅重視保育亦強調再生，不留任何廢料或造成能源耗損，以有限資源創造優質社會，讓地球生態取得零廢氣環境，以達永續利用與零排放之目標[2]。根據聯合國貿易發展委員會文獻指出，藍色經濟為改善人類福祉和社會公平，同時減少環境風險和生態災難的海洋經濟[3]。世界銀行則定義為可持續利用海洋資源，促進經濟增長，改善生計及就業，同時保持海洋生態系統之健康[4]。

由於利益關係人之偏好，藍色經濟的解釋常偏重於特定利益，甚而引發衝突問題。藍色經濟須經利益關係人進行跨國界及跨部門之合作，以貫徹保護世界海洋資源之念想[5]，透過各項評估設立目標加以實踐。將海洋價值納入經濟活動面向，藉藍色經濟策略使海洋產業的收益增加且成本減少。藍色經濟的目標及目的，如表1所示。

表1／藍色經濟的目標及目的

關鍵課題	目標及目的
經濟之成長	就業情況、國民生計、平均薪資成長、善用再生資源、藍色經濟所生利益，以實現海洋空間規劃（MSP）
環境永續性	環境與自然資源的保護與恢復力、減緩氣候變遷，與維護大眾的健康與福祉
社會包容性	食安問題、縮小貧富差距、社區參與、包容性、小型漁業（SSF）的適應力
政府管理機制	創立協調與整合計畫、監督機制及具彈性與適應性高的夥伴關係
科技研發能力	海上安全、海上科技研發、投資、融資

資料來源／Johnstone and Vaghefi (2019) [1]



可知藍色經濟包含「經濟之成長、環境永續性、社會包容性、政府管理機制、科技研發能力」等關鍵課題。

## 藍色經濟的機會及挑戰

在實施藍色經濟過程，有賴海洋產業提供資料，以探求對收益、人民福利、生態系統的潛在貢獻，此將影響藍色經濟受益計算，甚至產業不被規劃於藍色經濟策略[1]。足見，將藍色經濟進行協調、規劃與整合實乃關鍵因素。現階段許多國家已構建藍色經濟部門，將職責整合於政府機構中，以協調部門間的規劃項目。

隨著環保意識興起，人們逐漸意識到海洋面臨的壓力日增，瞭解海洋對人類福祉之重要性，加強對海洋之關注，制定海洋永續性政策。因藍色經濟實施，不論海上或岸上，亦不論規模大小，皆應遵循藍色經濟概念，不僅有助於公私部門實踐結果之評估，且有助審視海洋永續發展要素之缺失，進而改進發展模式以解決海洋問題[6]。

## 馬來西亞藍色經濟產業

發展藍色經濟之利益，馬來西亞檳城地理位置優越，擁有豐富水資源，創造就業機會，提供穩定糧食，改善居民生計[1]。有關檳城藍色經濟的替代及新興產業，如表2所示。

表2／檳城藍色經濟的替代及新興產業

現有產業	替代及新興產業
漁業 水產養殖 海鮮食品加工 航運 港區作業 海洋及沿海旅遊 海洋研發 海洋製造（如船舶或食品） 海事工程建設	可恢復的小型漁業 永續性水產養殖 生態旅遊 海上運輸 安全與監控 再生能源／藍色能源 高科技海事服務 生物科技／產品

資料來源／Johnstone and Vaghefi (2019) [1]

由表2可知，邁向藍色經濟，必須對經濟、社會、環境、技術進行投資，使小型企業獲得更多發展機會；根據Johnstone and Vaghefi (2019) [1]研究主張：

- 一、可恢復的小型漁業：小型漁業係檳城漁業之核心，攸關漁業永續性及漁民之生計；能為糧食安全有所貢獻，與沒落漁村合作以延續社會文化。
- 二、永續性水產養殖：人類食用魚貨，來自小型漁業及水產養殖業，可提供低廉、營養、高品質水產食品，不僅提升經濟利益，亦減少漁獲捕撈。
- 三、生態旅遊：旅遊業帶來就業機會及經濟成長，端賴環境品質優劣。透過藍色經濟使生態系統受重視，有助於旅遊業多樣化，亦減少生態旅遊對環境衝擊。



圖1/海上運輸 圖片提供/鍾政棋



圖2/海洋科技

圖片來源/林宥勝提供（左）、Flickr-Courtesy of Officers and Crew of NOAA Ship PISCES（右）

- 四、海上運輸：全球經貿約90%透過海洋運輸。馬來西亞將貨物主要輸往東亞市場，因緊鄰印度洋有望成為魚類出口國。檳城係輸往印尼、泰國、馬來西亞運輸樞紐，透過鏈結而受益。
- 五、安全與監控：近年來，港口、離岸設施與船舶之安全挑戰日益提升，將危及船員、船舶、貨物、海洋生物等，因此須不同藍色經濟利益關係人共同制定新法規並執行，以阻止各種威脅與犯罪活動。
- 六、再生能源／藍色能源：隨著能源消耗持續攀升，檳城具有發展再生能源潛力，如太陽能、風能及潮汐能等，藉海流與波浪能提供持續性能源。
- 七、高科技與海洋生技服務：生物資源開發因海洋環境而開創新領域，從開發化學藥品至個人護理產品，如海洋物種製作化妝品、營養品、止痛藥等。



## 臺灣藍色經濟發展省思

臺灣於2018年成立海洋事務專責機關「海洋委員會」，設置海巡署、海洋保育署及國家海洋研究院，形成執法、保育及研究3大支柱。建議臺灣邁向藍色經濟發展面向如下：

### 一、人才培育

整合公私部門教研資源，共同培育海洋產業開發人才。為培育離岸風電產業所需人才，臺灣海洋大學與萬濠船舶管理公司於2020年10月簽署合作，提供獎助學金及實務見習機會，為公私部門共同合作培育人才的最佳實例。

### 二、海上運輸

臺灣地理位置優越，但天然資源缺乏；不但有利基且須發展航運事業。不論散裝航運或貨櫃航運服務，國人擁有船噸均名列前茅。面對全球激烈的航運市場，為提升營運競爭力，有賴政府政策支持，並重視海洋環境污染規範，以健全航運產業發展。

### 三、海洋科技

我國擁有豐富的海洋資源及優良生技研究基礎，具有海洋生物資源開發潛力。海洋科技產業已開發離岸風電及海洋深層水，可研擬發展波浪能、洋流發電及深海資源探勘[7]。

### 四、海洋觀光

臺灣海岸地形特殊，具有多元海洋文化資源，乃發展海洋觀光的有利條件。近年郵輪產業興起，應改善碼頭硬體設施，轉型為客運碼頭及親水空間；推行有利郵輪產業政策，放寬通關檢疫及旅遊簽證限制，增進郵輪航商來臺意願[8]。

### 五、海洋漁業

漁業為我國重要的海洋產業，受海洋氣候變遷、漁業資源過度開發等原因，致良好競爭條件與生態環境不再。應加強漁業執法，檢討漁業補貼政策措施，發展海洋牧場減少漁獲捕撈[9]。



圖3／海洋觀光

圖片來源／neufal54 from Pixabay（左）、海大帆船隊提供（右）

## 結語

地球暖化嚴重且資源短缺，各國積極投入海洋資源開發及利用。追求海洋經濟發展，同時應兼顧社會及環境保護。藍色經濟利益，馬來西亞檳城之產業，可作為臺灣策略發展之借鏡。我國擁有豐富的海洋資源，對藍色經濟發展，應建立公私部門緊密合作，培育海洋產業科技人才，發展高端智慧海洋運輸，投入替代能源科技研發，促進郵輪遊艇觀光產業，以及解決漁獲資源枯竭問題。

藍色經濟已邁入實踐及探索階段，各國紛紛提出海洋發展策略及計畫，惟充分瞭解及保護海洋係人類持續使用海洋資源之先決條件。期許各國增加國際人才、技術、資訊之交流，研究人類和氣候對海洋生態系統之影響，加強海洋環境管理，共同承擔全球責任，攜手打造對海洋環境友善的世界。

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# 馬來西亞海洋政策及業務執行機關介紹

撰文／黃釋緯（台灣經濟研究院副研究員）

陳璋玲（國立成功大學海洋科技與事務研究所教授）

洪承豐（台灣經濟研究院助理研究員）

關鍵字／海洋治理、海洋政策、主權、永續發展、馬來西亞

馬來西亞位於東南亞要衝，西控制麻六甲海峽，東與南中國海接壤，並與新加坡與印尼隔水相連，馬來西亞海岸線長達4,809公里，約為臺灣海岸線長度3倍，島嶼多達879個。大部分沿海地區為平原，其中西馬海岸線長度將近2,608公里，東馬海岸線長達2,607公里，沿海資源豐富，擁有豐富的自然生物多樣性。沿海地區為社會經濟活動的重要區域，各種行業在此發展，如農業、漁業、水產養殖、石油和天然氣開採，也有運輸、旅遊、郵輪、娛樂等功能。無論從地理、經濟、或是歷史發展來看，馬來西亞為重要的海洋國家，其生活與經濟生產活動均與海洋緊密相連[1]。



圖1／馬來西亞位處麻六甲海峽地理位置

圖片來源／維基百科

[https://en.wikipedia.org/wiki/File:Strait\\_of\\_malacca.jpg](https://en.wikipedia.org/wiki/File:Strait_of_malacca.jpg)

## 海洋業務執行機關多 資訊共享是重點

馬來西亞之海洋政策與法規散於各個政府機關，各機關依法定職權訂定法規或政策以實施特定事務之管理。各機關的管理權責似有重疊或衝突的現象（如海洋公園與石油開採），易產生管理上問題，包括多用途使用衝突、管轄重疊和競合、工作重複等。因此，相關海洋機關間的橫向聯繫和協調，以及資訊流通共享極為重要，如此才能有效地推展海洋治理。

馬來西亞聯邦政府設有多個政府單位，分別負責漁業、海洋公園（農業部）；航運、港口（交通部）；海上執法、搜救、海事安全（海域執法署）、海洋觀光（旅遊促進局）；氣候變遷、廢棄物、能源等科技研究（科學、科技、氣候變遷及環境部）；海軍（國防部）；海洋科學研究（國家海洋局）；海洋政策研究（海事研究所）；環境監測、自然環境和多樣性保護（環境局）[2]。

馬來西亞之海洋治理有十數個管理項目措施，分別由11個主管部會（交通部管理港口、運輸、燈塔，亦管理與海相關之林業及野生動物），各部會轄下又有30多個機關及單位為海洋事務主管機關[3]，詳如下表1。各海洋事務政府機關，原則上係各部會依其法定職權及通過的年度預算執行業務。政府機關的預算每年編列，由聯邦政府提交國會審查通過後，作為各部會的下年度經費，以從事職掌的工作項目。部會除有既定的常態工作外，有時基於國家對某特定業務的發展需求（如增強海域執法能力），事涉相關的部會亦會合作研提計畫或政策，並以特定編列預算執行此項工作。

表1 / 馬來西亞海洋管理及主管機關

管理項目	主管機關
港口	交通部 國際貿易與工業部
運輸	
燈塔	
非生物資源	科技部
生物資源、漁業	農業部
林業	自然資源暨環境部 交通部
野生動物	
管轄權、執法	內政部／國防部
旅遊	文化、藝術與旅遊部
文化遺址	
電信	通信與多媒體部
教育	教育部
貿易與服務	經濟部
爭議處理	司法機關

資料來源／Hisham Omar et al. (2015) [3]

## 確保主權與永續發展為海洋政策核心

馬來西亞擁有廣大海域及其豐富資源，因此承擔龐大的責任管理和處理所轄海域的各項海洋事務與議題，尤其是確保海洋領土的主權完整性，以及海洋資源的永續發展。海洋在馬來西亞占有相當大的戰略利益，因此需要特別重視海洋事務管理。馬來西亞海域面積大，有時須和鄰國競爭或共同使用海洋資源，包括動物、植物、運輸，還有海域開發使用，如娛樂區域、科學研究及礦物和碳氫化合物開採。鑑此，馬來西亞的海洋政策涵蓋面向多元，目前推動的海洋政策主要有4大類：政經策略、教育策略、生態保育策略，以及環境保護策略。政經策略包括打擊走私和非法偷渡政策、藍色經濟政策、



南海政策、海洋軍事發展與鄰國的國際合作政策、船艦現代化政策；教育策略包括海洋教育政策；生態保育策略主要包括設立海洋公園；環境保護策略包括海洋污染防治政策、海岸防護政策、船舶氣體排放政策。

### 一、打擊走私、非法偷渡政策

馬來西亞透過巨龍行動計畫（Operation Dragon）打擊走私等活動、捍衛國家水域安全，其主辦單位為海域執法署（MMEA）、海洋警察部隊、皇家海軍、農業部聯手。

### 二、藍色經濟政策

馬來西亞在藍色經濟概念下，選取既有之海洋重點發展產業，盤點各產業發展所面臨問題，並研擬後續產業發展規劃建議，確立藍色經濟發展的核心，例如於2018年推出一套海洋經濟活動之全面計畫，如水產捕撈與養殖、港埠管理、海運管理等，並針對整體性問題進行後續討論與規劃。

### 三、南海政策

為解決與應對各國在南海爭議之議題，成立了南海潛在衝突管理委員會，並參與南海國際研討會，該研討會自1990年開始辦理，以開拓中國、臺灣與東南亞國協間的合作，並蒐集南海各種摩擦或潛在問題。

### 四、海洋軍事發展與鄰國國際合作政策

除重視海洋軍事發展外，近年來馬來西亞亦積極推動與鄰國進行軍事合作，如馬菲之間在蘇祿海（Sulu Sea）進行漁業、海軍、海域警衛隊等合作，特別針對犯罪類型如：人質、搶劫、毒品走私、武器販運、海上寶藏盜竊、非法捕撈、環境污染等活動作常規演習。

### 五、船艦現代化政策

馬來西亞透過現代化計畫，於1980年代中期之馬來西亞計畫（1986-1990）中列入創建潛艦兵力，於1990年代雖因財政問題暫停，並於2000年5月重啟潛艦需求之初步研究，隔年由馬來西亞國防部成立潛艇研究小組並進行前置作業。在2008年全球金融風暴後，馬國在軍購上轉為謹慎，許多計畫都尚未付諸實行，例如懸缺已經10年的兩棲船艦。儘管財務困難，2015年海軍提出重大的「15-5」計畫。15是指馬國海軍現有15種船艦，過於多元導致後勤的困難，故企圖簡化為5種。

### 六、海洋教育政策

馬來西亞積極進行國內之海洋教育宣導，尤其著重國內學術研究與區域安全相關倡議與研究等，此外值得一提的是，在主權活動方面，馬來西亞也同時著重向下紮根的學校教育，透過共同推動之政府機關包括：皇家空軍、警察之海事團隊、皇家海關、海事處及空中小組等，執行及演練所有國家海事法律，對學生進行海洋教育。

### 七、海洋保育政策

為保護海洋自然資源和生物多樣性，設置海洋保護區並立法管制，馬來西亞聯邦法和州法或條例皆有管理規定。在馬來西亞宣布的第一個海洋保護區是1974年沙巴的Tunku Abdul Rahman公園，人為威脅、生物多樣性保護等為設置海洋保護區的標準之一。如依據1985年漁業法案，Rantau Abang被宣布為漁業禁區，以保護海龜數量及登陸區，特別是針對瀕危的巨型棱皮龜。大多數海洋保護區都對公眾開放，享受和欣賞大自然的遺產，並訂定相關規則和條例，以確保資源的保護。

## 八、海洋污染防治政策

根據2015年科學雜誌 (Science Magazine) 研究指出，馬來西亞是全球塑膠廢棄物排名第8的國家，5大塑膠污染國依序分別為中國、印尼、菲律賓、泰國和越南。上述5國皆在亞洲且部分領土與馬來西亞交界，塑膠廢物傳播無國界，必然增加馬來西亞海洋中塑膠垃圾之問題。巨大的漂浮塑膠可能只占海洋中塑膠垃圾的5%，其餘可能在水下持續破壞海洋生態系統並扼殺海洋生物，同時大量的塑膠被分解成細小微粒，最終因食物鏈落到人類的餐盤上，因此馬來西亞相關政策主要在海洋塑膠污染問題之因應，以解決海洋垃圾問題。沿海垃圾造成的污染不僅對海灘和沿海地區的美學產生負面影響，而且還對全球經濟產生負面影響。



圖2／從Kota Kinabalu City海岸可看到Tunku Abdul Rahman中的3個島嶼

圖片來源／Wikimedia Commons (CC BY 3.0)

<https://en.wikipedia.org/wiki/File:KKseaisland.jpg>

## 九、海岸防護政策

馬來西亞政府於1984年至1985年啟動國家沿海侵蝕研究，並成為全國重大關注的問題，由總理辦公室的環境和自然資源司 (Environmental and Natural Resources Unit) 負責，該項研究為長期規劃，目的是為防止海岸侵蝕提出建議，並於1987年成立兩個與沿海地區管理有關的重要機關並進行後續政策推動，分別為沿海工程技術中心 (CETC) 和國家沿海侵蝕控制委員會 (NCECC) 。

表2／馬來西亞海洋政策

政策類別	政策
政治經濟	打擊走私和非法偷渡政策
	藍色經濟政策
	南海政策
	海洋軍事發展與鄰國的國際合作政策
教育	海洋教育政策
生態保育	海洋保育政策
環境保護	海洋污染防治政策
	海岸防護政策
	船舶氣體排放政策

資料來源／黃釋緯等人 (2019) [4]



## 十、船舶氣體排放政策

國際海事組織有關減少船舶排放二氧化硫（SO<sub>x</sub>）係依據2005年生效的《國際防止船舶污染公約》（MARPOL）附件六（Annex VI）。最近的排放規定是，自2020年1月1日起，在指定排放控制區（designated emission control areas, DESC）以外航行的船舶所使用的燃油中的硫含量需降低至0.5%，以維護港口和沿海地區居民之健康。

綜理上述政策，可歸納為海洋政策可分為政經策略、教育研發、生態保育及環境保護等4個面向，整理如表2。

## 海洋治理有賴完善的法規制度

馬來西亞海洋事務相關的法規大致可分6大類：海域管轄權法規、漁業管理法規、航運管理法規、環境保護法規、生態保育法規及海事安全法規。海域管轄權法規包括訂定領海法、專屬經濟海域法、海域區域基線法、大陸礁層法。漁業管理法規主要是漁業法及其配套之法規。關於航運管理法規主要在沿海、邊境或內陸口岸執行進出郵寄物品、貨物、旅客行李、貨幣、金銀、證券和運輸工具進行監管檢查、徵收關稅，並執行查禁走私等任務。環境保護法規主要在預防、減少和控制污染和改善環境。生態保育法規主要在保護野生動物、設立國家公園或海洋公園、防止海龜干擾規則及禁止捕獵海龜及其他海洋生物等。海事安全法規主要在確保海事安全、預防與打擊海上犯罪及進行海上搜救等行動[5]。

隨著氣候變遷、海洋污染、棲地破壞及海洋垃圾等問題受到國際社群重視，馬來西亞民間的非政府機構亦逐漸關心海洋相關議題，並採取行動。例如每年參與ICC淨灘活動；致力珊瑚礁、海龜保育與研究的珊瑚礁觀測協會、亞丁加奴大學海龜研究所、海龜保護協會；投入棲地與海洋生物保育工作的馬來西亞世界自然基金會；推廣生態旅遊的大自然協會—海洋愛好組、生態旅遊與保護等。

馬來西亞在海洋治理上，重點包括海事安全與執法、海軍船艦現代化、南海石油天然氣開採、海洋觀光遊憩、海洋保護區、和南海周邊國家的合作互動、參與國際組織等。雖然每個國家有其面臨的海洋事務議題，但基於海洋議題有許多共通性。馬來西亞在對外的海洋事務上，非常重視南海油氣田開採和海事安全策略。以上是馬國的重要經濟命脈，可看出馬國對多元的海洋事務上，有其優先重點的考量，在多元的海洋事務議題中，哪些是攸關國家重大利益，唯有成本效益才是政策規劃的重點。

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# 馬來西亞海洋熱能轉換技術

撰文／吳俊毅（國立臺灣海洋大學機械與機電工程學系助理教授）

關鍵字／海洋熱能、溫差發電

面對國際政經情勢快速變遷以及能源、環境、經濟發展間如何平衡的挑戰，各國均將能源轉型視為下世代發展的重要關鍵，能源將為直接影響各國經濟發展的重要因素，綠能科技亦成為國家創造新興產業與綠色就業的重要引擎，能源與綠能科技已成為全球共同關注的課題。

臺灣自產能源相當匱乏，能源供給高度依賴進口，易受到國際能源情勢動盪與能源價格波動所影響，為了降低進口能源依賴並提升能源自主及多元，臺灣積極開發推動離岸風電等海洋綠能科技[1]。同時世界先進國家為因應能源短缺與環境問題，大力投入各式再生能源的研發並加速邁入能源轉型。全球工業界也提高再生能源的使用比例以減少碳足跡。這些新的改變，帶動綠能科技及再生能源產業躍升。臺灣積極研發綠能科技並推動綠能建設，通過新的法案，例如「綠能科技產業創新推動方案」，以及完成「能源發展綱領」修正，成功以政策與法令引導推動綠能科技產業，成為能源轉型及驅動經濟發展的新引擎。在面對未來更多的挑戰，如何借鏡鄰國的發展計畫，運用臺灣固有特色，將可幫助臺灣在世界綠能發展上占有一席之地[2]。

馬來西亞位於熱帶地區，溫暖的氣候並面對資源充沛的南海（圖1），造就了馬來西亞發展海洋溫差發電的動力[3]。馬來西亞近年來投入海洋能源研究，積極地朝海洋溫差發電前進[4][5]。

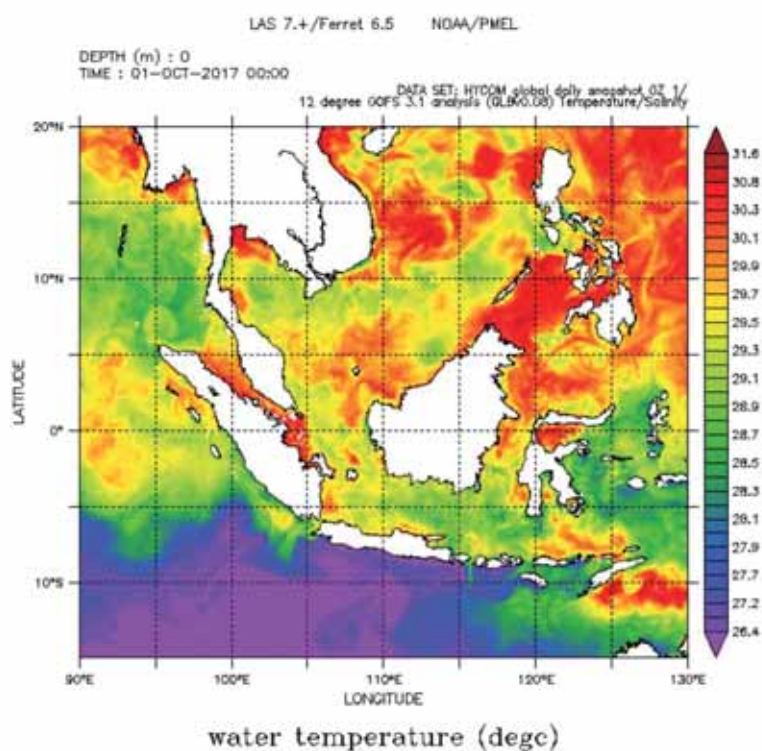


圖1／2017/10/01 00:00 馬來西亞海域海水溫度，馬來西亞附近海域仍有約30°C  
圖片來源／<http://apdrc.soest.hawaii.edu/data/data.php>



## 海洋溫差發電

地球表面約有70%的面積被海洋覆蓋，當太陽持續地將熱能傳達到地球，表層海水有效的吸收並儲存太陽的能量，使海洋成為最大的天然集熱器。在熱帶地區，表層海水日夜經年溫度可穩定達到28°C以上。來自熱帶地區的溫暖海水，也向兩極流動後產生了密度高且溫度低的冰冷海水，這股冰冷海水沿著海洋底部流向熱帶地區，海洋深層海水是終年維持低溫且安定的水塊，鮮少因為外在環境影響而變動。在全球大部分的地區，1,000公尺深的海水溫度常年維持約5°C。在熱帶與亞熱帶地區表層的暖海水與深層的冷海水溫差大，具開發海洋溫差發電之潛力（圖2）。

熱能是再生能源領域重要的研究課題，在許多研究報告都指出，海洋溫差發電具有極大的潛力，尤其是熱帶與亞熱帶許多國家與研究機構，都投入相當的資源在這個領域當中，目前美國、日本、韓國都建構了海洋溫差發電廠。

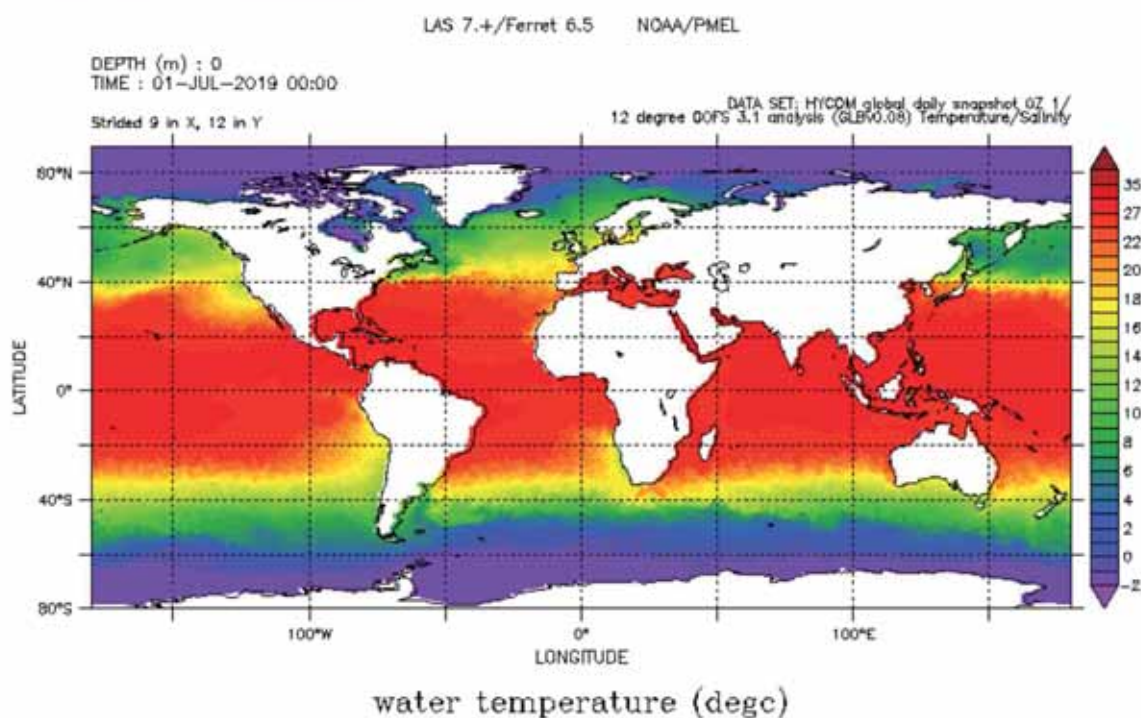


圖2/2019/07/01 00:00，全球海洋溫度，可見熱帶與亞熱帶地區海水表面溫度高，具開發海洋溫差發電之潛力

圖片來源/<http://apdrc.soest.hawaii.edu/data/data.php>

## 海洋溫差發電的種類

海洋溫差發電與火力發電廠的原理類似。首先利用溫度較高的表層海水，將低沸點的工作流體蒸發氣化，利用此蒸氣推動渦輪發電機；氣化的蒸氣再利用低溫的深層海水冷凝而回歸液態。周而復始的工作。目前有封閉式循環系統、開放式循環系統、混合式循環系統等，其中以封閉式循環系統技術較成熟。而在地點的設置上，則有陸基式、陸棚式和浮臺式差別。

封閉式海洋溫差發電，是使用低沸點的工作流體來驅動渦輪機發電，海洋表層溫暖的海水透過熱交換器以蒸發工作流體，汽化後的工作流體轉動渦輪機後，再經由深層海洋水冷凝成液體，這樣即完成一個完整的循環（圖3）。

開放式海洋溫差發電（圖4），是將溫暖表層海水抽入低壓艙內使之氣化，此氣體將推動渦輪機發電，並利用深層海洋水使此氣體冷凝液化，由於氣化的氣體已去除鹽分，故冷凝之液體可作為多方面的應用。

混合式海洋溫差發電，結合了前述兩種溫差發電的特性，循環開始時類似開放式循環，將溫暖的表層海水引進真空艙內使其氣化成水蒸氣，水蒸氣再進入氨蒸發器，氣化工作流體來轉動渦輪機發電，因此一般認為混合式循環兼具開放式循環與封閉式循環兩者的特性。

然而閉迴路與混合系統，均有可能使用氨氣作為工作流體，而氨在中等濃度下是有毒的。由於海洋溫差發電長期處於較嚴苛的自然環境（例如鹽分與濕度）當中，有毒流體外洩的風險高，例如金屬管路因鏽蝕而造成有毒流體外洩，影響環境之風險，是海洋溫差發電必須面對的課題。

## 世界海洋溫差發電的現況

在30年代，第一座海洋溫差發電場在加勒比海建成，由於當時技術的限制，世界第一座海洋溫差發電廠並未能成功發電而產出負功率。一直到70年代，第一座海洋溫差發電場才正式成功輸出電能。目前已有數個國家以海洋溫差進行發電，例如美國夏威夷，以及比臺灣更高緯度的日本久米島和韓國。海洋溫差發電通常也與其他產業結合，例如海水淡化、空調、水產養殖、海洋深層水等產業。據工研院調查，臺灣東岸有數個理想的海洋溫差發電潛力場址，例如南澳、和平、七星潭、石梯、樟原、金崙、綠島、蘭嶼等地。海洋溫差發電場需抽取深層海水，臺灣東岸多處水深1,000公尺離岸距離僅約為10公里內，這種得天獨厚的地形可減少工程難度，使得臺灣發展海洋溫差發電深具潛力。

## 臺灣海洋溫差發電的現況

目前臺灣海洋能發展的主軸以西部位於臺灣海峽的離岸風電為主，然而臺灣四面環海，海洋能蘊藏豐富，東部海域有黑潮流經，海域終年表層海水溫度達 $24^{\circ}\text{C}$ 以上，且東海岸大陸棚陡峭，離岸約3、4公里深度即可達1,000公尺，而海水溫度則低至約 $5^{\circ}\text{C}$ 。臺灣擁有全球最適合發展海洋溫差發電的地理環境之一，有效開發可提升電力安全，開創海洋綠能產業。從80年代起經濟部能源局與台電公司和工研院等單位，已陸續完成多項海洋溫差發電相關研究計畫。

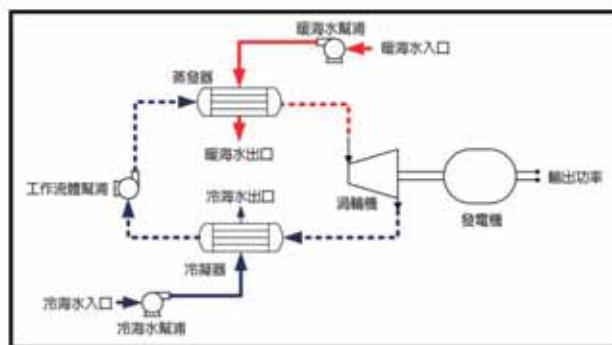


圖3/封閉式海洋溫差發電工作原理示意圖  
圖片來源/Azhim et al. (2013) [6]

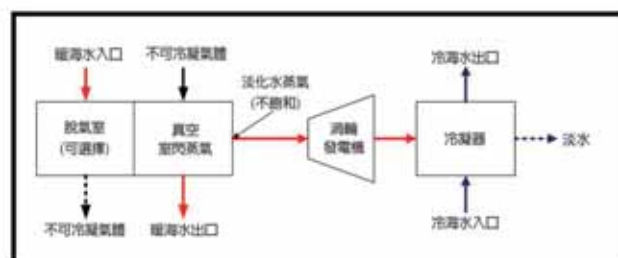


圖4/開放式海洋溫差發電工作原理示意圖  
圖片來源/Azhim et al. (2013) [6]



## 馬來西亞海洋溫差發電之發展與現況

馬來西亞位處熱帶地區，表層海水終年可穩定達到 $28^{\circ}\text{C}$ 以上，據資料顯示，馬來西亞周邊約13萬平方公里的海域深度達700公尺以上，此深度所達之溫差具潛在能源以 $800\text{kW}/\text{km}^2$ 計算，預估海洋溫差發電總含量約100,000MW，馬來西亞海洋溫差發電可行地點，多為南海與周邊。例如南沙海槽深度達1,000公尺以上，即為馬來西亞積極研究的海洋溫差發電場域之一，現有研究報告評估馬來西亞附近數個場域可能具有海洋溫差發電潛力，例如彈丸礁（馬來文稱為Pulau Layang-Layang）、瓜拉峇蘭（Kuala Baram）、卡蘭邦島（Pulau Kalumpang）、瓜拉班尤（Kuala Penyu）等地。

彈丸礁為南沙群島的一個環形珊瑚礁，彈丸礁是潛水勝地，礁上有馬來西亞海軍基地、渡假村、潛水學校、機場等設施，目前提出的是浮動型的海洋溫差發電場。預估距礁緣1.5公里處，底層海水溫度可達 $5^{\circ}\text{C}$ 。

瓜拉峇蘭位於砂拉越州，靠近婆羅洲汶萊邊界。這個區域有石油與天然氣等天然資源。目前提出以陸基型固定式的海洋溫差發電場。由於離深水區較遠，冷水管的長度須達約28公里。此長度之冷水管將會是一個必須被克服的技術挑戰。

馬來西亞科技大學（Universiti Teknologi Malaysia, UTM）為馬來西亞推動海洋溫差發電之重要學術機構，該校海洋熱能研究中心（Ocean Thermal Energy Centre - UTM-OTEC）積極投入此領域。該中心已與日本佐賀大學海洋能源中心（Institute of Ocean Energy of Saga University）簽署共同研究書，將共同研發實驗用之不銹鋼熱交換器的混合型系統。他們也將研究新型3千瓦渦輪發電機組、奈米級工作流體、取用海水中之eDNA以及研究如何提高高價值海產品與產量[7]。

## 世界與馬來西亞有關海洋溫差發電之相關法規

世界各國均曾經針對海洋溫差發電而研擬相關法案，美國透過立法賦予了美國國家海洋暨大氣總署（National Oceanic and Atmospheric Administration, NOAA）在海洋能源管理上之法源依據。美國國家海洋暨大氣總署有權限負責授權海洋溫差發電場。美國眾議院於1980年通過了《海洋溫差發電法案》，用以規範海洋溫差發電場位於美國海岸之選址、建設和運行等相關規定，並提供一定程度的財務協助，以推動海洋溫差發電。另一個正式的法案為美國卡特總統簽署的《海洋溫差發電研究、開發和示範法案》。

目前在馬來西亞法律系統當中，《馬來西亞憲法》已清楚規範所有有關能源相關的管轄權隸屬於聯邦層級而非地方權限，因此馬來西亞議會擁有制定馬來西亞全國能源相關法律。馬來西亞《2011年再生能源法案》列舉了數種再生能源，並未將海洋溫差發電列於其中，海洋溫差發電或可廣義歸納於熱能發電並受到此再生能源法案規範[8]。

馬來西亞宣告200海哩專屬經濟海域，並制定了專屬經濟區法案和大陸棚架法案等數個法案，期能建立馬來西亞對海洋資源的勘探、開發、管理和養護的法源依據，尤其是馬來西亞發展海洋溫差發電其中重點區域為南沙海槽、南海一帶。這些法案，或可在一定程度上適用於馬來西亞海洋溫差發電相關事宜。

## 馬來西亞海洋溫差發電之未來

馬來西亞研究機構UTM-OTEC與日本的研究機構佐賀大學海洋能源中心將合作進行海洋溫差發電、渦輪發電機組、奈米級工作流體、取用海水中之eDNA以及如何提升高價值海產品與產量等相關議題之研究。相信馬來西亞未來更可利用海洋溫差發電的獨特性—擁有大量的低溫深層水，進行更多元的利用，例如：1.原水利用：利用深層水具有低溫性、潔淨性、富礦物質等特性，可以進行養殖冷水魚類、種原培育、種苗繁殖、溫控農業等低溫原水應用於農漁相關產業；2.分水利用：也可以將深層水進行分水成原水、淡水、礦物質水等類，可做為包裝飲用水、飲料、酒類、食品、海水療、醫療、化妝品等相關產業；3.二次能源利用：利用海洋深層水，促進藻類生長，並利用藻類產出生質能；4.空調利用：發電過後的海洋深層水仍具低溫特性，可用於需要冷卻之建築物或工廠，或是需溫控之農業[9]。

## 結論

臺灣不僅東部海域深具發展海洋溫差發電之潛力，南海海域也深具海洋溫差發電的潛力。臺灣東岸所產生的電，將可直接納入電網以供使用；南海所擷取的海洋溫差電能，可利用氫能運回臺灣使用。馬來西亞積極投入海洋能源開發，臺灣擁有更多自然條件，相信若能將資源投入海洋溫差發電產業，將可開發更多的可能性。

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# 馬來西亞海域執法機關與海域法規

撰文／曾煥昇（國立臺灣海洋大學環境生物與漁業科學學系助理教授）

關鍵字／馬來西亞、海域執法署、聯合國海洋法公約、海域法規

馬來西亞對海洋資源極為重視，於1994年簽署1982年《聯合國海洋法公約》，1996年經國內程序批准及生效，長期以來即積極加強海洋管理。因此，瞭解馬來西亞的海域執法機關與相關執法作為，可提供臺灣借鏡，有助提升海洋政策。

## 前言

馬來西亞海岸線總長約4,809公里，並擁有418,000平方公里的專屬經濟區，而漁業資源是其動物蛋白主要來源，幾十年來一直發揮重要作用，根據2017年統計，該國漁業總產量為170萬噸，其中近150萬噸來自海洋捕撈[1]。可見海洋對馬來西亞的重要性，如何守護海洋資源也成為重要議題。

馬來西亞於2005年成立「海域執法署」（Malaysian Maritime Enforcement Agency, MMEA），亦稱之為「馬來西亞海巡署」（Malaysia Coast Guard），作為主要海域執法機關，專職海域執法及救難任務，此外，政府也陸續訂定相關海域法規，捍衛海域權利。

## 海域執法署（MMEA）—馬來西亞海域執法機關之主力

MMEA成立緣由係參考馬來西亞政府於1999年4月所進行的研究，該研究指出，馬來西亞海域執法成效不力是因參與機構過多，導致疊床架屋，及資源分配不當所致[2]。

在過去，原有隸屬於內政部皇家警察專職海域執法之「海洋警察部隊」，但政府為節省國家成本及顧及海洋專業化，於2004年5月國家安全委員會舉辦籌設專門海域執法機構可行性的國家會議，會議決議籌設海域執法專門機構。隨後於2004年7月1日公布《馬來西亞海事執法機構法》，並於2005年2月15日生效，同時將部分「海洋警察部隊」併入新機關MMEA，開始運作。MMEA原直接受馬來西亞總理指揮，2018年移入內政部。現行的海洋相關執行能量包含：MMEA、海軍、皇家關稅局、海洋警察部隊（圖1），在和平時期是海域執法機關，但於戰爭時期，則需支援空軍與海軍。

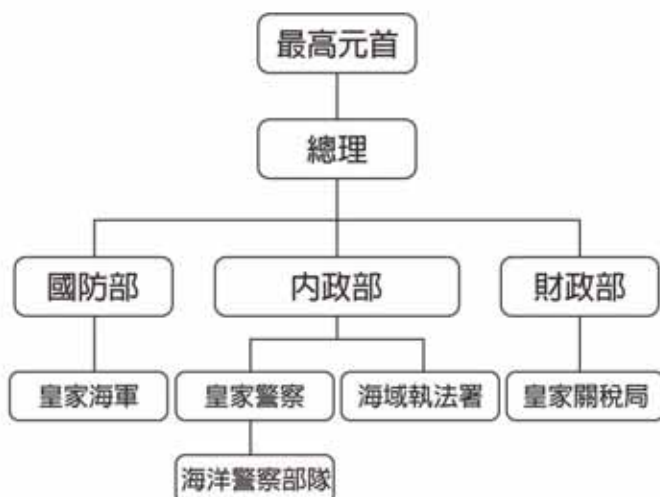


圖1／馬來西亞海域執法相關機關  
圖片來源／作者繪製

MMEA成立願景為「躋身世界最佳海事法律執行機關之列」，其目標是「確保馬來西亞『海事區』(Malaysian Maritime Zones, MMZ)的安全與保障，在海上執行法律、拯救生命及財產」[3]，所謂MMZ是指馬來西亞的水域，包含：領海、專屬經濟區、大陸礁層與漁業水域及其上空(圖2)。

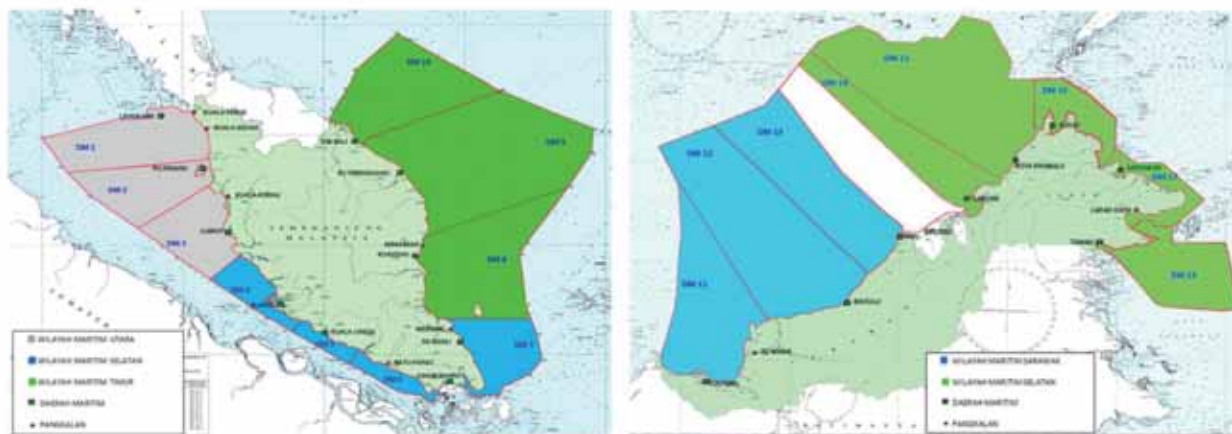


圖2／馬來西亞海事區 (MMZ)

圖片來源／馬來西亞海域執法署

<https://teisat.mmea.gov.my/eng/index.php/en/citizens-and-public/36-malaysian-maritime-zone>

有關MMEA的任務如下[4]：

- 一、根據任何馬來西亞法律執行法律及維持秩序。
- 二、進行海上搜救。
- 三、防止在馬來西亞海域的任何犯罪。
- 四、根據《2002年刑事事項互助法》(第621號法)的規定，在外國的請求下，提供任何刑事案件援助。
- 五、進行沿海及空中監控。
- 六、為相關機構提供服務及支援的平臺。
- 七、建立及管理海事培訓機構。
- 八、履行任何義務以確保海上安全與保障或及其有關的所有事項。
- 九、控制及防止海洋污染。
- 十、防止在公海非法交易及非法販運麻醉藥品。
- 十一、在特殊危機緊急情況或戰爭期間成為馬來西亞武裝部隊的戰力。

MMEA由海軍將領擔任指揮官，其他軍職人員亦由馬來西亞皇家海軍派任，MMEA亦設置「專屬特種部隊」(Special Tactical of Action and Rescue, STAR)，其任務是負責海域救難任務，並在國內河流與領海地區執行反恐行動。MMEA將海岸線至專屬經濟區分成5大區域：北部、南部、東部、沙巴地區與砂拉越地區，再細分成18個責任區(圖3)，MMEA以領海、專屬經濟海域為執法範圍，並對領海內海洋科學研究的建物與資源進行保護。

MMEA巡防艦艇執行海域搜救任務時，皇家海軍、警察、港務局、海關、漁業及消防等其他部門，也會支援MMEA巡防艦艇需求。在空中能量上，MMEA也有定翼機及直升機編制，陸海空三軍、皇家警察、民航機構及消防機關也可支援航空任務。





圖3／馬來西亞海域執法署責任區

圖片來源／馬來西亞海域執法署

<https://telsat.mmea.gov.my/eng/index.php/en/citizens-and-public/10-mmea-responsible-area>

為增強海域執法能量，MMEA在2015年增購6艘配有無人機設備的巡防艦[5]。此外，日本政府2016年9月承諾馬來西亞提供MMEA巡防艇，於2017年上半年交付，以對抗中國在馬來西亞海域軍事活動[6][7]。MMEA於2020年2月也採購直升機，加強保護馬來西亞水域安全[8]。

MMEA也經常與周邊國家進行合作演練，MMEA與泰國皇家海軍每年會舉行2次海事演習，演習的重點海域是馬來西亞和泰國之間的水域邊界，主要目的是預防海盜及海上搶劫等，發展兩國之間良好關係與合作。MMEA與菲律賓海岸防衛隊也會進行年度演練，重點區域是在這兩國的海上邊界。MMEA與印尼政府海事局及漁業局的演練區域則著重在麻六甲海峽，進行預防武器及毒品的走私[9]。

## 馬來西亞主要海域法規

馬來西亞於1996年10月14日批准《聯合國海洋法公約》（以下簡稱《公約》），並於1996年11月14日生效，此後，陸續依《公約》制（訂）定或修正相關法律。馬來西亞主張並劃定海域包含：內水、領海、專屬經濟區、大陸礁層及漁業水域，同時作為MMEA執法範圍。

### 一、內水及領海

馬來西亞2006年制定《海區基線法》，確定基點的地理坐標，各基點所連成的線，即為基線，基線向陸一側的海域則為內水[10]。依《2012年領海法》規定，馬來西亞領海寬度為基線外側12浬，鄰近沙巴及砂拉越的部分領海範圍不超過3浬[11]。

### 二、專屬經濟區

馬來西亞早在1980年即宣布200浬專屬經濟區，並享有勘探、開發、養護與管理海床、底土及其上層水域的自然資源，及保護海洋環境的管轄權。馬來西亞1984年制定《第311號專屬經濟海域法》，規範漁業、保護與保存海洋環境、海洋科學研究、人工島礁、設施與構築物、海底電纜及管道等事項。該法也針對防止海洋污染進行規範，依該法第10條規定，若任何油、含油混合物或污染物從任何船舶、陸地來源、設施、裝置或飛行器，由空中或藉由傾倒排放或流入專屬經濟海域等，均屬違法，且將處以最高100萬元馬幣（約新臺幣580萬元）之罰鍰[12]。

### 三、大陸礁層

馬來西亞早於1966年即通過《大陸礁層法》主張大陸礁層相關權利，以利開發近海石油和天然氣資源[13]，該法配合《公約》已於2009年修正，希望依《公約》擴大享有對大陸邊緣外緣的主權權利，因沿海國可被允許行使距基線最長350浬或距2,500公尺等深線以下之100浬的大陸礁層權利[14]。

### 四、馬來西亞漁業水域

馬來西亞也於1985年制定《漁業法》，確保漁業水域中的海洋、河口漁業養護、管理及發展。此外，相關機關可以建立海岸公園與海洋保護區，以加強對水生動植物的保護並促進科學研究，規範部分地區的娛樂活動和其他活動，以避免對環境造成不可逆轉的破壞。當發生犯罪時，授權官員應採取執法措施，例如：扣押船隻、漁獲、設備或逮捕等。

《漁業法》規範對象包含本國人及外國人，如果船舶是外國漁船，或者人員是外國國民違反《漁業法》，即屬犯罪行為，對船東或船長，每人處以不超過100萬元馬幣的罰款，對每位船員而言，處以10萬元馬幣（約新臺幣58萬元）的罰款，處較重之處罰[15]。

### 結語

MMEA的執法能量包含巡防艦艇及航空器，大大提升海空立體執法的效能。此外，馬來西亞因位居麻六甲海峽，尚存在海盜威脅，所以MMEA每年會定期與周邊各國進行執法演習，目的就是為了嚇阻違法情事發生，也促進與他國執法機關合作機會。

馬來西亞擁有豐富石油資源，很早即宣布主張大陸礁層的主權權利。此外，漁業及環境資源對馬來西亞亦極為重要，因此，藉由相關法律進行管理措施。如外國漁船於馬來西亞水域違反《漁業法》，最重可處100萬元馬幣，嚇阻外國船舶在其管轄海域非法進行漁撈活動，對漁業資源進行保護。如於馬來西亞專屬經濟區發生油污染，即違反《第311號專屬經濟海域法》，最重可處100萬元馬幣，確保其海洋環境。

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## Continuing to Salute to the Seas in the Year of Renewed Confidence and Strength

Translated by Linguitronics

Minister of the Ocean Affairs Council: Chung-Wei Lee

Achieving balance between the environment and the economy and sustainably managing the oceans are issues that the entire global community needs to face. Malaysia, located in Southeast Asia, is rich in marine resources and is of great reference value in terms of its marine strategies and industries. In this issue, therefore, Malaysia is taken as an example with "International Issues" introducing Malaysia's National Policy on Biological Diversity 2016-2025 which declares the government's determination and action taken to protect land and marine biodiversity. Furthermore, "Industry Dynamics" shares the case of Malaysia's blue economy, while "Latest News" introduces Malaysia's active development of ocean thermal energy conversion, a policy that can serve as a reference for the marine resource development strategy of Taiwan. As ocean governance is predicated upon sound legislative and regulatory planning, this issue also unveils Malaysia's commitment to diverse maritime development and maritime law enforcement from the perspectives of ocean policy and maritime law enforcement.

Taiwan started promoting the "Salute to the Seas" policy in 2020 and began to plan for active opening, effective management, and diversified use of marine resources so that even as we open up the ocean, balancing marine recreation and safety remains the first priority. With the Taiwan Open of Surfing that takes place in JinJun, Taitung, as an example, this issue's "Special Report" introduces various dynamic information services that utilize marine environmental monitoring technology to support marine recreational activities, demonstrating how marine scientific information can be applied and innovated to facilitate the vibrant development of marine recreational activities, thereby contributing to the positive cycle of growth for Taiwan's marine recreational industry.

Looking forward to 2021, the Ocean Affairs Council will continue to implement the six policy objectives of the "National Ocean Policy White Paper" (2020), and remain committed to carrying out tasks in nine major aspects including strengthening the maritime legal system. It will also take the initiative to perform important work pertinent to the "Salute to the Seas" policy so that, under the vision of "sustainability", "marine security", and "industrial prosperity", Taiwan's maritime development will flourish and the goal of becoming a sustainable maritime nation is realized at the earliest time possible.



Lionfish in the waters of Pulau Layang-Layang (in Malay), Malaysia  
Image by Arnhue Tan from Pixabay  
<https://pixabay.com/photos/lionfish-scuba-diving-underwater-1430225/>



## Innovative Trials of Information Service for Marine Recreation ~ An example on the Taiwan Open of Surfing

Jian-Wu Lai (Research Fellow, Marine Industry and Engineering Research Center, National Academy of Marine Research)

Jian-Ming Liao (Research Fellow and Director, Marine Industry and Engineering Research Center, National Academy of Marine Research)

Pei-Hung Chen (Assistant Research Fellow, Marine Industry and Engineering Research Center, National Academy of Marine Research)

Keywords: Marine information services, Marine recreational activities, Safety risk assessment of recreational sea, Salute to the Seas

The purpose of this article is to report that the National Academy of Marine Research (NAMR), in conjunction with the Taitung County Government who held the Taiwan Open of Surfing in November 2020, is experimenting with the use of marine environment monitoring technology to support marine recreational activities on the JinJun Coast, and to kick off a forward-looking infrastructure project in tribute to the sea with a "dynamic information system for the safety of marine recreational activities. We hope to use technology to bring us closer to the ocean.



Figure 1/ Five principles and its specific strategies of the "Salute to the Seas" policy  
Source/ Redrawn in accordance with the OAC Policy Briefing

Following the successful experience of "Salute to the Mountains", the Executive Yuan is planning to promote "Salute to the Seas" in 2020, encouraging people to "know the ocean", "close the ocean" and "into the ocean", so that we can enjoy the beauty of the mountains and the ocean. In order to implement the "Salute to the Seas" policy, and in accordance with the five principles of "openness, transparency, service, education, and responsibility" revealed by the Executive Yuan. The Ocean Affairs Council has coordinated with relevant sea-related ministries and commissions to jointly plan various administrative actions to actively open, effectively manage, and diversify the use of marine resources to ensure the sustainable development of the ocean.

On December, 2020, the Ministry of Science and Technology (MOST) held the "Scientific Development Strategy Consultation Meeting" to draw up a blueprint for future scientific research and development, with a view to developing "people-oriented" science and technology, strengthening exploratory scientific research and developing emerging technologies through open innovation and alliances and collaborations, nurturing high-quality high-level talents, and strengthening the research and innovation ecosystem.



After the release of the open ocean message, the first issue that has aroused widespread concern is safety. In the records of the seminars held by the Marine Council in various counties and cities, it can be found that the management of recreational activities in the waters and the conflict over the use of sea space are often the most heated topics of discussion. Therefore, it is important to draw up concrete action plans to improve our relationship with the ocean, guided by the five principles of the Seaward Tribute Policy and its strategies.

As reported by Chen et al. (2020) [1], modernized maritime countries have made active efforts in recent years to integrate information that is important for water safety, such as beach hazard classification and beach safety information network. In the past two years, the Ocean Affairs Council and its NAMR have been actively exploring the environmental risk factors of various recreational activities in our ocean through the integration of marine environmental information, cross-disciplinary data collection, and stakeholder interviews in order to identify recreational risks and improve coastal management strategies in our ocean.

### Progress in the designation of recreational risks in the sea in recent years

For example, in 2019, the environmental threshold values of low, medium, and high recreation risk levels were established to link various recreational activities with marine environmental factors for risk assessment [2]. Based on this, the risk classification of 57 coastal seas in the country for various types of recreational activities will be evaluated in 2020. For example, in Table 1, the risk classification results of the four townships of Beinan, Donghe, Chenggong, and Changbin in Taitung are evaluated as high risk for surfing and wind surfing activities during the winter monsoon period (October to March) [3].

Such classification results are subtle in relation to the International Surfing Competition held in November every year in JinJun, Taitung. This also highlights the fact that the results of such work, although providing more academic criteria for analysis of recreational activities and safety management measures in the sea, are based on the assumptions that 1. the risk tolerance of the majority of the population is assessed, regardless of individual differences; 2. historical data are compiled on a monthly basis and the dynamic variances in the marine and atmospheric environment are not considered. Therefore, it is the core spirit of the project "Dynamic Information System for the Safety of Recreational Activities in the Ocean" hosted by NAMR to provide the participants of marine recreational activities and sea area management units with the destructive and innovative marine information services they need in the context of people-oriented and dynamic changes in the ocean.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Activities												
Swim												
Surfing												
Diving												
Windsurfing												
water ski												
Parasailing												
Jet ski												
Kayaking												
Banana boat												
Rubber boat												
Floating tire												
Kite surfing												
SUP												
Fishing												

Table 1/ Results of the risk classification of various marine recreational activities in the northern waters of Taitung County

Red: High risk

Yellow: Medium risk

Green: Low risk

Source/ NAMR (2020) [3]

## New state of the art of dynamic environments information service for the marine recreational activities

In recent years, with the government's efforts to promote marine sports, the development of marine sports has been booming. However, these marine sports usually generate behaviors through marine water, environmental or climatic factors, so many studies have been conducted in the past to investigate the causality and interaction between the two [4][5][6][7][8][9][10][11][12].

Taking surfing as an example, Walker (1974) proposed recreational surf parameters [4], and Jackson et al. (2001) [8], understanding that the skill level of the surfer and the safety needs of all surf consumers also have a significant impact on the surfing experience, further proposed a classification of surfing ability and the relationship between wave height ( $H_b$ ), wave direction ( $\alpha$ ) and wave travel speed ( $V_s$ ) was further proposed as shown in Table 2. Subsequently, Scarfe et al. (2003) went further with the title "The Science of Surfing Waves and Surfing Breaks" [11], hoping to convey the basic knowledge of surf science to surfers and non-surfing coastal planners, scientists and engineers.

In the past 10 years, the Taiwan Open of Surfing, an international surfing event hosted by the Taitung County Government at the JinJun Fishing Port in Donghe Township, has brought the surfing culture and international popularity of Taiwan to a new era.

Wave params. Surfers' skill	$H_b$ (m)	$\alpha$ (deg)	$V_s$ (m/s)
Beginners	<1.2	60~90	<3.0
Intermediate	<2.5	60	<7.5
Experienced	<8.0	>30	<12.0

Table 2/ The relationship between surfers' skill level and wave parameters  
Source/ Adapted from Jackson et al. (2001) [8]

The 10th Taiwan Open of Surfing was held from November 18 to 22, 2020. The NAMR and the Taitung County Government cooperated to set up a high-resolution X-Band wave observation system in the JinJun beach during the event (Figure 2). The system also integrated the prediction information of the Central Weather Bureau and the NAMR, and provided the surfers and the organizers with the information of the surfing environment in an easy-to-understand graphical interface (Figure 3). This time, with reference to the description of wave conditions by surfing experts and communities, the traditional marine science description of the marine environment was translated into a dynamic information service as below:



Figure 2/ Temporary wave/current monitoring system at JinJun Beach  
Image by Jian-Wu Lai





Figure 3/ Environmental Information Service for the Taiwan Open of Surfing  
Image by National Academy of Marine Research

## I. Wave Information

Surfers lie on the surfboard and wait for a suitable wave for the challenge. In order to provide surfers with useful information about the marine environment, the authors find out corresponding information from the perspective of marine science, which includes wave height, period, direction, energy, uniformity of the swell, as well as tide, sea temperature and bottom topography, bed characteristics, etc. Since waves suitable for surfing are usually longer period swells, wave information for this activity is mainly based on X-Band wave current radar information from the temporary measuring station in JinJun and WaveWatch wind and wave model operated by the NAMR. The correlation between relevant information and surfing is explained as below.

Swell is especially preferred by surfer, because swell is the wave caused by the wind field in the remote area, which has the characteristics of longer wavelength, smoother waveform, faster transmission speed and long transmission distance. There is a wave quality assessment index (Surf Quality Index), the surfer believe that if the wave height exceeds 0.9 meters, this index indicates the impact of various periods of waves on the surfing experience, i.e., period 6-8 seconds belongs to "Average surf condition", period 8-10 seconds belongs to "Go for it", and period 10-12 seconds belongs to "Wax up", and period longer than 13 seconds is classified as "Epic session", this indicator highlights the surfer's pursuit of long wave/swell.

As for how to collect long wave information by observation, the NAMR operated an ocean radar to measure the roughness of the sea surface remotely for the wave information service at the JinJun surf site. The wave age criterion proposed by Hanson and Philips (2001) [13] was used to separate long waves from wind waves in the directional spectrum of the sea surface echo signals, so as to provide the swell information of most interest to surfers, including wave height, period and direction. It is worth mentioning that this kind of information can be further combined with the topographic characteristics of regional water depth to develop into a part of the coastal long wave warning mechanism.

## II. Meteorological information

Surfing is a recreational activity on the surface of the sea, and how surfers find the best balance on the board is also influenced by the wind speed and direction. The meteorological information for this event was mainly obtained from the integrated meteorological observatory at the temporary station in JinJun and the WRF weather research and forecasting model operated by the Central Weather Bureau.



The wave quality for surfers also depends on the speed and direction of the wind. When the wind blows from the shore to the ocean, the wind inhibits the speed of wave breakup and makes them sharper, which is the wind preferred by surfers. On the contrary, winds blowing from the ocean to the shore accelerate wave breakup and are less preferred by surfers. Of course, wind speed is the key to wave shape. Strong winds can change wave conditions quickly, generally from 4m/s to 8m/s or more, resulting in confusing wave conditions.

### III. Information Simplification and Translation

During the event, we explained the content of the information and conducted questionnaires for the observers, athletes and event organizers. 252 valid questionnaires were received, and the demand for information on the marine environment was fully responded. We can find that the direct provision of ocean observation data is a cognitive barrier for non-marine science users, especially for beginners. In the future, we will classify the waves according to their energy, frequency and direction, and concentration, and provide information to surfers with different skill by green, yellow and red lights for their reference.

### Conclusion

The Executive Yuan is promoting the policy of "Salute to the Seas", and the relevant departments are integrating information on all of the country's beaches, establishing risk classification, and building a one-stop service information platform for marine recreational activities in order to enhance the safety of our beaches. This will increase visitors' understanding of potential risks in the sea and help them to take appropriate measures when they encounter dangerous situations.

While encouraging the public to get closer to the ocean, we are not only improving coastal management strategies, but also actively working towards helping the public and related industries to understand the ocean, and strengthening innovative services to facilitate the flourishing of marine recreational activities, enhance the strength of our country in international sporting events, which in turn will drive the development of sports tourism, service industries and related peripheral industries, and promote the positive cycle of marine recreational activities in our country.

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# Moving Toward a New Age of Biodiversity: Malaysia's National Policy on Biological Diversity 2016-2025

Chung-Ling Chen (Professor, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University)

Chien-Ho Liu (PhD candidate, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University)

Keywords: Malaysian, biodiversity, marine ecological protection

National Policy on Biological Diversity 2016-2025 is a national document dedicated to protect terrestrial and marine ecological environments. The leading agency in charge of this Policy is the Ministry of Natural Resources and Environment (NRE). It specifies five principles, five goals, 17 targets and numerous actions and measures. It details the implementation framework which involves the establishment of various coordinating platforms at the federal and state levels. To ensure effective implementation of this Policy, the NRE reviews the progress periodically and publish reports.

## Introduction

Malaysia, a country of Southeast Asia, lying just north of the Equator, is composed of two noncontiguous regions: Peninsular Malaysia (also called West Malaysia) and East Malaysia, which is on the island of Borneo. The climate is subtropical rainforest. The total land area is 330,345 square kilometers, including the area of 879 outlying islands. The length of the coastline is 4,809 kilometers and the sea area is 453,186 square kilometers. Malaysia has rich terrestrial and marine ecosystems. To date, there are an estimated 15,000 species of vascular plants, 307 known species of mammals, including at least 30 that are endemic to Malaysia, 785 species of birds, 242 species of amphibians, 567 species of reptiles and a total of 2,068 species of freshwater and marine fishes. The rich biodiversity constitutes an extraordinary natural capital that gives Malaysians food, water and numerous economic benefits.

The first National Policy on Biological Diversity was formulated in 1998. Since then, the nation has undergone significant population increase and social-economic changes; the population has increased from 23 million in 1998 to 30 million in 2015; the per capita GDP and country's exports have tripled and grown seven folds, respectively. Following housing and industrial areas, townships and infrastructure having been built, the country's transition to become a developed, high-income nation has exerted enormous pressure on biodiversity, leaving many species vulnerable with some facing threats of extinction.

Habitat fragmentation, invasive alien species, pollution, poaching, increasing competition for land as well as climate change all pose threats to biodiversity. Furthermore, there is a general lack of awareness on importance of biodiversity throughout the country as well as significant knowledge gaps. There are also weaknesses in management capacities and shortage of funding – both which are crucial to ensure that Malaysia's biodiversity is effectively conserved. Therefore, following the 1998 Policy, the National Policy on Biological Diversity 2016-2025 (hereafter the Policy) provides the direction and framework to conserve biodiversity and use it sustainably in the face of the increasingly complex challenges. (Most of the content relating to the National Policy on Biological Diversity 2016-2025 is excerpted from [1].)

## Principles, Goals and Targets

The Policy states that Malaysia is committed to conserve its biological diversity, promote its sustainable use and endure the fair and equitable sharing of benefits arising from the utilization of biological resources. It has five principles, five goals and 17 targets. Each target comes with corresponding actions and measures. The targets will be achieved by 2025.

### I. Principles

#### Principle 1: Heritage

- Biological diversity is a national heritage. It must be sustainably managed, wisely utilized and conserved for future generations.

#### Principle 2: Precautionary

- The lack of full scientific certainty should not be used as a reason to postpone measures to minimize biodiversity loss.

#### Principles 3: Shared responsibility

- The conservation and sustainable utilization of biodiversity are the shared responsibility of all sectors of society.

#### Principle 4: Participatory

- Planning and management of biodiversity must be carried out in a participatory manner.

#### Principle 5: Good governance

- Good governance, including accountability and transparency, is crucial to biodiversity conservation.

### II. Goals and Targets

Goal 1: We have empowered and harnessed the commitment of all stakeholders to conserve biodiversity.

- Target 1: More Malaysians are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
- Target 2: The contributions of indigenous peoples and local communities, civil society and the private sector to the conservation and sustainable utilization of biodiversity have increased significantly.

Goal 2: We have significantly reduced the direct and indirect pressures on biodiversity.

- Target 3: Biodiversity conservation has been mainstreamed into national development planning.
- Target 4: Production forests, agriculture production and fisheries are managed and harvested sustainably.
- Target 5: Tourism is sustainably managed and promotes biodiversity conservation.

Goal 3: We have safeguarded all our key ecosystems, species and genetic diversity.

- Target 6: At least 20% of terrestrial areas and inland waters, and 10% of coastal and marine areas, are conserved through a representative system of protected areas and other effective area-based conservation measures.
- Target 7: Vulnerable ecosystems and habitats, particularly limestone hills, wetlands, coral reefs and seagrass beds, are adequately protected and restored.



- Target 8: Important terrestrial and marine ecological corridors have been identified, resorted and protected.
- Target 9: The extinction of known threatened species has been prevented and their conservation status has been improved and sustained.
- Target 10: Poaching, illegal harvesting and illegal trade of wildlife, fish and plants are under control and significant reduced.
- Target 11: Invasive alien species and pathways are identified, priority species controlled and measures are in place to prevent their introduction and establishment.
- Target 12: A comprehensive biosafety system inclusive of a liability and redress regime is operational to manage potential adverse impacts of modern biotechnology on biodiversity and human health.
- Target 13: The genetic biodiversity of cultivated plants and farmed and domesticated animals and of wild relatives is adequately conserved.

Goal 4: We have ensured that the benefits from the utilization of biodiversity are shared equitably.

- Target 14: Malaysia has an operational access and benefit sharing (ABS) framework that is consistent with the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization.

Goal 5: We have improved the capacity, knowledge and skills of all stakeholders to conserve biodiversity.

- Target 15: Capacity for the implementation of the national biodiversity strategies, the CBD and other related Millennium Ecosystem Assessment (MEA) has significantly increased.
- Target 16: Knowledge and the science base relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are significantly improved and applied.
- Target 17: There is a significant increase in funds and resources mobilized for the conservation of biodiversity from both government and non-government sources.

### Measures of marine ecological protection

The Policy has 17 targets. Each target comes with a series of actions and measures. This section dwells on the measures related to marine ecological protection. They are presented below.

- Develop and implement community engagement programs that enable indigenous peoples and local communities living in marine and terrestrial protected areas and within buffer areas to be involved in biodiversity conservation.
- Reduce water pollution from various sources through the use of new technologies, increasing coordinated enforcement and by imposing deterrent penalties.
- Promote and provide incentives for fisheries certification, e.g., Marine Stewardship Council.
- Develop a program to control illegal, unreported and unregulated (IUU) fishing.
- Eliminate the use of detrimental fishing gear and enforce the use of Turtle Exclusion Devices (TED) to protect marine turtles.
- Formulate a program for strengthening the national MPA network with a focus on expanding the under-represented ecosystems, in particular coral reefs, seagrass beds and turtle nesting beaches.
- Establish new transboundary MPAs cooperation involving Indonesia, Brunei and the Philippines – giving priority to those critical for the success of the Coral Triangle Initiative (CTI).
- Formulate and implement management plans for all MPAs and fisheries prohibited areas (FAPs) to ensure reestablishment of targeted species population.



- Develop a complete spatial database of all terrestrial and marine protected areas – including information related to legal protected status, known threats to their biota, biodiversity and key ecosystem services.
- Identify, map and protect known migratory pathways of marine life.
- Implement provisions of the International Maritime Organization (IMO) Ballast Water Management Convention to safeguard against marine invasive species.
- Undertake a comprehensive review of all national and state legislation related to fisheries, marine parks and marine biodiversity including examination of the gaps and overlaps pertaining to jurisdiction over marine biodiversity and assess the feasibility of expanding the role/jurisdiction of the Department of Marine Park Malaysia.
- Undertake the national marine and freshwater life stocktaking survey encompassing detailed assessments of marine and freshwater resources.

### Implementation Framework

The Federal government via the Ministry on Natural Resources and Environment (NRE) is a leading role in implementing the Policy. This includes providing overall direction, coordinating stakeholder actions, establishing appropriate institutional platforms, facilitating resource mobilization and initiating review of the Policy. State governments have jurisdiction over the management of inter alia land, water and forests and play crucial roles in delivering the actions. There will be many opportunities for civil society, indigenous peoples and local communities, and private sectors to be active partners in the implementation of this Policy.

The National Biodiversity Council, under the auspice of the NRE, is the highest decision-making body, under which several other coordinating platforms are established. They include the National Steering Committee (NSC), the State Steering Committee (SSC), the Meeting of Ministers of the Environment (MEXCOE) and the National Biodiversity Roundtable (NBR). While these various platforms serve different functions, they collectively maximize synergies and reduce conflicts in implementing and monitoring the Policy.

The NSC is the primary coordinating platform, in which various working groups (WG) have been established to facilitate the implementation such as WG Community Based Natural Resources Management and WG Biodiversity Research. The SSC is the main coordinating platform at the state level for the implementation of the Policy. The MEXCOE is a coordinating and information-sharing platform for state ministers and state executive committee members responsible for environment and biodiversity. The NBR is led by civil society and the private sector and provides technical advice and supports to the NRE and the NSC in the implementation of the Policy.

Monitoring the implementation of the Policy is a crucial task. NRE is in charge of monitoring progress which is deliberated by the NSC and the NBC. NRE will review the actions of the Policy and publish reports on the implementation of the Policy at the end of each implementation phase.

### Marine ecosystems

Malaysia's Exclusive Economic Zone overlaps with the Coral Triangle area which is thought to have the greatest diversity of marine life in the world. Therefore, the marine and coastal areas are rich in biodiversity, including mangroves, corals and seagrass beds. The shoreline is rich with mangroves, which are feeding and nursery grounds for fisheries, as well as the habitats of several important commercial fishes and shrimps. The area is 544,032 ha. Five mangrove areas are designated as Ramsar sites. Among them, the Matang Mangrove Forest Reserve has been acknowledged as one of the best-managed mangrove ecosystems in the world.



Coral reefs are found in shallow marine waters, mostly in Sabah and along the east coast of Peninsular Malaysia. Coral diversity is highest in Sabah and Sarawak, which is estimated to have over 550 species while Peninsular Malaysia has over 480 species. The value of ecosystems services provided by coral reefs is estimated at USD\$45 billion every year. Seagrass beds are diverse marine habitats. Studies have shown that about 100 fish species and 20 prawn species are dependent on seagrass beds for nursing, feeding and breeding. They are crucial for the survival of the endangered dugong and sea turtles.

Besides, Malaysia is well-known for nesting grounds of four species of marine turtles: Green, Hawksbill, Olive Ridley and Leatherback turtles. In particular, Leatherbacks were once a prime tourist attraction. Now their numbers have declined significantly due to uncontrolled overharvesting of their eggs that they are considered to be extinct. Conservation efforts now focus on ensuring successfully nesting of the remaining three marine turtle species.

### Marine Protected Areas

Malaysian waters cover approximately 453,186 square meters, of which 1.4% is currently designated as marine protected areas (MPAs), including marine parks, turtle sanctuaries, fisheries prohibited areas. There are currently 47 marine parks with a total area of 456,336 ha, 14 turtle sanctuaries and fisheries prohibited areas covering a further 207,723 ha. Among them, Pulau Sipadan Park is one of the world's best diving spots.

Sipadan, a tiny coral island of just 12 ha, lying off the east coast of Sabah, is Malaysia's only oceanic island, rising 600 meters from the seabed. It features rich marine ecosystems. 70 genera of hard and soft corals and over 3,000 species of fish are recorded in its water, a diversity similar to Australia's Great Barrier Reef [2]. This tiny island attracts many divers annually. With the consequent destruction of terrestrial and marine environments brought about by tourists, Malaysia closed all resorts in 2004 and moved them to the nearby Mabul island. It further implemented a diving permit system in 2008, allowing only 120 divers per day and since April 2019 allowing 176 divers per day. Moreover, for one month, starting yearly from 1st till 30th November 2020, Sipadan is closed to all tourists [3].



Dive spots of Sipadan island

Source/ <http://www.sabahparks.org.my/index.php/the-parks/sipadan-island-park> [4]

### Conclusion

The Policy embodies Malaysia's commitment and action to protect terrestrial and marine biodiversity. It specifies several measures related to fisheries, water pollution, protected areas, and ballast water, etc. This shows the protection of marine biodiversity is inherently involves cross-sector cooperation, which can serve as a reference for our endeavors in promoting marine ecological protection.

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## The Blue Economic Way to Taiwan: Reflection from Malaysia's Case

Compiled by Cheng-Chi Chung (Distinguished Professor, Dept. of Shipping and Transportation Management, and Chairman of Bachelor Degree Program in Ocean Tourism Management, National Taiwan Ocean University); Yu-Ching Liao, Meng-Chieh Liu, Chi-Han Huang, Chun-Yao Chiu, Chao-Chun Hsu (Master Degree Student, Dept. of Shipping and Transportation Management, National Taiwan Ocean University)

Keywords: Sustainability, Blue Economy, Oceans Policy, Maritime Transport

As the global population continues to grow, the creation of sustainable resources is a crucial issue that must be considered in advance when facing crises in resource scarcity, environmental pollution, and climate change, etc. With global economic, trade and technological development, marine resources have become a priority for both public and private stakeholders. While pursuing industrial development, the preservation of the environment and sustainable resources should not be ignored. Thus, the concept of Blue Economy refers to a sustainable marine economy that maximizes economic benefits and minimizes environmental burdens, as well as emphasizing the harmony and coexistence of human activities and the ocean [1].

### The Definition and Issues of Blue Economy

The term "Blue Economy" refers to a circular economic model that emphasizes not only conservation but regeneration, leaving no waste or energy consumption. Its goal is to create an ideal society with limited resources and to achieve a zero-emissions environment for the earth's ecology, thereby achieving the goal of sustainable use and zero emissions [2]. A report from the UNCTAD defines "Blue Economy" as an ocean economy that improves human well-being and social equity while reducing environmental risks and ecological disasters [3]. The World Bank specifies it as the sustainable utilization of marine resources to promote economic growth, improve livelihoods and employment, along with maintaining the stability of marine ecosystems [4].

Due to the preference of stakeholders, the interpretation of Blue Economy is often biased towards specific interests, which may even lead to conflict issues. Therefore, it is committed to protecting the world's marine resources through cross-border and cross-sectoral cooperation among stakeholders [5], and be implemented through various evaluations and target-setting. By incorporating the value of the ocean into the economic activities, marine industry's benefits are increased and costs are reduced through the Blue Economy strategies. The goals and objectives of the Blue Economy are shown in Table 1.

Therefore, it is clear that the Blue Economy encompasses key issues including "economic growth, environmental sustainability, social inclusion, government and institutional mechanisms, and technical capacity."

### Opportunities and Challenges of Blue Economy

The implementation of the Blue Economy requires information from marine industries to explore their potential contribution to revenue, people's welfare, and ecosystems. This will affect the calculation of Blue Economy's benefits, even if the industries are excluded from the Blue Economy strategies [1].



Table 1/ Goals and Objectives of the Blue Economy

Theme	Goals and Objectives
Economic growth	Employment, livelihoods, income generation, resource utilization, blue growth, and marine spatial planning (MSP)
Environmental sustainability	Environmental protection and restoration, natural capital, climate change mitigation, and community health and well-being
Social inclusion	Food security, poverty alleviation, community engagement, inclusiveness, and resilient small-scale fisheries (SSF)
Governance and institutional mechanisms	Coordination, integrated planning, monitoring, and resilient partnership
Technical capacity	Maritime security, research and development (R&D), investment, and financing

Source/ Johnstone and Vaghefi (2019) [1]

Therefore, the coordination, planning and integration of the Blue Economy are the critical factors. Currently, many countries have already established Blue Economy departments, and integrated their responsibilities into government agencies to coordinate interdepartmental programs.

With the rise of environmental awareness, people are gradually concerned about the increasing pressure on the oceans and their importance to human well-being, thereby raising concerns for the oceans and developing policies for their sustainability. The implementation of Blue Economy should follow its sustainable concept, regardless of its scale, or whether at sea or onshore. This will not only contribute to the evaluation of the public and private sectors, but also assist in examining the deficiencies in the elements of sustainable development of the oceans; hence improve the developing model to solve ocean issues [6].

### Blue Economy in Malaysia

According to a research conducted in Malaysia, the benefits of developing a Blue Economy include Penang's advantageous location, abundant water resources, job creation, stable food supply, and improved livelihoods [1]. The alternative and emerging sectors of Penang' Blue Economy are illustrated in Table 2.

Table 2/ Blue Economy Key Sectors in Penang

Existing Sectors	Alternative and Emerging Sectors
Fisheries Aquaculture Seafood processing Shipping Port activities Marine and coastal tourism Marine R&D Marine manufacturing (e.g. boat & food) Marine construction	Resilient small-scale fisheries Sustainable aquaculture Ecotourism Maritime transport Safety and surveillance Renewable energy / blue energy High-tech marine services Biotechnology / bio-products

Source/ Johnstone and Vaghefi (2019) [1]

From Table 2, it is obvious that moving towards a Blue Economy requires investment in economic, social, environmental, and technological aspects, enabling small businesses to gain more development opportunities. The following are some descriptions of alternative and emerging sectors [1].





Figure 1/ Maritime Transport  
Image by Cheng-Chi Chung



Figure 2/ Marine Technology  
Image by Yu-Sheng Lin (left), Flickr-Courtesy of Officers and Crew of NOAA Ship PISCES (right)

- I. Resilient small-scale fisheries (SSF): Small-scale fisheries are at the heart of Penang's fisheries sector, which are vital to the sustainability of the sector and the livelihood of fishermen. It contributes to food security, and in partnership with isolated fishing villages to sustain the community culture.
- II. Sustainable aquaculture: Fish for human consumption from the small-scale fisheries and aquaculture sector can provide low cost, nutritious, high quality aquatic food, which not only enhances economic benefits but also reduces fish harvesting.
- III. Ecotourism: Tourism industry produces jobs and helps economic growth; it is also highly dependent on the environment quality. The importance of ecosystems through the Blue Economy will encourage tourism diversification and minimize the impact of eco-tourism on the environment.
- IV. Maritime transport: About 90% of global trades are transported by sea. Malaysia exports its goods mainly to East Asian markets, and is expected to be a fish exporter due to its close proximity to the Indian Ocean. Penang, as a transportation and logistics hub in the Indonesia-Thailand-Malaysia triangle, benefits from the connectivity.
- V. Safety and surveillance: In recent years, the security challenges of ports, offshore facilities and ships have increased, endangering the crew, ships, cargo, marine life, etc. Therefore, new regulations need to be developed and implemented by different Blue Economic stakeholders to stop various threats and criminal activities.





Figure 3/ Ocean Tourism  
Image by neufal54 from Pixabay (left), NTOU Sailing Team (right)

- VI. Renewable energy / blue energy: As energy consumption continues to climb, Penang possesses the potential to develop renewable energy sources, such as solar, wind, wave, and tidal energy, to provide sustainable energy through ocean currents and wave energy.
- VII. High-tech and biotech marine services: The marine environment offers a new frontier of biological resources to develop a range of products from pharmaceuticals and chemicals to personal care products, including cosmetics, dietary supplements, and painkillers made from marine species.

## Reflections on the Development of Blue Economy in Taiwan

Taiwan has established the Ocean Affairs Council in 2018, a specialized authority for ocean issues, and set up the Coast Guard Administration for law enforcement, the Ocean Conservation Administration for conservation and the National Academy of Marine Research for research. The development directions for Taiwan to move towards a blue economy are the following:

### I. Talent Cultivation

The public and private sectors integrate teaching and research resources to jointly cultivate talents for the development of the marine industry. Taiwan's offshore wind power industry currently requires insufficient talents. In order to cultivate offshore wind power talents, National Taiwan Ocean University and W&H Ship Management and Consulting Corporation signed a cooperation agreement in October 2020 to provide scholarships and practical internship opportunities, which is the best case of public-private cooperation in cultivating talents.

### II. Maritime Transport

Taiwan is strategically located, but lacks natural resources. It is not only advantageous but also essential to develop the shipping industry. In addition, regardless of bulk shipping or container shipping services, Taiwanese own the high rank of ship tonnages. In order to enhance the competitiveness of the operation in the fierce shipping market, it relies on the government's policy support and emphasis on the regulation of marine environmental pollution, so as to strengthen the development of the shipping industry.

### III. Marine Technology

Taiwan has rich marine resources and an excellent biotechnology research base, resulting in the potential for the development of marine biological resources. The marine technology industry has already explored offshore wind power and deep water. It is possible to develop wave energy, ocean current energy generation, and deep-sea resource exploitation [7].

#### IV. Ocean Tourism

The unique topography of Taiwan's coastline and its diverse marine cultural resources are favorable conditions for the development of ocean tourism. In recent years, the cruise industry has been on the rise. It is important to improve the hardware facilities of the terminal and transform it into a passenger terminal and water-friendly space. It should also implement policies beneficial to the cruise industry and deregulate the restrictions on customs clearance and tourist visas, to increase the willingness of cruise operators in visiting Taiwan [8].

#### V. Marine Fishery

The fishery is one of the major marine industries in Taiwan. However, due to marine climate change and overexploitation of fishery resources, good competitive conditions and ecological environment are no longer available. It is recommended to strengthen fisheries law enforcement, review fisheries subsidy policies and measures, and promote marine ranch to reduce fish harvesting [9].

### Concluding Remarks

With severe global warming and shortage of resources, countries are actively investing in the development and utilization of marine resources. The pursuit of marine economic development should be accompanied by social and environmental protection. Regarding the interests of Blue Economy, the industry in Penang, Malaysia can be a guideline for Taiwan's strategic development. In the development of the Blue Economy, close public-private cooperation should be established to nurture scientific and technological talents in the marine industry, to develop high-end intelligent marine transportation, to invest in research and development of alternative energy technologies, to promote the cruise and yacht tourism industries, and to eliminate the problem of depleted fishery resources.

The Blue Economy has entered the stage of practice and exploration. Several countries have proposed strategies and plans for marine development, but a full understanding and protection of the ocean is a prerequisite for the sustainable utilization of marine resources. It is expected to intensify the international exchange of talents, technology and information among countries. Through studying the impact of human and climate on the marine ecosystem, the management of the marine environment will be strengthened. Most of all, it is an imperative that all countries share the global responsibility to create a world with friendly marine environment.

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# Introduction to Malaysia's Ocean Policy and Maritime Administrative Agencies

Shi-Wei Huang (Associate Researcher, Taiwan Institute of Economic Research); Chung-Ling Chen (Professor, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University); Cheng-Li Hung (Assistant Research Fellow, Taiwan Institute of Economic Research)

Keywords: Ocean governance and policy, sovereignty, sustainable development, Malaysia

Malaysia is located at a key point in Southeast Asia, controlling the Strait of Malacca to the west, bordering the South China Sea to the east, and neighboring Singapore and Indonesia across the water. The Malaysian coastline is 4,809 kilometers long, about three times the length of Taiwan's coastline, and the nation's territory comprises as many as 879 islands. Most of the coastal areas are plains with the western coastline nearly 2,608 kilometers and the eastern coastline 2,607 kilometers long. The coastal resources are rich in natural biodiversity. Coastal areas are important regions for social and economic activities, such as agriculture, fishery, aquaculture, as well as oil and natural gas extraction. They also serve as premises for functions such as transportation, tourism, cruises, and entertainment. Whether from the perspective of geographical, economic, or historical development, Malaysia is an important maritime country, and its life and economic production activities are closely connected with the ocean [1].



Malaysia is geographically located in the Strait of Malacca  
Source/ Wikipedia  
[https://en.wikipedia.org/wiki/File:Strait\\_of\\_malacca.jpg](https://en.wikipedia.org/wiki/File:Strait_of_malacca.jpg)

## Information sharing is the focus when there are many marine administrative agencies

Malaysia's marine policies and regulations are implemented among various government agencies, and each agency has its powers and authorities to formulate regulations or policies to implement the management of specific affairs. The management powers and responsibilities of various agencies appear to overlap or conflict (such as ocean parks and oil exploration), which is prone to raise the management problems, including conflicts in use of multi-purpose facilities, overlapping jurisdictions and competition, and repetitive work. Therefore, horizontal contact and coordination between relevant maritime agencies as well as information circulation and sharing are extremely important, so that ocean governance can be effectively promoted.



The Federal Government of Malaysia has several government units responsible respectively for fisheries and marine parks (Ministry of Agriculture and Food Industries); maritime transportation and ports (Ministry of Transport); maritime law enforcement, search and rescue, maritime safety (Maritime Enforcement Agency), ocean tourism (Tourism Promotion Board); scientific research on climate change, waste, energy, etc. (Ministry of Energy, Science, Technology, Environment & Climate Change); navy (Ministry of Defense); marine scientific research (State Oceanic Administration); marine policy research (Maritime Institute of Malaysia); and environmental monitoring, natural environment, and diversity protection (Department of Environment) [2].

There are more than a dozen management projects and measures for ocean governance in Malaysia overseen by 11 competent ministries (the Ministry of Transport manages ports, transportation, lighthouses, and also manages forestry and wildlife related to the sea), and there are more than 30 agencies and units that are maritime affairs authorities under the ministries [3], as shown in Table 1 below. In principle, all marine affairs government agencies execute affairs in accordance with their statutory powers and approved annual budgets. The budgets of government agencies are compiled every year, and after the federal government submits them to the Parliament for review and approval, they will be used as the next year's funding for various ministries and committees to carry out their duties. In addition to the established regular tasks, sometimes based on the country's development needs for a specific business (such as enhancing maritime law enforcement capabilities), relevant ministries and committees will also cooperate in the development of plans or policies, and set a specific budget to perform this work.

Table 1/ Malaysia's Marine Management and Competent Authorities

Management item	Competent authority
Ports	Ministry of Transport Ministry of International Trade and Industry
Transportation	
Lighthouses	
Non-biological resources	Ministry of Science, Technology and Innovation
Biological resources, fisheries	Ministry of Agriculture and Food Industries
Forestry	Ministry of Energy and Natural Resources Ministry of Transport
Wildlife	
Jurisdiction, law enforcement	Ministry of Interior Ministry of Defense
Travel	Ministry of Tourism, Arts and Culture
Cultural sites	
Telecommunications	Ministry of Communications and Multimedia
Education	Ministry of Education
Trade and Services	Ministry of Economic Affairs
Dispute handling	Judicial agencies

Source/ Hisham Omar et al. (2015) [3]

### Ensuring sovereignty and sustainable development is the core of Malaysia's ocean policy

Malaysia has vast sea areas and abundant resources, and therefore assumes huge responsibilities in the management and handling of various maritime affairs and issues in the sea areas under its jurisdiction, especially to ensure the sovereign integrity of maritime territories and the sustainable development of marine resources. The ocean holds considerable strategic interests for Malaysia, therefore special



attention needs to be paid to ocean affairs management. Malaysia has a large sea area, and sometimes it has to compete with neighboring countries or jointly use marine resources, including animals, plants, transportation, and open use of sea areas, such as entertainment zones, scientific research, and mining of minerals and hydrocarbons. In view of this, Malaysia's maritime policy covers multiple aspects. The marine policies currently being promoted mainly fall into four categories: Political and economic strategies, education strategies, ecological conservation strategies, and environmental protection strategies. Political and economic strategies include anti-smuggling and illegal immigration policies, blue economic policies, South China Sea policies, maritime military development policies, international cooperation policies with neighboring countries, and vessel modernization policies. Educational strategies include marine education policies; ecological conservation strategies mainly include the establishment of marine parks; while environmental protection strategies include marine pollution prevention and control policies, coastal protection policies, and ship gas emission policies.

### **I. Anti-smuggling and illegal immigration policies**

Through Operation Dragon project, Malaysia combats smuggling and other activities to safeguard the security of its national waters. The implementation units of the operation are the Malaysian Maritime Enforcement Agency (MMEA), the Marine Police Force, the Royal Malaysian Navy, and the Ministry of Agriculture and Food Industries.

### **II. Blue economy policies**

Under the concept of blue economy, Malaysia selects key marine industries, focuses on the problems faced by the marine industries, and formulates follow-up industrial action plan and recommendations to establish the core capability of blue economy. In 2018, Malaysia launched a comprehensive plan for marine economic activities, such as aquatic fishing and aquaculture, port management, shipping management, etc., and will conduct follow-up discussions and planning on overall issues.

### **III. South China Sea policies**

In order to resolve and respond to the issues of disputes in the South China Sea, Malaysia established a committee on managing potential conflict in the South China Sea and participated in the South China Sea International Symposium, which has been held since 1990 to explore cooperation between China, Taiwan and the Association of Southeast Asian Nations, and collect information on various frictions or potential problems in the South China Sea.

### **IV. Marine military development policies and international cooperation policies with neighboring countries**

In addition to attaching importance to maritime military development, Malaysia has also been actively promoting military cooperation with neighboring countries in recent years, such as cooperation on fisheries, navy, and maritime guards with the Philippines in the Sulu Sea, and conduct regular exercises especially for crime types such as hostage taking, robbery, drug smuggling, arms trafficking, theft of treasures at sea, illegal fishing, environmental pollution, and other activities. After the global financial tsunami in 2008, Malaysia became cautious in defense procurement. Many plans have been pending, such as amphibious ships that have been suspended for almost ten years. Despite financial difficulties, the Navy proposed the 15-5 plan in 2015. The first 15 refers to the 15 types of ships currently in the Malaysian Navy, which are too diversified and cause logistical difficulties, so they tried to simplify them to 5 types.

### **V. Vessel modernization policies**

Malaysia's modernization plan included the creation of a submarine force as part of the Malaysian Plan in the mid-1980s (1986-1990). Although the plan was suspended due to financial problems in the 1990s, preliminary research on submarine demand was resumed in May 2000. The following year, the



Malaysian Ministry of Defense established a submarine research team and conducted preparatory operations.

## **VI. Marine Education Policies**

Malaysia actively promotes domestic maritime education, with particular emphasis on domestic academic research and regional security-related initiatives and research. In addition, it is worth mentioning that in terms of sovereignty activities, Malaysia also focuses on fundamental school education through the joint promotional efforts of government agencies including the Royal Malaysian Air Force, the Marine Police Force of the Royal Malaysia Police, Royal Malaysian Customs, the Marine Department and air team, etc., which are responsible for implementing and exercising all national maritime laws and provide maritime education to students.

## **VII. Ocean conservation policies**

In order to protect marine natural resources and biodiversity, set up marine protected areas and implement legislative control, Malaysian federal laws and state laws or regulations stipulate management regulations. After Malaysia declared the Tunku Abdul Rahman Park in Sabah as the country's first marine protected area in 1974, man-made threats and biodiversity protection have become the standards for establishing marine protected areas. For example, according to the Fisheries Act 1985, Rantau Abang was declared a fishery restricted area to protect sea turtle populations and landing areas, especially for endangered giant leatherback turtles. Most marine reserves are open for to the public to enjoy and appreciate the heritage of nature, and relevant rules and regulations have been formulated to ensure the protection of resources.

## **VIII. Marine pollution prevention and control policies**

According to a 2015 study published by Science Magazine, Malaysia ranks eighth in the world for plastic waste with the top five plastic pollutants being China, Indonesia, the Philippines, Thailand, and Vietnam. The above five countries are all in Asia and part of them are close to the territory of Malaysia. As the spread of plastic waste has no borders, this will inevitably increase the problem of plastic waste in the oceans of Malaysia. Huge floating plastic may only account for 5% of the plastic trash in the ocean, while the rest may continue to destroy the marine ecosystem and strangle marine life underwater. At the same time, a large amount of plastic is decomposed into fine particles, and eventually falls on human dinner plates due to the food chain. Therefore, the relevant policies of Malaysia mainly address the problem of marine plastic pollution to solve the problem of marine debris. The pollution caused by coastal garbage not only negatively affects the aesthetics of beaches and coastal areas, but also negatively affects the global economy.

## **IX. Coastal protection policies**

The Malaysian government initiated the national coastal erosion study from 1984 to 1985, a study that became a major national concern. The Environmental and Natural Resources Unit of the Prime Minister's Office is responsible for the study, the purpose of which is to make recommendations for long-term planning to prevent coastal erosion. In 1987, two important agencies related to coastal area management were established to follow-up on subsequent policy implementation, namely the Coastal Engineering Technology Center (CETC) and the National Coastal Erosion Control Committee (NCECC).

## **X. Ship gas emission policies**

The International Maritime Organization's initiative to reduce SOx emissions from ships is based on Annex VI of the "International Convention for the Prevention of Pollution from Ships" (MARPOL) that entered into force in 2005. The latest emission regulation is that starting from January 1, 2020, the sulfur content in fuel used by ships sailing outside of designated emission control areas (DESC) must be



reduced to 0.5% to maintain port environments and the health of residents in coastal areas.

In summary, the above policies can be summarized as marine policies that can be divided into four aspects: political and economic strategy, education research and development, ecological conservation and environmental protection [4].

### Ocean governance depends on comprehensive laws and regulations

The laws and regulations related to maritime affairs in Malaysia can be roughly divided into 6 categories: maritime jurisdiction regulations, fishery management regulations, shipping management regulations, environmental protection regulations, ecological conservation regulations, and maritime safety regulations. Maritime jurisdiction laws include the formulation of territorial sea law, exclusive economic sea area law, maritime zone baseline law, and continental shelf law. Fishery management regulations comprise mainly the Fisheries Act and its supporting regulations. Customs management laws and regulations mainly regulate supervision and inspection of incoming and outgoing postal items, goods, passenger luggage, currency, gold and silver, securities and transportation vehicles along coastal areas, at the border or at inland port, collection of customs duties, and enforcement of anti-smuggling tasks. Environmental protection laws and regulations mainly focus on preventing, reducing and controlling pollution and improving the environment. Ecological conservation laws and regulations mainly focus on protecting wildlife, setting up national parks or marine parks, preventing sea turtle interference, and prohibiting the hunting of sea turtles and other marine life. Maritime safety regulations mainly focus on ensuring maritime safety, preventing and combating maritime crimes, and conducting maritime search and rescue operations [5].

As issues such as climate change, marine pollution, habitat destruction, and marine debris have attracted the attention of the international community, private non-governmental organizations in Malaysia are showing increasing concern about marine-related issues and taking actions such as participating in ICC beach cleaning activities every year. Organizations include the Coral Reef Observation Association which is dedicated to the conservation and research of coral reefs and sea turtles; the Sea Turtle Research Unit of the Universiti Malaysia Terengganu (UMT); the Turtle Conservation Society of Malaysia; the World Wildlife Fund for Nature in Malaysia, which is engaged in habitat and marine life conservation; and the MNS Marine Group - Selangor Branch that promotes ecotourism and conservation, etc.

Malaysia's maritime governance focuses on maritime safety and law enforcement, naval ship modernization, South China Sea oil and gas exploration, marine tourism and recreation, marine protected areas, cooperation, and interaction with neighboring countries in the South China Sea, and participation in international organizations. Although each country has its own maritime issues, there are many commonalities. Malaysia attaches great importance to South China Sea oil and gas field exploration and maritime security strategies in its external maritime affairs as they constitute important economic lifelines for the nation, demonstrating that Malaysia has priority considerations on diversified maritime affairs by highlighting those of major national interests and designating cost-effectiveness as the sole focus of policy planning.

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## Malaysia's Ocean Thermal Energy Conversion Technology

Chun-I Wu (Assistant Professor, Department of Mechanical and Mechatronic Engineering, National Taiwan Ocean University)

Translated by Linguitronics

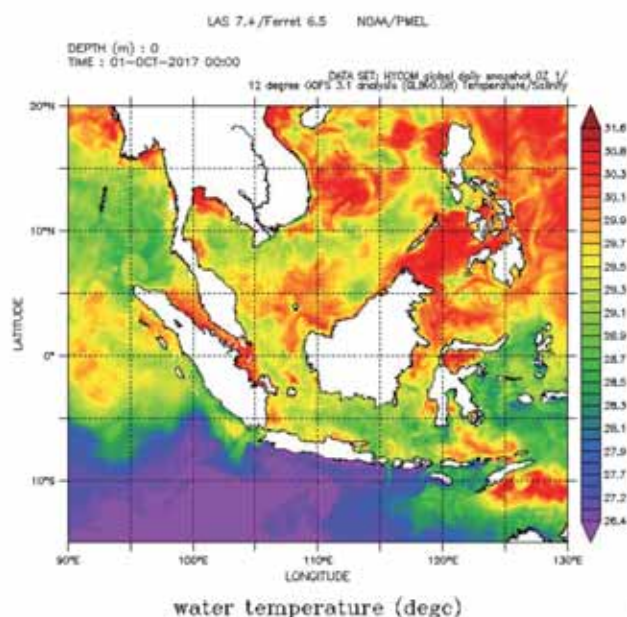
Keywords: Ocean thermal energy, ocean thermal energy conversion

In the face of rapid changes in the international political and economic environment and the challenge of how to balance energy, environment, and economic development, all countries regard energy transition as an essential key to growth for the next generation. As energy will be an important factor that directly affects all countries' economic development, green energy technology has also become an important engine driving countries to establish emerging industries and create green jobs. From this perspective, it is clear that energy and green energy technology have become common worldwide topics.

As Taiwan lacks self-produced energy, its energy supply is highly dependent on imports, making the nation vulnerable to international energy turbulence and fluctuations in energy prices. To reduce dependence on imported energy and increase energy independence and diversification, Taiwan is actively developing and promoting offshore wind power and other marine green energy technologies [1]. At the same time, in response to energy shortages and environmental issues, advanced countries across the world have invested heavily in the research and development of various renewable energy sources and accelerated their energy transition. Global industries are also increasing the use of renewable energy to reduce their carbon footprint. These new changes have led to great leaps forward in green energy technology and renewable energy industries. Taiwan actively develops green energy technology and promotes green energy construction, and has passed new bills such as the "Green Energy Technology Industry Innovation Promotion Program," completed the amendment to the "Guidelines on Energy Development," and successfully prompted advancements in the green energy technology industry with policies and laws that serve as new engines driving energy transition and economic development. In the face of more challenges in the future, Taiwan must learn from neighboring countries' development plans and utilize the nation's inherent characteristics to become a full-fledged player in the world's green energy development [2].

Malaysia is located in the tropics. With a warm climate and abundant resources in the South China Sea (Figure 1), Malaysia is perfectly poised to develop ocean thermal power generation [3]. In recent years, the country has invested in ocean energy research and actively moved towards greater utilization of ocean thermal energy conversion [4][5].

Figure 1/ 2017/10/01 00:00  
The sea temperature in the waters of Malaysia;  
the waters near Malaysia remain at about 30°C  
Source/ <http://apdrc.soest.hawaii.edu/data/data.php>





## Ocean thermal energy conversion

About 70% of the earth's surface is covered by the ocean. As the sun continuously transmits heat energy to the planet, the surface seawater effectively absorbs and stores the sun's energy, making the ocean the largest natural heat collector. In the tropics, surface seawater temperature can reach above 28°C day and night continuously. Warm seawater from the tropics also flows to the poles to produce cold seawater with high density and low temperature, while this cold seawater flows along the bottom of the ocean back to the tropics. Meanwhile, the deep ocean water is a block of water that remains low temperature and stable throughout the year, rarely changing due to external environmental influences. In most parts of the world, seawater temperature at a depth of 1,000 meters maintains about 5°C all year round. There is a large temperature difference between the surface warm seawater and the deep cold seawater in tropical and subtropical regions, harboring the potential for developing ocean thermal energy conversion (Figure 2).

Thermal energy is an important research topic in the field of renewable energy. Many research reports have pointed out that ocean thermal energy conversion has great potential, especially in tropical and subtropical countries, and research institutions have invested considerable resources in this field. At present, the United States and Japan, and Republic of Korea have all constructed ocean thermal power plants.

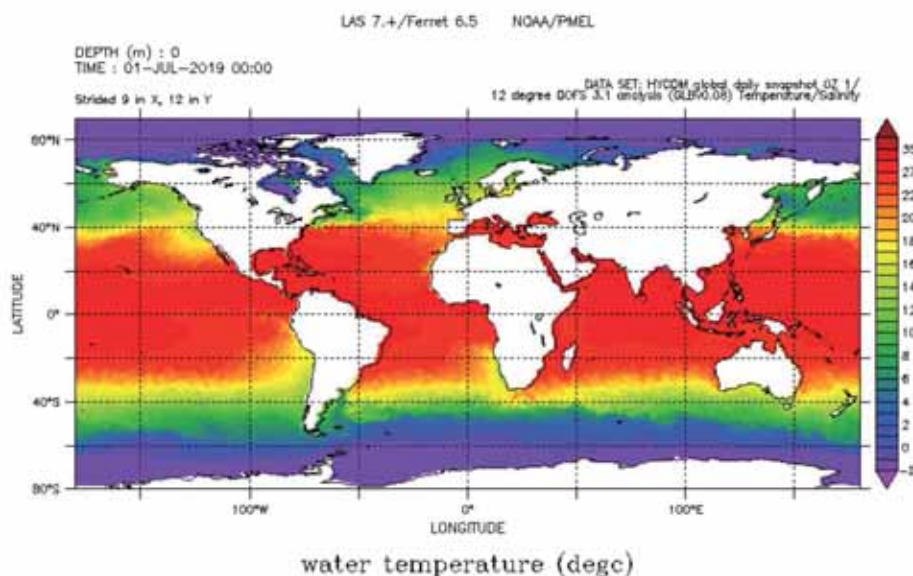


Figure 2/ 2019/07/01 00:00, the global ocean temperature; it can be seen that the sea surface temperature in tropical and subtropical regions is high, harboring the potential for developing ocean thermal energy conversion  
Source/ <http://apdrc.soest.hawaii.edu/data/data.php>

## Types of ocean thermal energy conversion

The principle of ocean thermal energy conversion is similar to that of thermal power plants. First, surface seawater with higher temperature is used to evaporate and gasify a low boiling point working fluid, and the vapor thus generated is utilized to drive the turbine generator. The vaporized vapor is then condensed by low-temperature deep seawater and returned to the liquid state, and the cycle is repeated to produce energy. There are three ocean thermal energy conversion systems: closed-cycle, open-cycle, and hybrid system. In terms of location, there are three types of ocean thermal energy conversion plants: land-based, shelf-based, and floating type plants.

A closed-cycle ocean thermal energy conversion system uses a low boiling point working fluid to drive a turbine to generate electricity. The warm seawater on the ocean surface passes through a heat exchanger to evaporate the working fluid. After the vaporized working fluid turns the turbine, it is condensed into a liquid through deep ocean water, thus forming a complete cycle (Figure 3).



Open-cycle ocean thermal energy conversion system (Figure 4) is to pump warm surface seawater into a low-pressure cabin to vaporize into a gas that drives turbines to generate electricity. Deep ocean water is then used to condense and liquefy the gas. As the vaporized gas has been desalinated, the condensed liquid can be used in many applications.

Hybrid ocean thermal energy conversion system combines the characteristics of the two ocean thermal energy conversion systems mentioned above. It is similar to an open-cycle as warm surface seawater is introduced into the vacuum chamber to vaporize into water vapor at the beginning of the cycle. The water vapor enters the ammonia evaporator for vaporizing the working fluid, which turns the turbine to generate electricity. Therefore, it is generally conceived that the hybrid cycle features both the open- and closed-cycle characteristics.

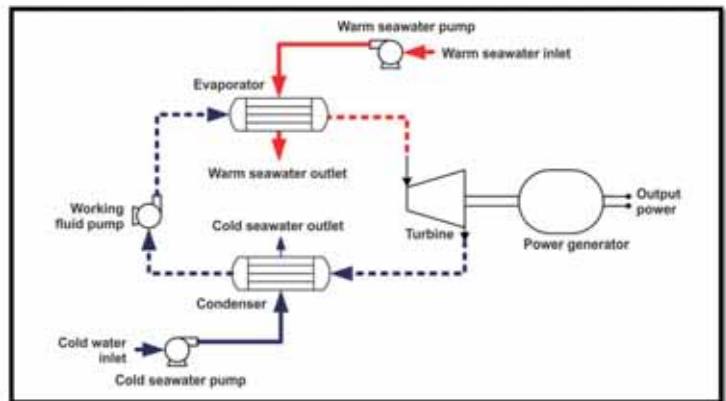


Figure 3/ Schematic diagram of the working principle of closed ocean thermoelectric power generation

Source/ Azhim et al. (2013) [6]

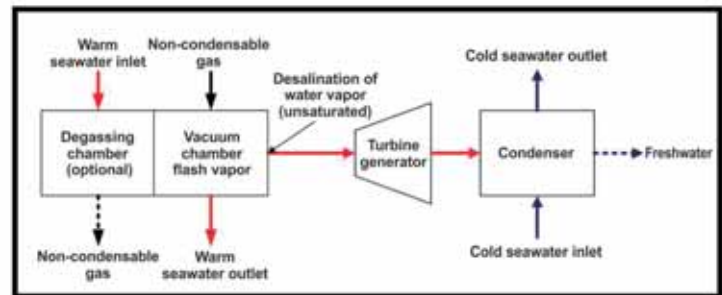


Figure 4/ Schematic diagram of the working principle of open ocean thermal energy conversion

Source/ Azhim et al. (2013) [6]

However, both closed-loop and hybrid systems may use ammonia as a working fluid, and ammonia is toxic at moderate concentrations. Since ocean thermal energy conversion plants are usually located in harsh natural environments (such as salt and humidity), the risk of toxic fluid leakage is high for prolonged periods. For example, metal pipes may corrode and cause toxic fluid leakage. Hence, the risk of environmental impact is an issue that developers and operators of ocean thermal energy conversion must face.

### Current status of ocean thermal energy conversion in the world

In the 1930s, the first ocean thermal energy conversion power plant was built in the Caribbean Sea. Due to technological limitations, the world's first ocean thermal energy conversion power plant failed to generate electricity and produced negative power. It was not until the 1970s that the first ocean thermal energy conversion power plant officially successfully output electrical energy. Several countries use ocean thermal energy conversion to generate electricity, such as Hawaii, the United States, Kume Island, Japan, and Republic of Korea. The latter two are at higher latitudes than Taiwan. Ocean thermal energy conversion is usually combined with other industries, such as desalination, air conditioning, aquaculture, and deep ocean water production. According to a survey conducted by the Industrial Technology Research Institute, there are several ideal ocean thermal energy conversion potential sites on the east coast of Taiwan, such as Nan'ao, Heping, Qixingtian, Shiti, Zhangyuan, Jinlun, Ludao, and Lanyu, etc. At these locations, the distance from the shore to a depth of 1,000 meters is only about 10 kilometers.

### Current status of Taiwan's ocean thermal energy conversion

At present, Taiwan's ocean energy development mainly comprises offshore wind power west of the island within the Taiwan Strait. However, Taiwan is surrounded by sea and has abundant ocean energy.



For instance, the eastern sea has a Kuroshio current with surface seawater temperature above 24 °C all year round. A steep continental shelf along the coast with depths up to 1,000 meters and seawater temperature as low as about 5°C just 3 or 4 kilometers from the shore. As such, Taiwan has one of the most suitable geographical environments in the world to develop ocean thermal energy conversion. Effective development can improve power safety and create a marine green energy industry. Since the 1980s, the Bureau of Energy of the Ministry of Economic Affairs, TaiPower Company, the Industrial Technology Research Institute, and other units have successfully completed a number of research projects related to ocean thermal energy conversion.

### Development and current status of ocean thermal energy conversion in Malaysia

Malaysia is located in a tropical region with surface water, reaching a stable temperature above 28°C throughout the year. According to data, the sea area of approximately 130,000 square kilometers around Malaysia has a depth of 700 meters or more. The temperature difference at this depth has a potential energy content of 800kW/km<sup>2</sup> according to calculations, and the estimated ocean thermal energy conversion content is about 100,000 MW. The feasible locations for ocean thermal energy conversion in Malaysia are mostly the South China Sea and its surrounding areas. For example, the Nansha Trough has a depth of 1,000 meters or more and is one of the ocean thermal energy conversion power plant sites actively researched by Malaysia. Existing research reports assess that several areas near Malaysia may have ocean thermal energy conversion power generation potential, such as Pulau Layang-Layang (in Malay), Kuala Baram, Pulau Kalumpang, and Kuala Penyu, among others.

Pulau Layang-Layang is a circular coral reef in the Spratly Islands that is a haven for diving enthusiasts. There are also Malaysian naval bases, resorts, diving schools, airports, and other facilities located on the reef. Currently, the floating-type ocean thermal energy conversion power plant is proposed for this site. It is estimated that 1.5 kilometers away from the edge of the reef, the bottom seawater temperature can reach 5°C.

Kuala Baram is located in Sarawak State, close to the border of Borneo and Brunei. This area has natural resources such as oil and natural gas. At present, land-based fixed ocean thermal energy conversion power plants are proposed for this site. Due to the distance to the deepwater area, the length of the cold water pipe must be approximately 28 kilometers, presenting technical challenges that must be overcome.

Universiti Teknologi Malaysia (UTM) is an important academic institution in Malaysia promoting ocean thermal energy conversion. The Ocean Thermal Energy Centre (UTM-OTEC) is actively engaged in this field. The center has signed a joint research agreement with the Institute of Ocean Energy of Saga University, Japan, to jointly develop a hybrid system for experimental stainless steel heat exchangers. They will also study new 3 kW turbine generator sets, nano-level working fluids, extract eDNA from seawater, and study how to improve high-value seafood production capacity [7].

### Laws and regulations on ocean thermal energy conversion in Malaysia and around the world

Countries around the world have drafted related bills for regulating ocean thermal energy conversion. The United States has given the National Oceanic and Atmospheric Administration (NOAA) the legal basis for ocean energy management through legislation. The NOAA of the United States has the authority to authorize ocean thermal energy conversion power plants. The US House of Representatives passed the "Ocean Thermal Energy Conversion Act" in 1980 to regulate the location, construction, and operation of ocean thermal energy conversion power plants on the coast of the United States and provide a certain degree of financial assistance to promote ocean thermal energy conversion. Another legal bill is the "Ocean Thermal Energy Conversion Research, Development, and Demonstration Act" signed by President Carter of the United States.



Currently, in the Malaysian legal system, the Constitution of Malaysia clearly stipulates that all energy-related affairs are under federal jurisdiction rather than local jurisdiction. Therefore, the Malaysian Parliament has the right to formulate national energy-related laws in Malaysia. Malaysia's "Renewable Energy Act 2011" lists several types of renewable energy; ocean thermal energy conversion is not included. However, ocean thermal energy conversion can be broadly summarized as thermal power generation and can be regulated by this Renewable Energy Act [8].

Malaysia declared 200 nautical miles of exclusive economic waters and formulated several bills such as the Exclusive Economic Zone Act and the Continental Shelf Act, which are expected to establish the legal basis for the exploration, development, management, and conservation of marine resources in Malaysia, especially the development of the Nansha Trough and the South China Sea which are key areas for Malaysia's development of ocean thermal energy conversion. These bills may apply to a certain extent in ocean thermal energy conversion in Malaysia.

### The future of ocean thermal energy conversion in Malaysia

UTM-OTEC, a Malaysian research institution, and the Institute of Ocean Energy of Saga University, a Japanese research institution, will collaborate on ocean thermal energy conversion, turbine generator sets, nano-level working fluids, extracting eDNA from seawater, and methods to increase high-value seafood production capacity as well as research on other related topics. It is believed that Malaysia will be able to put the large amounts of low-temperature deep seawater within its oceans, an indispensable feature of ocean thermal energy conversion, to more diversified uses, such as 1. Raw water utilization: Deep seawater, which has the characteristics of being low temperature, clean, and rich in minerals, can be used for farming and fishery-related industries such as cold-water fish breeding, seed cultivation, seedling propagation, and temperature-controlled agriculture; 2. Water utilization: Deep seawater can also be divided into raw water, freshwater, mineral water, etc., which can be used for packaging drinking water, beverages, alcohol, food, seawater therapy, medical treatment, cosmetics, and other related industries; 3. Secondary energy utilization: Deep seawater can be utilized to promote the growth of algae, which can, in turn, be used to produce biomass energy; 4. Air conditioning utilization: After power generation, deep seawater retains its low-temperature characteristics and can be used in buildings or factories that require cooling or agriculture that requires temperature control [9].

### Conclusion

Taiwan has the potential for the development of ocean thermal energy conversion in the eastern seas and the South China Sea. The electricity generated on the east coast of Taiwan can be directly incorporated into the grid for use, while energy extracted from the South China Sea can be transported back to Taiwan using hydrogen energy. Malaysia is actively investing in ocean energy development. It is believed that Taiwan, with an even greater abundance of natural conditions, can discover more possibilities if resources can be invested in the ocean thermal energy conversion industry.

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# The Maritime Law Enforcement Agencies and Maritime Laws and Regulations in Malaysian

Huan-Sheng Tseng (Assistant Professor, National Taiwan Ocean University)

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Malaysia attaches great importance to marine resources, it signed the 1982 "United Nations Convention on the Law of the Sea" in 1994 and was approved and entered into force by domestic procedures in 1996. Malaysia has been actively strengthening marine management for a long time. Therefore, by understanding Malaysia's maritime law enforcement agencies and related law enforcement actions can provide Taiwan reference, and help to improve maritime policy.

## Introduction

Malaysia's coastline is about 4,089 kilometers long and has an exclusive economic zone of 418,000 square kilometers. Fishery resources are the main source of animal protein and have played an important role for decades. According to 2017 statistics, the country's total fishery production was 1.7 million tons, nearly 1.5 million tons came from marine fishing [1]. It can be seen that the ocean is important to Malaysia, and how to protect marine resources has also become an important issue.

Malaysia established the "Malaysian Maritime Enforcement Agency" (MMEA) or also known as the "Malaysia Coast Guard", in 2005, as the main maritime law enforcement agency, and is also responsible for maritime law enforcement and rescue missions. In addition, the government has also successively formulated relevant maritime laws and regulations to defend maritime rights.

## Main Maritime Law Enforcement Agencies of Malaysia- MMEA

MMEA was formed as a result of a study undertaken by the Malaysian government in April 1999. The study revealed that enforcement was not effective because too many agencies were involved that resulted in overlapping functions, overlapping jurisdiction, and uneconomical use of resources [2].

In the past, the "Marine Police Force" was originally under Royal Malaysian Police, the Ministry of Home Affairs which was responsible for the maritime law enforcement. However, in order to save national costs and consider maritime specialization, the National Security Council held a national conference on the feasibility of establishing a special maritime law enforcement agency in May 2004, the meeting resolved to prepare a special agency for maritime law enforcement. Subsequently, the "Malaysian Maritime Enforcement Agency Act" was promulgated on July 1, 2004 and became effective on February 15, 2005. At the same time, the part "Marine Police Force" was merged into the new agency MMEA and started operation. MMEA is directly under the jurisdiction of the Prime Minister of Malaysia at first. In 2018, MMEA was merged into the Ministry of Home Affairs. The current maritime-related execution energy includes MMEA, Navy, Royal Malaysian Customs Department and Marine Police Force (Figure 1). It is the maritime law enforcement agency in peacetime, but it needs to support the air force and navy in wartime.

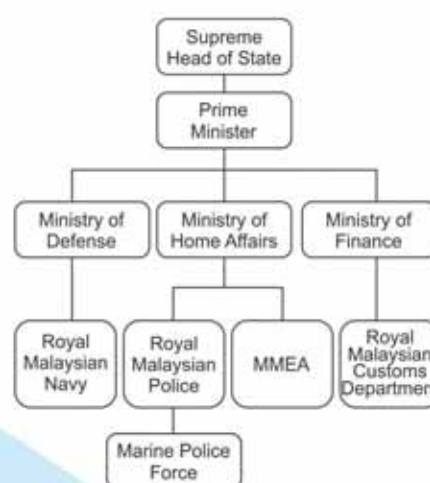


Figure1 / Maritime-related execution energy of Malaysia  
Image by Huan-Sheng Tseng



The vision of MMEA is to "be among the best maritime law enforcement agencies in the world", and its goal is to "to enforce laws, saving lives and properties at sea in order to ensure the safety and security of Malaysian Maritime Zone (MMZ)" [3]. The so-called MMZ refers to the waters, territorial sea, continental shelf, exclusive economic zones and fisheries of Malaysia and includes the airspace over the Zone (<https://telsat.mmea.gov.my/eng/index.php/en/citizens-and-public/36-malaysian-maritime-zone>).

The tasks related to MMEA are as follows [4]:

- I. To enforce law and order under any federal law;
- II. To perform maritime search and rescue;
- III. To prevent any offences in the Malaysian Maritime Zone;
- IV. To lend assistance in any criminal matters on a request by a foreign country as provided under the Mutual Assistance in Criminal Matters Act 2002 (Act 621);
- V. To carry out coastal and air surveillance;
- VI. To prepare a platform for service and support for relevant agencies;
- VII. To establish and manage maritime institutions for training;
- VIII. Perform any obligation to ensure maritime safety and security or do all matters incidental to its;
- IX. To control and prevent of ocean pollution;
- X. Prevent piracy and illicit trafficking of narcotic drugs on the high seas;
- XI. Placed under the control of the Malaysian Armed Forces during a period of special crisis emergency or war.

MMEA is commanded by navy generals, and other military personnel are also assigned by the Royal Malaysian Navy. MMEA has also set up the "Special Tactical of Action And Rescue" (STAR), whose mission is to be responsible for search and rescue at sea, and carry out anti-terrorist operations in domestic rivers and territorial waters. MMEA divides the coastline to the exclusive economic zone into 5 major areas: the north, south, east, Sabah and Sarawak, and then subdivided into 18 Responsible Areas (Figure 2). MMEA takes the territorial waters and exclusive economic waters as the scope of law enforcement, and protect the buildings and resources of marine scientific research in the territorial waters.

When MMEA patrol ships perform maritime search and rescue missions, the Royal Navy, police, port authority, customs, fishery agency, fire rescue and other departments will also support the needs of MMEA patrol ships. In terms of air energy, MMEA also has fixed-wing aircraft and helicopters. The army, navy and air forces, the Royal Police, civil aviation agencies and fire rescue agencies can also support aviation missions.



Figure 2/ MMEA Responsible Area

Source/ MMEA

<https://telsat.mmea.gov.my/eng/index.php/en/citizens-and-public/10-mmea-responsible-area>



In order to enhance the law enforcement energy in sea areas, MMEA purchased 6 more frigates equipped with UAV equipment in 2015 [5]. In addition, the Japanese government promised Malaysia in September 2016 to provide MMEA patrol boats, which will be delivered in the first half of 2017 to counter China's military activities in Malaysian waters [6][7]. MMEA also purchased helicopters in February 2020 to strengthen the protection of Malaysian waters [8].

MMEA also often conducts cooperative exercises with neighboring countries. MMEA and the Royal Thai Navy will hold two maritime exercises each year. The focus of the exercise is the water boundary between Malaysia and Thailand. The main purpose of the exercise is to prevent piracy and maritime robbery, and develop a good relationship and cooperation between the two countries. MMEA and the Philippine Coast Guard will also conduct annual exercises, focusing on the maritime border between the two countries. The training area between MMEA and the Indonesian government from Marine and Fishery Department focuses on the Strait of Malacca to prevent arms and drug smuggling [9].

## Maritime laws and regulations in Malaysia

Malaysia ratified the "United Nations Convention on the Law of the Sea" (hereinafter referred to as the "Convention") on October 14, 1996 and entered into force on November 14, 1996. Since then, it has successively formulated or revised relevant laws in accordance with the "Convention". Malaysia advocates and delimits sea areas including internal waters, territorial waters, exclusive economic zones, continental shelf, and fishery waters, as well as the scope of MMEA law enforcement.

### I. Internal water and territorial sea

Malaysia enacted the "Baselines of Maritime Zones Act" in 2006 to determine the geographic coordinates of the base points. The line connecting the base points is the baseline, and the sea area on the land-facing side of the baseline is the internal water [10]. According to "Territorial Sea Act 2012", the width of Malaysian territorial sea is 12 miles outside the baseline, however, part of the territorial waters adjacent to Sabah and Sarawak do not exceed 3 nautical miles [11].

### II. Exclusive Economic Zones

Malaysia declared Exclusive Economic Zones (200 nautical miles) as early as 1980, and enjoys the jurisdiction to explore, develop, conserve and manage the natural resources of the seabed, subsoil and upper waters, and to protect the marine environment. Malaysia enacted the "Exclusive Economic Zone Act No. 311" in 1984 to regulate fisheries, protection and preservation of the marine environment, marine scientific research, artificial islands and reefs, facilities and structures, submarine cables and pipelines. The law also regulates the prevention of marine pollution. According to Article 10 of the law, if any oil, oily mixture or pollutant is discharged from any ship, land source, facility, device, or aircraft, discharged from the air or by dumping Economic sea areas, etc., are all illegal and will be fined up to 1 million MYR (about NT\$5.8 million) [12].

### III. Continental shelf

As early as 1966, Malaysia adopted the "Continental Shelf Act" to claim the rights of continental shelf to develop offshore oil and natural gas resources [13]. The Act was amended in 2009 in line with the Convention, and hopes to expand the sovereign right over the outer edge of the continental margin. Because coastal countries are allowed to exercise the right to the continental reef layer up to 350 miles from the baseline or 100 miles below the 2,500-meter depth counter [14].

#### IV. Malaysian fishery waters

Malaysia also enacted the "Fisheries Law" in 1985 to ensure the conservation, management and development of oceans and estuaries in fishery waters. In addition, relevant agencies can establish marine parks and marine reservation to strengthen the protection of aquatic animals and plants, promote scientific research, and regulate recreational activities and other activities in certain areas to avoid irreversible damage to the environment. When crimes occur, authorized officials should take enforcement measures, such as seizing ships, catch, equipment, or arrests.

The targets of the "Fisheries Law" include nationals and foreigners. If the ship is a foreign fishing vessel or the person is a foreign national who violates the "Fisheries Law", it is considered as a crime. The shipowner or captain shall be fined no more than 1 million MYR per person, and a fine of NT\$100,000 (about NT\$580,000) for each crew member, which is a heavier penalty [15].

#### Conclusion

MMEA's law enforcement energy includes patrol ships and aircraft, which greatly enhances the effectiveness of sea and air law enforcement. In addition, because Malaysia is located in the Strait of Malacca, there is still a threat of piracy. Therefore, MMEA regularly conducts law enforcement exercises with neighboring countries every year. The purpose is to deter the occurrence of violations and promote opportunities for cooperation with law enforcement agencies of other countries.

Malaysia is rich in oil resources and has declared its claim to the sovereign right of the continental reef long ago. In addition, fisheries and environmental resources are also extremely important to Malaysia, so management measures are implemented by relevant laws. If a foreign fishing vessel violates the "Fisheries Law" in Malaysian waters, the maximum penalty can be 1 million MYR to deter foreign vessels from illegal fishing activities in the waters under their jurisdiction and protect fishery resources. If oil pollution occurs in the exclusive economic zone of Malaysia, it is a violation of the "Exclusive Economic Seas Act No. 311". The maximum penalty can be 1 million MYR to ensure its marine environment.

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發行：海洋委員會

地址：806610高雄市前鎮區成功二路25號4樓

電話：(07)3381810

E-mail：master@oac.gov.tw

網址：https://www.oac.gov.tw/

執行：財團法人台灣經濟研究院

地址：104222臺北市中山區德惠街16-8號7樓

電話：(02)2586-5000分機888

傳真：(02)2595-7131

網址：http://www.tier.org.tw/

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Address：4F., No. 25, Chenggong 2nd Road,  
Qianzhen District, Kaohsiung City 806610,  
Taiwan

Telephone：(07)3381810

E-mail：master@oac.gov.tw

Website：https://www.oac.gov.tw/

Executive：Taiwan Institute of Economic Research

Address：7F., No. 16-8, Dehuei St., Jhongshan District,  
Taipei City 104222, Taiwan

Telephone：(02)2586-5000 Ext.888

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