國際海洋資訊
International Ocean Information

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美國海洋保護區和國家海洋保護區系統
Marine Protected Areas and the National System of MPAs of the US

海洋委員會 Ocean Affairs Council 發行

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主任委員：李仲威

海洋保育的關鍵：彙集經驗與智慧，展開行動！

關鍵字／海洋永續發展、海洋保護區、美國國家海洋暨大氣總署、環境DNA

對海洋做出承諾，讓海洋永續發展，是全世界皆應努力的方向。而在海洋政策、資源管理與物種保育等方面，美國皆已有數十年的經驗，本期以「美國」為題，將先進國的海洋經驗與讀者共享。

美國國家海洋暨大氣總署（NOAA）是美國海洋政策的主導機構，NOAA關注大氣和海洋變化，並維護、管理海洋和沿海的資源。除了介紹NOAA與其相關組織外，產業面則以NOAA最新一期的「美國海洋及大湖經濟報告」為主，該期分析美國目前海洋產業的勞動率高、因應景氣波動能力強，更具有多樣性的組合；在法規面則專文條列NOAA對於海洋漁業管理、物種保存及海岸地區管理相應的法規。

如何保育海洋的生物多樣性，以減緩海洋開發、過漁、氣候變遷等對海洋生態系的負面影響，海洋保護區（MPAs）是一個公認的重要管理手段。本刊第一期曾報導近年來對「愛知目標11」（2020年至少17%的陸地和內陸水域以及10%的海岸和海洋區域獲得保護）的推動與進展，此次「專題報導」介紹美國為保護生物多樣性熱點、具歷史價值的沉船遺跡、重要的魚群資源而設立的海洋保護區制度，2008年，美國更建置整合性的國家海洋保護區國家系統，其完整架構可供我國參考。而「資訊新知」則介紹國際在環境DNA（eDNA）技術的研究進度，從海水或沉積物等環境樣本中提取海域生物之微量DNA，可在不傷害生物的前提下分析出該海域曾出沒的生物，乃是以科學技術的提升來保護海洋的新方法，甚至有潛力發展成全民共同參與的海洋生態研究。

除了美國的經驗分享，「國際議題」專欄則介紹Our Ocean Conference（我們的海洋會議），自2014年起由美國國務卿凱瑞倡議的這場會議，迄今已辦理6屆，會議中聚焦於經驗的分享，更在各國產官學通力合作下，做出保育海洋的承諾。我國與會者也在2019年會議上呼應支持WTO降低IUU漁業補貼的承諾，展現共同維護海洋環境的決心！

圖說／圖為小夏威夷僧海豹（Hawaiian monk seal）

圖片來源／NOAA Photo Library Flickr (CC BY 2.0)

https://www.flickr.com/photos/noaaphotolib/41240740071/

美國海洋保護區和國家海洋保護區系統

撰文／陳璋玲（國立成功大學海洋科技與事務所教授）
關鍵字／海洋保護區、美國國家海洋暨大氣總署、國家海洋保護區系統

長期以來海洋保護區被視為重要的海洋資源保育和管理工具。美國有1,700處海洋保護區，分別由100多個單位設立，每個保護區都有其設立的法規依據與目的。美國政府為加強既有海洋保護區的管理成效，以及促進區域性的保護區網路連結和合作，於2008年建置國家海洋保護區國家系統，將部門式管理導入整合式管理。此系統代表美國多元的海洋生態系及自然和文化資源。

美國海洋保護區概況

美國有30個州和5個海外屬地（關島、美屬薩摩亞、北馬里亞納群島、波多黎各、美屬維京群島）靠海，海岸線全長13,600公里（包括五大湖），專屬經濟海域面積共11,350,000平方公里，為全球第一。海洋、海岸和湖區水域支持豐富的生物資源和多樣性，為確保該等水域生態系長期健康及海洋資源永續使用，海洋保護區是重要的管理手段，其主要由聯邦和州政府的相關部門設立，包括公園、漁業、野生動物、自然和文化資源等單位。

海洋保護區的名稱各有不同，且設立目的也不一致，包括保護生物多樣性熱點、保存有歷史價值的沉船遺跡、保育對商業漁業和休閒漁業重要的魚群資源等。每個保護區的保護程度不一，從保護程度高的禁捕，到允許多重使用，包括漁業、觀光和工業使用等。

以聯邦政府而言，主要有3個單位負責海洋保護區的設立與管理：1.商業部的國家海洋暨大氣總署（National Oceanic and Atmospheric Administration, NOAA），2.內政部的國家公園署（National Park Service, NPS）和3.內政部的魚類暨野生動物署（Fish and Wildlife Service, FWS）。

圖說／美國國家海洋保護區中心示意圖

圖片來源／NOAA

https://marineprotectedareas.noaa.gov/aboutmpas/mpacenter/

NOAA海洋庇護區辦公室（Office of Marine Sanctuaries）依據「國家海洋庇護區法」（National Marine Sanctuaries Act），設立14處國家海洋庇護區，其中佛羅里達礁島群庇護區（Florida Keys National Marine Sanctuary）有壯觀的珊瑚礁和沉船遺跡資源，允許多功能使用，是著名的觀光潛水勝地。NOAA海岸管理辦公室（Office for Coastal Management）依據「海岸地區管理法」（Coastal Zone Management Act, CZMA）設立29處國家河口研究保留區（National Estuarine Research Reserves, NERRs），保護程度最高，總計涵蓋1.3萬公頃河口水域面積，作為自然野外實驗室，供保護、研究、訓練及教育等用途。

圖說／美國河口研究保留區分布圖

圖片來源／NOAA

https://coast.noaa.gov/nerrs/

NPS依「國家公園法」（National Park Act）授權設立國家公園，其中一些位於海岸或島嶼。例如位於加州外海的海峽群島國家公園（Channel Islands National Park），涵蓋5個島嶼及島嶼外海3浬海域，其和NOAA海洋庇護區辦公室設立的海峽群島海洋庇護區（Channel Islands National Marine Sanctuary）重疊，但後者的海域面積更擴大至島嶼外海6浬。此保護區擁有大型海藻生態系、珊瑚礁、海豹、海鳥等資源，由NOAA和NPS共同管理。

圖說／海峽群島海洋庇護區擁有豐富海藻及海鳥等自然資源
圖片提供／陳璋玲

FWS則依據許多不同的法規，如避難所行政法（Refuge AdministrationAct）、國家野生動物避難所志工改善法（National Wildlife Refuge Volunteer Improvement Act）、第12996號行政命令（Executive Order 12996）、避難所遊憩法（Refuge Recreation Act）等，設立多處位於河口、濕地或離岸沙洲的國家野生動物避難所（National Wildlife Refuge），以保護野生動物棲息地。該等保護區構成全美面積最大國家野生動物避難所系統（National Wildlife Refuge System, NWRS），計568處，面積達150百萬公頃，提供約700種鳥類、220種哺乳類、250種爬蟲和兩棲類，以及超過1,000種魚類的棲息地。

除上述單位依據相關法規劃設海洋保護區外，美國總統得依「古物法」（Antiquities Act）授權宣布位於政府土地上或政府控制的歷史地標或建物等為國家遺址（national monuments）。例如，布希總統2006年6月15日依據「古物法」授權，發布8031號命令（Proclamation 8031），宣布在夏威夷海域成立全美面積最大的國家遺址海洋保護區—Papahānaumokuākea National Monument。該保護區涵蓋太平洋580,000平方英里面積海域（約150萬平方公里），擁有豐富的珊瑚礁及7,000多種海洋生物，由4個單位依各自權責共同管理，包括商業部（NOAA）、內政部（FWS）、夏威夷州政府，及夏威夷事務辦公室。

就州政府層級而言，亦有多個單位設立海洋保護區，如州立公園（State Park）、自然保留區（Nature Reserve, Natural Area Preserve）、野生動物管理區（Wildlife Management Area, WMA）等。例如德拉威爾州的Cape Henlopen State Park擁有海灘、沙丘、海岸林、步道、碉堡等自然和人文資源；加州Hearst San Simeon State Park保護海象棲息地，遊客在岸上可看到海象而成為著名的景點。

圖說／加州Hearst San Simeon State Park保護海象棲息地
圖片提供／陳璋玲

國家海洋保護區系統

鑑於海洋保護區對於海洋資源保育的重要，以及加強MPA彼此之間的連繫與管理能力，柯林頓總統於2000年5月26日頒布第13158號行政命令（Executive Order 13158），要求商業部和內政部和其他聯邦單位協商，建置國家海洋保護區系統。此命令明確表示此系統是國家系統，不是聯邦系統，因此要求須與州、屬地、原住民部落，以及區域性漁業管理委員會等單位諮商。此命令亦明確指出此系統必須以科學為基礎，且涵蓋全面性，以代表美國多元的海洋生態，以及自然和人文資源。此命令另要求訂定此系統的管理架構，以及在NOAA下建立國家海洋保護區中心（National MPA Center），以利推動國家海洋保護區系統和協調後續的執行。但值得注意的是此國家系統不成立新的單位來指定、管理及改變既有的海洋保護區，也不改變既有的海洋保護區法規或計畫，也就是說，參加國家系統的海洋保護區仍由原主管單位管理，新的海洋保護區仍由其權責單位劃設。

國家海洋保護區系統架構於2008年建置完成，其重點內容如下：

- MPA定義：任何海洋環境中，依據聯邦、州、領地、部落或地方法令規章劃設，以持久性地保護其中部分或全部自然和文化資源的區域。
- MPA分類系統：以5項功能特徵描述MPA，包括1.保護焦點（自然資產、人文資產、永續生產）、2.保護程度（全區一致性多重使用、分區多重使用、分區多重使用和禁捕、禁捕、禁止影響、禁止進入）、3.保護持久性（永久、條件式、暫時）、4.保護期間（全年、季節性、輪替區域）、5.保護尺度（全區海洋生態系、特定資源）。
- 建立國家系統：聯邦單位和相關夥伴合作，確認、提名及將符合條件MPA納入國家系統中。至2013年4月，已有437處列入國家系統中，約占既有MPAs（1,700處）的四分之一。列入國家系統的MPAs不會限制主管單位對其轄屬保護區的管理，亦即管理單位得依權責，進行轄屬MPA有關保護程度、保護區面積大小或其他方面的調整。此外，列入名單的保護區若因管理單位要求退出、保護區已不存在或未符合條件者，都將被移除該名單。

- 列入國家系統的MPA資格條件：1.符合MPA定義、2.擬具保護區管理計畫、3.支持至少一項保護目的、4.保護標的為文化資源者，另須符合是國家歷史場域名錄（National Register of Historic Places）、或印地安人、阿拉斯加原住民、夏威夷原住民、大平洋島民認為重要的區域。符合上述條件者，經一定的提名和審核程序，決定是否列入國家系統。
- 追蹤、報告與評估：國家海洋保護區中心每兩年報告國家系統的進度，並追蹤和評估國家系統的管理成效。

表／設立MPA的聯邦單位、法規和MPA用詞

聯邦單位	法規	MPA用詞
NOAA 海岸管理辦公室（Office for Coastal Management）	海岸地區管理法（Coastal Zone Management Act）	國家河口研究保留區（National Estuarine Research Reserve）
NOAA 海洋庇護區辦公室（Office of Marine Sanctuaries）	國家海洋庇護區法（National Marine Sanctuaries Act）	國家海洋庇護區（National Marine Sanctuary）
國家公園署（National Park Service）	國家公園法（National Park Act）	國家公園（National Park）、國家海岸（National Seashore）
魚類暨野生動物署（Fish and Wildlife Service）	避難所行政法（Refuge Administration Act）、國家野生動物避難所志工改善法（National Wildlife Refuge Volunteer Improvement Act）、第12996號行政命令（Executive Order 12996）、避難所遊憩法（Refuge Recreation Act）	國家野生動物避難所（National Wildlife Refuge）
相關單位（NOAA, NPS, FWS等）	古物法（Antiquities Act）*	國家遺址（National Monument）

* 古物法授權總統得宣布歷史地標或建物為國家遺址

製表／陳璋玲

對海洋的承諾：Our Ocean Conference

撰文／黃向文（海洋保育署署長）
關鍵字／我們的海洋、永續漁業、海洋酸化、海洋污染

對海洋做出承諾，讓海洋永續發展，是全世界皆應努力的方向。本篇介紹已舉辦6屆的「我們的海洋會議」，介紹全球致力於海洋保育，互相分享經驗、提供看法、並起身行動的努力。

圖說／「我們的海洋會議」合照（2019年）

圖片來源／Utenriksdepartementet UD Flickr (CC BY-NC-ND 2.0)

https://www.flickr.com/photos/utenriksdept/48947031352/

緣起

Our Ocean Conference（我們的海洋會議），並非國際組織，也沒有祕書處。卻擁有全球海洋界的高度參與，遑論其募款能力、高度執行力，及產官學合作無間。6年來，我們看到關注議題的焦點與轉變，從過程感受世人對於海洋的熱忱。究竟這是怎麼做到的？

這一切始自於2014年美國國務卿凱瑞的倡議，身為國務卿的他，滿懷對海洋的關懷，憂心海洋將被破壞殆盡，國際間卻總是說得太多，做得太少。於是，他登高一呼，在華府召開第一屆會議，超過90國代表齊聚一堂。不僅邀請到李奧納多基金會等民間基金會慷慨解囊，吉里巴斯總統等島國領袖對於氣候暖化的憂慮更令人動容。大眾齊心以永續漁業、海洋酸化、海洋污染為題，承諾投入8億美元、劃定300萬平方公里的海洋保護區，推動相關保育措施，共同維護海洋環境。

此波對海洋的熱愛逐漸擴散，2015年於智利瓦萊帕萊索、2016年於美國華府、2017年於歐盟馬爾他、2018年於印尼峇里島、2019年於挪威奧斯陸，接下來2020年8月將於帛琉舉辦第7屆會議，在此讓我們回顧這6年所累積的資產。

圖說／2015年「我們的海洋會議」於智利舉辦，美國國務卿凱瑞於會議上發言（左），智利復活島原住民與外交部長等慶賀通過海洋保護區（右）
圖片提供／黃向文

圖說／2018年印尼會議，左為出席高層官員，右為會外展覽場館
圖片來源／https://ourocean2018.org/（左）、黃向文提供（右）

會議核心與特色

從一開始，美國國務卿凱瑞就強調本會議的宗旨在於「匯集經驗、分享科學、提供看法、展現行動」。因此，會中不會長篇大論討論原則，而是聚焦於行動，挪威奧斯陸會議所用的3個字表達最為傳神：Learning, Sharing and Acting。

有別於一般研討會或國際會議的型式，會議就選定之行動領域，每節安排權威學者或高階官員（從總統、王儲到相關部會首長）闡述議題背景，接續以座談型式安排各國政要、非政府組織或企業代表CEO，分享經驗，再交換意見，中間穿插部分國家或組織的承諾（通常以1分鐘為限），時程安排緊湊，頗有起承轉合的邏輯思維。

在這樣緊密節奏下，正式議程並無討論時間，為把握機會交流，與會代表會在周邊安排雙邊會議，會場有展覽空間及周邊會議，讓各團體向大眾推廣理念。

此會議的特色是公開，因此，我們今天仍可從網站看到6次會議的討論過程，甚至歐盟會議還安排多語同步翻譯。再者，因為上臺報告人數極有限，時間短，挪威特別安排讓承諾者可在場外錄製短片上網，讓大家得以暢所欲言。

從歷屆會議的安排，可以注意到地主國為求取平衡，會廣邀各大洲代表，就同項議程讓產官學同臺對話。平衡之餘，仍可以感受地方特色，例如在印尼的熱帶氛圍，以及挪威高緯度的北海風格。

參與會議的民間代表，包括非政府組織、基金會或企業，扮演重要的推手。許多基金會本著對於環境的關懷，願意承諾高額資金，挹注新創事業。在挪威的會議上，Ocean Bottle的年輕CEO便是因為之前參加此會議，成功獲得資助，得以開創事業。也使得挪威安排許多新創者分享新產品或新想法，希望得到企業界的青睞，獲得第一筆資金。

而隨著瑞典環保少女Greta Thunberg的風潮，這兩年看到印尼少女Isabel Wijsen提倡的Bye Bye Plastic Bags、以及挪威的 Penelope Lea 站出來，呼籲高階官員積極行動。海洋青年論壇也起源於 Daniela V. Fernandez 參與會議後，得到凱瑞國務卿以及相關企業的資助，成立 Sustainable Ocean Alliance（https://www.soalliance.org）。從2016年開始辦理的青年論壇，藉由全球青年報名海選，擇出優秀者、贊助其旅費參與會議。論壇中會邀請各界賢達向青年分享海洋保育重點工作，包括在挪威會議上邀請帛琉第一夫人分享帛琉海洋保育經驗，並共同討論。Fernandez在會中期許「我們的海洋會議」各與會代表承諾的腳步可以加快，不要進行深海採礦等破壞海洋的行為，以及呼籲各界設立獎學金，鼓勵青年領袖提出創新想法。

行動領域

討論主題前後計有9項。包括4項固定議題：氣候變遷（前幾年以海洋酸化為題）、永續漁業、海洋污染（著重海廢塑膠）、海洋保護區為4大核心。其次是海事安全、藍色經濟，至於對海岸社區的重視以及能力建構、科學研究等3項議題，則相對篇幅有限，或融入前述其他議題中（參見下頁表）。

永續漁業之所以被重視，在於漁業提供數千萬人的經濟以及食物來源，有超過五千萬人以漁業為生，特別在許多開發中國家。也因此使得海洋漁業資源的永續面臨極其嚴苛的挑戰。會議聚焦於如何減少過度漁撈以及消除非法漁業、強化區域性漁業組織、重視科學評估以制定漁業管理政策，充分運用各種工具及合宜的處分措施，並確實督導。再者，如何透過媒體宣導，喚起民眾海洋保育的意識也非常重要，公民團體的倡議則有助於建立彼此的橋樑。

海洋污染的核心在於海洋塑膠污染，幾乎每位代表都會提到每年800萬噸垃圾流入海洋，2050年海洋當中的垃圾可能比魚多等預測。知名海廢研究學者Jambeck也多次參與會議討論，推廣如何減塑作法。越來越多企業投入承諾減少塑膠產品的使用或者提升循環利用的比例。

氣候變遷，一開始以海洋酸化為題，因應2019年IPCC5報告出爐，挪威會議當中有超過8成資金挹注於改善氣候變遷問題，包括運用離岸風電等降低溫室氣體的排放、增加再生能源的利用。

海洋保護區被認為是改善海洋環境的重要方法，也是永續發展目標第14項（SDG14）的重要指標。包括美國於第1屆會議公告夏威夷保護區，智利於第2屆會議宣示將復活島鄰近海域劃設為全球第3大海洋保護區等。海洋保護區的公告、管理及成效成為每年度檢視的重點。

至於新進提出的海事安全、藍色經濟，則凸顯出海洋產業永續的重要性。

表／「我們的海洋會議」討論主題

年度		2014	2015	2016	2017	2018	2019
日期		6/16-17	10/5-6	9/15-16	10/5-6	10/29-30	10/23-24
地點		美國華府	智利	美國華府	歐盟馬爾他	印尼峇里島	挪威奧斯陸
與會國家		>90	>50				>100
倡議（項）			>80	>136	437	305	374
承諾資金		>18億美元	>21億美元	>52.4億美元	>72億歐元	>107億美元	>638億美元
宣示海洋保護區面積		>300萬平方公里	>190萬平方公里	400萬平方公里	250萬平方公里	1,400萬平方公里	
主題	1海洋酸化（2016後稱氣候變遷）	V	V	V	V	V	V
	2永續漁業	V	V	V	V	V	V
	3海洋污染	V	V	V	V	V	V
	4海洋保護區		V	V	V	V	V
	5能力建構		V	V			
	6支持海岸社區		V	V			
	7海洋科研			V			
	8海事安全			V	V	V	V
	9藍色經濟				V	V	V

整理／黃向文

NGO的倡議與行動

國際海洋NGO組織，包括World Wildlife Fund（WWF）、Ocean Conservancy、Global Ghost Gear Initiative（GGGI）、Global Fishing Watch（GFW）都藉此會議拓展其影響力及尋覓合作夥伴。舉例來說，GGGI等組織與印尼社區合作，推廣漁具實名制。終結塑膠廢棄物聯盟也結合四十多家公司推動廢棄物管理。蒙特利水族館與越南、菲律賓合作成立永續蝦業、藍蟹漁業聯盟等，都是國際合作的成功案例。資訊公開也是許多NGO的倡議方向，包括GFW、Environmental Justice Foundation（EJF）、以及公部門都認為資訊公開（例如船舶AIS系統等）會是減少非法漁業，包括人權議題的利器。

企業社會責任並沒有被遺漏，許多大型企業在海廢議題上採取更多強化措施，例如愛迪達的海廢循環利用，雀巢希望使用100%可回收的包裝，IKEA、HP、可口可樂等都響應循環利用的做法。海洋管理委員會（Marine Stewardship Council, MSC）則是藉由科學認證程序，推廣永續產品，其成果相當豐碩，至今累計有400個漁業合作夥伴，代表1,200萬公噸或全世界16%的漁獲量，包括日本、中國等市場的合作夥伴都快速成長。

彭博慈善基金會從第1屆受到凱瑞國務卿號召而響應此活動，參與至今，6年來投入一億多美元保護珊瑚礁和漁業，協助保護425萬平方英里的海洋，以及參與GFW，希望促成20個國家參與該網絡。

省思

本會議的價值在於產官學通力合作，從出席代表可以看到許多科學家或組織提供科學研究或實證結果，以作為政策基礎。政府願意做出管理承諾，並共同支持民間團體，不論是相關產業、社會企業或者地方社區，如何透過資金的挹注、技術的研發到落實，才能真正達到保護海洋的目的。

儘管如此，雖然此會議非國際組織，政治色彩仍相當濃厚，臺灣的實質參與相對有限。我國代表多以專家或民間團體代表身分參與，本人以臺灣海洋大學教授等身分參與第2、5、6屆會議，得以與他國代表交流。至於承諾的部分，2017年於馬爾他會議，因應主辦方歐盟對於臺灣永續漁業的關切與期待，中華民國對外漁業合作發展協會（Overseas Fisheries Development Council of the Republic of China, OFDC）代表承諾「為強化遠洋漁船之漁業管理，臺灣願意投入7,750萬美元的5年計畫，以對抗非法漁業，加強電子監控與回報及執行港口國措施」。2019年則在美國的倡議下，呼應支持WTO降低IUU漁業補貼的承諾。

然而，不論參與與否，海洋是人類共同的資產，如何認真對海洋做出具體承諾，並付諸行動，才是吾輩應該思考的議題。最後，引用挪威會議中Oceana顧問Alexandra Cousteau的話作為結語：

「珊瑚不見了、漁業漸顯蕭條、漁村生計堪慮，保育及修復海洋的基金從來不夠，人們還不夠重視這些問題，但重建正在萎縮的海洋是當務之急。在做出每一個決定之前，想像我們現在的決定會對孩子將來的生活造成什麼影響。讓我們的孩子成為受益者，而非受害者。」

圖說／挪威會議高階官員對話（左）、挪威王儲哈孔展示挪威對於SDG的承諾（中）、Alexandra Cousteau發言（右）
圖片來源／Utenriksdepartementet UD Flickr (CC BY-NC-ND 2.0)
https://flickr.com/photos/45192101@N04/albums/72157711463396306/

NOAA最新美國海洋及五大湖經濟報告

撰文／黃釋緯（台灣經濟研究院副研究員）
關鍵詞／美國國家海洋暨大氣總署、海岸管理、海洋產業、藍色經濟

美國國家海洋經濟計畫（National Ocean Economics Program, NOEP）是蒙特利國際研究學院藍色經濟中心的核心研究項目，受到美國商務部國家海洋暨大氣總署（NOAA）的贊助。NOEP負責彙編、分析並發布海洋經濟相關數據，提供準確和即時的海洋和海岸經濟價值變化的估計。

NOAA依據NOEP出版的「美國海洋及海岸經濟狀況2016年版報告」，將海洋經濟（Ocean Economy）定義為：1.其活動與海洋有明確關聯的產業；或2.和海洋有部分關聯且位於鄰近海岸之區域。海洋經濟可分為6大部門，共計有23個相關產業，詳如表1所示。

表1／美國海洋經濟產業部門分類

部門	產業
海洋建築	海洋相關建築
生物資源	水產物種孵化與水產養殖
	漁獲捕撈
	水產食品市場
	水產食品加工
礦物採集	石油與天然氣探勘與生產
	石灰石、砂石與砂礫
船舶建造與維修	遊艇建造與維修
	船艦建造與維修
旅遊與娛樂	娛樂與休閒服務
	遊艇銷售
	餐飲
	住宿
	遊艇碼頭
	休旅車位與露營
	水上景點觀光
	運動商品
	動物園、水族館
海洋運輸	遠洋貨運
	海上客運
	海洋運輸服務
	搜索與航運設備
	倉儲

資料來源／國家海洋經濟計畫（NOEP 2016）；本研究整理

NOAA於2019年公布「美國海洋及大湖經濟報告（NOAA Report on the U.S. Ocean and Great Lakes Economy）」，本報告為NOEP於2016年公布的「美國海洋及海岸經濟狀況（State of the U.S. Ocean and Coastal Economies）」之更新，2016年版的海洋經濟數據呈現2010年和2013年的資訊，2019年的報告將相關數據更新到2016年。亦即，美國的海洋產業經濟資訊是每3年更新一次。以下為美國2016年海洋產業5項重點說明：

海洋產業的重要性

2016年美國海洋經濟公司行號共有15.4萬家，總計提供了330萬個工作機會，勞動參與約占全國的2.3%。海洋經濟產值為3,040億美元，占全國經濟比重為1.6%。以上占比看起來雖然很小，但是海洋產業的重要性不容小覷，例如以雇用的勞工來看，農作物生產業、電信業和建築業3個產業總雇用勞工合計為290萬人，尚不及海洋產業的330萬人。

海洋產業的堅韌性

海洋產業因應經濟景氣波動的能力較優於其他產業。以就業人口為例，相較於2007年起的金融海嘯而言，2016年海洋產業就業人數增加了14.5%，同期美國整體就業人口只增加4.8%。再由國內生產毛額來看，也可以顯示出海洋產業發展的彈性，2016年其生產總值成長了18.8%（經物價調整），遠高於整體經濟產值的10.7%。又由於2016年的經濟景氣不佳，在6大海洋產業部門中，只有生物資源和旅遊與娛樂等2個部門的就業數和經濟產值雙雙成長。

海洋產業組合的多樣性

海洋產業對於經濟的貢獻各有不同。例如，旅遊與娛樂部門是屬於勞力密集產業，2016年的雇用勞工占全體海洋產業的72%，但是其產值貢獻相對較小占40.9%；礦物採集部門則是資本密集產業，其雇用勞工占全體海洋產業只有4.1%，但是其經濟產值占全體海洋產業高達26.4%，僅次於勞力密集的旅遊與娛樂部門。

與海洋相關工作的重要性

海洋產業的薪資水準差異相當大。在2016年，礦物採集部門的年薪高達15.3萬美元，主要為海上石油平台工人或是支持探勘活動的工程師、地質學家或繪圖員等；相對地，旅遊與娛樂部門的年薪較低，約為2.5萬美元，主要的原因是此部門的勞工大部分為兼職工作，主要勞動力來源為學生或是剛進入勞動市場者。另外生物資源部門，例如漁業，其平均年薪為4.5萬美元遠低於全美國5.4萬美元的平均年薪。除了上述2個較為低薪的工作外，其他4個部門的年薪皆高於國家整體的年薪水準。

圖說／佛羅里達礁島群庇護區國家海洋庇護區的釣者
圖片來源／National Marine Sanctuaries
https://www.flickr.com/photos/onms/48779536487/

海洋產業個別部門整體表現不一

如上所述，海洋產業因其勞動力投入或是資本投入的差異，或是工作屬性的差異，造成不同部門的產業因應經濟景氣的彈性變化相當大，以下分別說明6大部門產業在2016年的表現：

一、海洋建築部門

本部門只計入相關海洋管溝建造、海岸線維護及碼頭建造等，並沒有包括油氣平台探勘建造部分，本部門在海洋產業占比相對較小，勞動力占1.4%，生產值占2.1%，其平均年薪為7.2萬美元，僅次於礦物採集部門，高於全國平均年薪5.4萬美元甚多。由於本部門不含私有的油氣產業之建築工程，其主要為政府支出，而主要的產值與雇用勞工，有超過一半來自於佛羅里達州、德州、加州和路易斯安那州。

二、生物資源部門

本部門在海洋產業占比也不高，勞動力占2.7%，生產值占3.7%，其平均年薪僅高於旅遊與娛樂部門，但是它和農業一樣重要，提供全國的海鮮及漁獲，其中水產食品加工業是本部門最大的產業，勞動力及產值皆占本部門4成之多。本部門有一重要的特質就是，其產業發展仰賴健全的海洋生態系統，其次它也有其文化上的意涵，捕撈漁業對於當地社區認同及社會網絡連絡是重要的一環。本部門另一重要特質是，很多勞工屬於自雇型的小型公司，其比例接近一半。

圖說／海洋運輸部門的重要性僅次於旅遊與娛樂及礦物採集二大部門

圖片來源／NOAA's National Ocean Service

https://www.flickr.com/photos/usoceangov/32780166561/

三、礦物採集部門

本部門最重要的產業為油氣生產，主要集中在墨西哥灣地區，且德州的油氣生產量占全國生產量超過8成。油氣生產屬於資本密集型產業，因此，本部門雇用的勞工相對較少，占海洋產業4.1%，且其生產技術及資本門檻高，整體產值亦高，占海洋產業26.4%。

四、船舶建造與維修部門

本部門在海洋產業之勞動力占比略高，約為4.8%，但其生產值僅占5.8%，平均年薪為6.7萬美元，高於全國平均年薪。船艇製造及維修業為本部門的核心產業，其勞動及產值占本部門比重，高達8成之多。本部門因製造成本逐年增加，易受整體經濟景氣之影響，主要的生產基地為維吉尼亞州及華盛頓州。

五、旅遊與娛樂部門

本部門為海洋產業中公司及勞工數最多的部門，雇用勞工占海洋產業達 72.7%，生產總值占40.9%。本部門最大的特性為產業活動具季節性（夏季人多，冬季人少），且勞工大多以兼職的學生為主，因此薪資相對較低。另外，因不少的設施屬於免費的公共設施，而且相關的產業如旅館業也只計入靠近海洋的部分，因此低估了本部門的市場價值。本部門的核心產業為旅館與飯店業，佛羅里達州與加州的勞工雇用及生產總值約占本部門產業的三分之一。

六、海洋運輸部門

本部門的重要性僅次於旅遊與娛樂及礦物採集二大部門，其勞動力占整體海洋產業的14.3%，生產值占21.2%，其平均年薪為7萬美元。倉儲業為勞力密集產業，其雇用勞工占本部門一半以上。加州是海洋運輸部門的重鎮，其雇用勞工及生產值高達本部門的四分之一。

表2／2016美國海洋經濟相關指標

產業部門	實績值		成長率（%）	
	勞工（萬人）	產值（十億美元）	勞工	產值
海洋建築	4.5	6.4	1.2	-0.4
生物資源	8.8	11.3	41.4	42.2
礦物採集	13.2	80	-15.9	-17.6
船舶建造與維修	15.8	17.5	-1.7	-6.4
旅遊與娛樂	236.8	124	3.2	0.6
海洋運輸	46.7	64.3	2.9	-0.8
總計	325.8	304	2.7	-6.7

資料來源／NOAA(2019)；本研究整理

美國國家海洋暨大氣總署與其轄屬部門之介紹

撰文／黃志誠（國立中央大學水文與海洋科學研究所副教授）
關鍵字／美國國家海洋暨大氣總署、NESDIS、NMFS、NOS、NWS、OMAO、OAR

本篇介紹美國國家海洋暨大氣總署的組織與6個轄屬部門。

美國國家海洋暨大氣總署的組織

美國國家海洋暨大氣總署（National Oceanic and Atmospheric Administration, NOAA）隸屬於商務部，該總署於1970年成立，整合美國海岸測量局、氣象局及漁業管理局3個單位。NOAA包含總務、溝通、教育、大氣事務的聯邦協調、國際事務、立法與政府間的庶務辦公室。除了行政部門外，它包含了6個業務部門，負責環境衛星、海洋漁業、海洋、氣象、海洋與航空作業、以及海洋與大氣研究。NOAA於2020年正在慶祝50年來的科學研究、服務及保育管理任務。

圖說／NOAA於2020年正在慶祝50年來的科學、服務及保育管理任務
圖片來源／NOAA
https://oceanservice.noaa.gov/

NOAA的任務

NOAA的主要目標為利用科學來富裕生活，因此，科學研究為NOAA所有業務的基礎根基，其任務涵蓋的領域從太陽表面延伸到海洋深處。科學研究、服務與保育管理（Science, Service and Stewardship）為該總署的主要使命，其主要任務包含3大項：1.理解及預測氣候、天氣、海洋、海岸的改變；2.知識與資訊共享；3.保存及管理海岸與海洋生態及資源。

NOAA的第一個任務為「科學研究」：旨在系統性的研究海洋、大氣、及其相關的生態系統的結構與行為，完成研究與分析的整合、進行觀測與監測、及建立環境模式。一般性的議題包含：1.研究海洋與大氣，及其研究知識可應用的議題，如氣候變遷的原因與後果；2.研究高影響天氣事件的物理動力機制；3.探索複雜生態系統及生物多樣性的動力機制；4.發展模式來預測這些複雜系統的未來狀態等。科學研究提供了NOAA服務與保育管理的任務基礎。

NOAA的第二個任務為「服務」：替國家的商務、社群、人民日常生活的使用，提供研究、資料、資訊及知識的溝通橋樑。提供的服務包含氣候預測及推測、氣象及水文的報告、預報及警示、航海圖及導航資訊、及持續提供地球觀測及科學數據讓大眾、私人及學術機構使用。

NOAA的第三個任務為「保育管理」：旨在保護人類與環境。NOAA有直接的管轄權來制定規章，以便支持海洋漁業及生態系、保護快要絕種的海洋物種、保護與復原棲地及生態系、保存海洋禁漁區及其他保護區、承擔環境緊急事件的應變、及災害復原的協助等。下圖展示了NOAA的任務領域。

圖說／NOAA的任務領域從太陽表面到海洋深處，主要使命包括科學研究、服務與保育管理3大項

圖片來源／NOAA

https://www.noaa.gov

NOAA的轄屬業務單位

NOAA有6個轄屬單位，其任務為：

一、**國家環境衛星、數據及資訊署（National Environmental Satellite, Data, and Information Service, NESDIS）**：該署任務為從衛星與其他資源，來取得並提供安全即時的全球環境資料與資訊，以促進及保護國家安全、環境、經濟及生活品質。

二、**國家海洋漁業署（National Marine Fisheries Service, NMFS）**：主要負責保育管理國家海洋資源及生態棲地，以合理的科學基礎與以生態系統為主的管理方式，來提供具生產力、永續的漁業資源、安全的水產海鮮，並復原及保存應被保護的資源及健康的生態系。

三、**國家海洋署（National Ocean Service, NOS）**：該署主要提供資料、工具及服務來支持海岸經濟及提升國家經濟力，NOS致力於提升及促進海洋有關的活動，旨在促進安全及有效率的運輸及商業活動、降低災害、並提升休閒與旅遊價值。NOS由以下幾個業務單位所組成：

（一）海洋作業產品與服務中心（Center for Operational Oceanographic Products and Services）：此中心蒐集了超過200年的美國海岸潮位資訊，負責提供潮位、海流的預報，及其他海洋及大氣資訊，也提供有害藻華（algal bloom）的預報。

（二）國家海岸科學中心（National Centers for Coastal Ocean Science）：此中心以科學研究為基礎，進行需要的監測與評估作業，來協助海岸生態的管理及協助國家社會對海岸環境的利用。

（三）國家大地測量辦公室（Office of National Geodetic Survey）：主要負責美國大地測繪業務。

（四）海岸管理辦公室（Office for Coastal Management）：主要的任務為融合私有部門、非營利、科學社群及政府機關致讓海岸社區更具有韌性。海岸管理旨在提供行動策略得以讓居民安全、經濟健全、及自然資源正常運作。在聯邦與州政府的合作關係計畫下，聯邦政府提供上位的命令，而該辦公室負責實際執行與提供技術上的協助。

（五）海岸調查辦公室（Office of Coast Survey）：該辦公室蒐集、管理資料，及將所需的資料與資訊轉成國家級的整套航海圖資。

（六）國家海洋庇護區辦公室（Office of National Marine Sanctuaries）：負責保存及保護美國最珍貴的水下保護區。

（七）應變與復原辦公室（Office of Response and Restoration）：該辦公室主要提供溢油污染發生時所需的科學及資訊，來協助美國海岸防衛隊；另外，和聯邦、州政府及自然部落的管理者合作，一起復原被溢油污染破壞的海岸資源。

四、**國家氣象署（National Weather Service, NWS）**：主要負責提供天氣、水資源、及氣候資料，以達成對生命財產、及促進國家經濟的預報及警示系統。

五、**海洋與航空作業辦公室（Office of Marine & Aviation Operations, OMAO）**：負責管理及操作NOAA的16艘研究與調查船、及9架飛機，也管理潛水、小船及飛航安全等計畫。

六、**海洋與大氣研究辦公室（Office of Oceanic and Atmospheric Research, OAR）**：此辦公室提供研究基金，負責NOAA的研究計畫，以研究來更瞭解地球裡各複雜的系統，以增進更好的預報及早期預警系統，來示警自然災害。主要的任務在提供正確、沒有偏差的科學資訊，來協助國家性及世界性的環境管理。

圖說／NMFS負責保育海洋資源（圖為潛水員從珊瑚礁中去除遺棄的網）

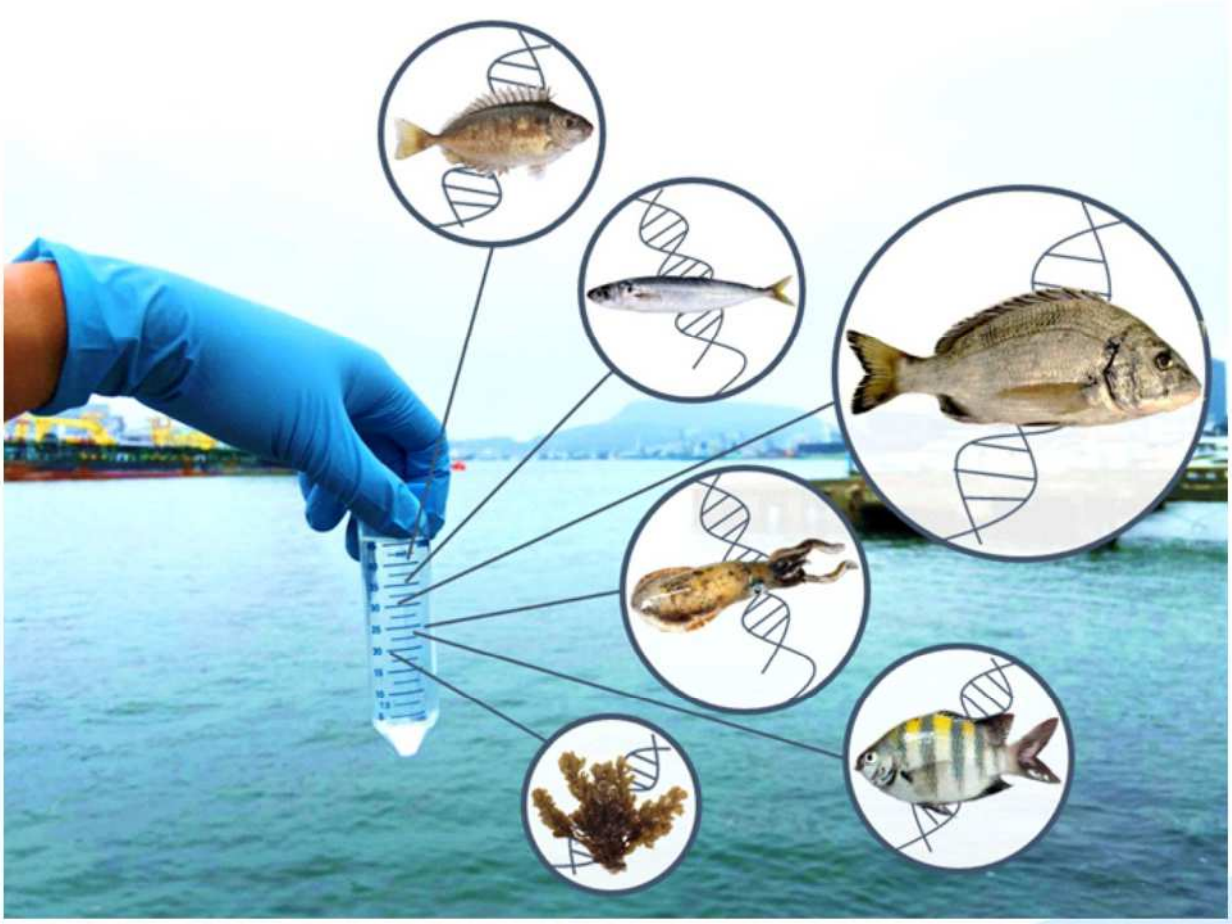
圖片來源／Dr. Dwayne Meadows, NOAA / NMFS / OPR

https://www.flickr.com/photos/noaaphotolib/5103120876/

翻轉海洋生態調查—環境DNA技術國際發展趨勢

撰文／陳宜暄（國家海洋研究院海洋生態及保育研究中心助理研究員）
關鍵字／環境DNA、海洋生態調查、生態保育、生物多樣性

從海裡提取一桶水來，就能知道這片海域有那些生物最近曾出現過，運用環境DNA（environmental DNA, eDNA）技術，將能大幅提升海洋生態調查研究速度，甚至有潛力發展成全民共同參與的海洋生態研究。



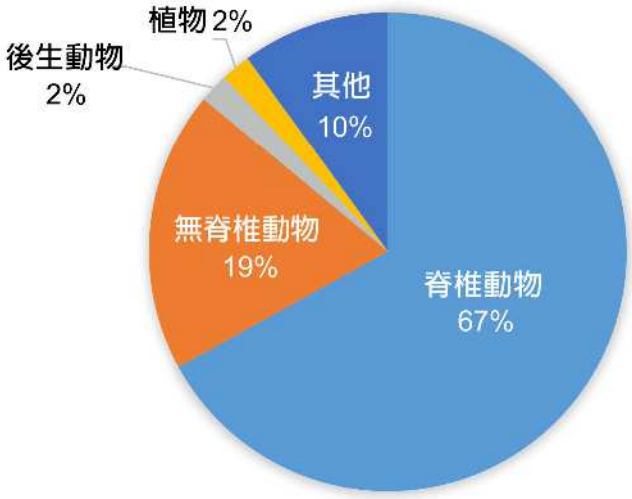
圖說／環境DNA示意圖
製圖／陳宜暄

環境DNA簡介

生物在活動及死亡過程中，會自然地遺留下皮屑、毛髮及鱗片等含有的細胞碎屑或游離DNA（deoxyribonucleic acid）至環境中，從水樣或沉積物等環境樣本提取之DNA，即稱為環境DNA。

一般而言，環境DNA很微量，且會隨時間自然降解；和沉積物相較起來，水樣中的環境DNA含量很容易被稀釋，由此可知，提取水樣中的環境DNA並非易事。然而，隨著近年來生物技術的蓬勃發展，我們得以運用聚合酶鏈鎖反應（Polymerase Chain Reaction, PCR）之DNA複製技術，在短時間內大量擴增DNA，並運用巨量條碼（Metabarcoding）或次世代定序（Next Generation Sequencing, NGS）等技術，同時分析多種生物之基因片段，因此使得從一桶水中即可一覽海洋生物出沒的蹤跡成為可能。

專家學者認為，環境 DNA 等新興技術的發展將為海洋生態保育打開新的篇章。在海洋保育上，生態系的生物多樣性長期變化為重要基礎資料。一般傳統調查方法包含水肺潛水、底泥採樣及網具採樣調查，然而，傳統調查仍有其限制，除了須投入大量人力及經費外，也受到氣候條件、採樣時間、生物隱蔽習性、形態鑑種之困難度等問題的限制。環境 DNA 技術的主要優點為僅需分析水樣或底質，不受生物組織樣本採集的限制，並能降低採樣對生物造成的傷害。



圖說／2008～2018年水域環境DNA之研究物種比率
資料來源／Tsuji, S., Takahara, T., Doi, H., Shibata, N., & Yamanaka, H. "The detection of aquatic macroorganisms using environmental DNA analysis—A review of methods for collection, extraction, and detection, " Environmental DNA 1, no. 2 (2019): 99-108

在現行環境DNA研究的物種（species）上，目前水域環境的目標物種以脊椎動物為主，並以魚類最多，而無脊椎動物中以軟體動物最多，其次為甲殼類（Tsuji et al., 2019）。以魚類研究為例，一份以日本千葉縣立中央博物館為首之研究，已研發出稱為MiFish的萬用PCR引子（primer），並成功鑑定出超過230種副熱帶海水魚（Miya et al., 2015）。

國際研究發展趨勢

一、封閉系統至開放系統

環境DNA最先源自於土壤微生物學，有別於陸域，水的流動特性使檢測更具挑戰性。水域環境DNA研究中，最先從較平靜且封閉的淡水湖泊生態系統開始，而海洋生態系統環境開放，易因波浪、潮汐、洋流等因素，造成環境DNA含量被稀釋。因此，科學家從水樣採集、過濾方式及萃取試劑等進行實驗方法改良，技術已見突破（Tsuji et al., 2019）。

二、單一物種至群聚組成

科學家如何從單一物種的鑑定，直至從水樣分析出群聚（community）中多種生物物種的組成？在1960年代，桑格定序（Sanger sequencing）使我們得以分析DNA遺傳密碼，生態學家採取單一生物組織樣本進行基因條碼分析（barcoding），獲得目標基因序列，實驗流程費時，且須投入大量人力及經費。而環境中的生物群聚組成複雜，過去並無法從水樣中分析各個DNA所屬的生物類別。

隨著生物技術的發展，基因定序方法大幅增快，成本相對降低，如次世代定序法能以大量短序列片段進行高速定序，甚至可應用於全基因體定序（Whole Genome Sequencing, WGS）。若將此項進展延伸應用至海洋生態調查，我們即可突破環境中的生物群聚組成複雜的問題，從一桶海水中的環境DNA，在短時間內得知含有那些魚類、甲殼類或珊瑚，將不是夢想。

目前環境DNA的研究，已有相當顯著及突破性的成果亮點，以下列舉目前應用於海洋保育的研究：

（一）物種分布

環境DNA技術可追蹤特定物種的分布，例如外來種、目標保育生物及環境指標生物等。在北海及波羅的海交界，丹麥科學家運用環境DNA發現了傳統調查法甚少紀錄的副熱帶沙丁魚種，推測牠的出現與氣候暖化有關（Thomsen et al., 2012）。藉由環境DNA分析可瞭解海洋生物的出現、分布及遷移模式，對於移除外來種、擬定保育策略及生態監測，能提供更豐富而完整的資訊。

（二）群聚組成

美國國家海洋保護區的長期生態調查研究，同時採用了多種傳統調查法及環境DNA技術調查保護區內生物群聚的組成，總共發現80個物種，所有調查方法中，以環境DNA鑑定出的物種最多，值得注意的是，以環境DNA分析出的群聚組成結果，2016及2017年間的差異正巧與海洋水文條件（例如：湧升流及海洋分層）變化相符（Closek et al., 2019），顯示環境DNA技術除了能提升海洋保護區的長期生態監測之外，也有助於我們分析生物群聚組成與環境變化的關聯。

三、學術研究至公民參與

隨著生物技術的演進，環境DNA研究不僅限於學術界，公民科學家參與研究計畫將日益可行。美國洛克斐勒大學（Rockefeller University）正在開發「Go Fish eDNA」簡易快篩工具，每個水樣鑑定單一物種只要15美元，每增加一個物種多加8美元（國家地理，〈革新海洋生態學的eDNA技術，究竟有何神奇之處〉，2018年12月，檢自https://reurl.cc/GVVrLy (Mar. 10, 2020)）。這種方法無須在專業的分子生物實驗室即可操作，明顯降低分析研究的成本。

另外，澳洲政府資助超過10億澳幣投入國家土地關懷計畫（National Landcare Program），其中一項EnviroDNA子計畫中，他們讓公民科學家參與農場水壩野生生物多樣性調查，由農場擁有者或其他公民科學家協助水樣的採集，送至實驗室分析。出乎意料地，他們發現野生近危物種－鴨嘴獸曾經出沒（EnviroDNA，“Farm Dam eDNA Biodiversity Report July 2019”，檢自https://www.envirodna.com/ (Feb. 11, 2020)）。這個計畫的特別之處，在於透過計畫參與，能讓一般民眾瞭解農場水壩的環境永續對生物多樣性的價值。

技術研發之挑戰

儘管環境DNA技術有許多優點，但仍有其限制，無法完全取代傳統生態調查。

首先，在進行PCR時需使用具專一性的引子，類似剪刀的功能，剪取目標基因片段，再將目標基因複製、擴增，然而目前環境DNA使用的引子並非萬能，大多數的物種目前仍缺乏適合的引子，或是存在解析度不高的問題，無法準確鑑定物種。

再者，現有的基因資料庫尚未完整，缺乏研究的生物類別，或親緣關係較複雜的物種，仍存在分類鑑種的問題。以魚類為例，非經濟魚種的基因序列資料相對較不完整。

理論上環境DNA的含量與生物量呈正比，但是目前的技術仍難以推算生物的族群數量、個體的體型大小及年齡組成結構等，這些仍須仰賴實施拖網採樣、潛水調查等傳統調查法獲得。因此，最佳策略是以現有生態調查搭配環境DNA技術進行研究，並逐漸充實當地的基因資料庫，以及研發適用之引子，逐步改進分析技術，以獲得完整的生態資訊，並建立長期生態監測機制。

圖說／環境DNA實驗流程示意圖
製圖／國家海洋研究院海洋生態及保育研究中心

結語

臺灣位於珊瑚大三角（Coral Triangle）的北端，地處海洋生物多樣性熱點，已被發現和登錄的海洋生物高達1萬3,000種（邵廣昭，「臺灣魚類資料庫」網路電子版，檢自http://fishdb.sinica.edu.tw (Feb. 12, 2020)）。其中，除了具經濟價值的魚種之外，我們對於臺灣大多數海洋生物的生活史、地理分布及族群結構，缺乏長期性、整合性的研究。當我們對其不瞭解時，就難以評估環境變遷的影響，以及保育政策的成效。

考量環境DNA具備方便及快速分析的潛力，我們建議未來海洋生態調查研究中，以實施傳統調查法配合環境DNA技術並行。為達成這個目標，首先應以充實序列比對的基因資料庫為基礎，設計適合的引子，並研發可應用於長期生態調查的環境DNA調查法，甚至於將來併入海域水質檢測項目中。

隨著未來生物技術的快速發展，環境DNA技術可望能促使整合性海洋生態監測研究的成本降低、效益提升，甚至納入公民參與，以提升國民海洋素養，將有助於臺灣海洋生態保育，以及海洋資源的永續發展。

延伸閱讀

"eDNA Expands Species Surveys to Capture a More Complete Picture," NOAA Fisheries West Coast Region, Dec. 19, 2018, https://www.fisheries.noaa.gov/feature-story/edna-expands-species-surveys-capture-more-complete-picture (Jan. 3, 2020).

美國國家海洋暨大氣總署主管之相關法律介紹

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關鍵字／美國國家海洋暨大氣總署、麥格努森-史帝文斯法、瀕危物種法、海洋哺乳類保護法、海岸地區管理法

本篇將針對美國國家海洋暨大氣總署（National Oceanic and Atmospheric Administration, NOAA）所主管之相關法律進行介紹。

〈麥格努森-史帝文斯法〉（Magnuson-Stevens Act, MSA）

〈麥格努森-史帝文斯法〉，全名為〈麥格努森-史帝文斯漁業保育與管理法〉（Magnuson-Stevens Fishery Conservation and Management Act）是處理美國聯邦水域中海洋漁業管理最主要的法律。該法於1976年通過，主要目的是使美國的海洋漁業資源能夠達成在生物與經濟層面上之永續發展。其主要目標包括避免過漁、重建已被過度捕撈之魚群、增進長期的經濟與社會利益、以及確保水產品安全與永續之供應。該法之主管機關為美國國家海洋暨大氣總署下之國家海洋漁業署（National Marine Fisheries Service, NMFS）。

在該法通過前，國際水域是從離岸12浬開始起算，其中之漁業資源則被許多未受規範的外籍漁船隊大量捕撈。該法在1976年通過，將美國的管轄水域擴展至離岸200浬之範圍，並建立了8個區域漁業管理委員會（regional fisheries management councils），由來自各沿海州及漁業利益相關方共同參與。這些委員會發展與該法保育與管理要求相符之漁業管理計畫，促進美國管轄水域之永續漁業管理。

美國國會曾兩度對該法進行大幅度的修正。第一次修正係在1996年，當時是為了〈永續漁業法〉（Sustainable Fisheries Act）之通過而進行修正，修正之內容包括強化避免過漁及重建已過漁漁業之規定、明訂漁業管理計畫中判定魚群狀態之目標及可量測標準、增加3個國家標準以處理漁船安全、漁捕社群及混獲等議題、以及導入「棲地」之概念並設為漁業管理之重要因素等。第二次修正則是在2007年，當年通過了〈麥格努森-史帝文斯法再授權法〉（MSA Reauthorization Act），修正內容包括建立年度捕撈限額、促進以市場為基礎之保育管理策略、強化科學在漁業管理之角色、以及強化國際合作以處理非法、未報告及不受規範（illegal, unreported and unregulated, IUU）漁撈行為之相關議題。

〈瀕危物種法〉（Endangered Species Act, ESA）

〈瀕危物種法〉係美國國會於1973年時所通過。認知到美國的自然遺產在美學、生態、教育、休閒娛樂及科學上對國家與民眾之價值，若不加以保存將會使得許多美國的原生動植物面臨滅絕。該法主要由NMFS及內政部下之美國魚類暨野生動物署（U.S. Fish and Wildlife Service, FWS）共同負責執行。前者主要負責海域範圍，而後者主要負責陸上及淡水水域之範圍。

在〈瀕危物種法〉之規範下，美國聯邦政府需負起下列責任保護下列各項物種：

一、瀕危物種：指全部或整個族群大部分面臨滅絕危險之物種；
二、受威脅物種：指在可見的未來有可能會變成瀕危物種之物種；
三、關鍵棲地：指被列為瀕危或受威脅之物種所占有及分布之特定地理區域，且上述區域包括了在保育上重要之物理或生物特徵，需要受到特別管理考量或保護之區域。

目前NMFS已表列有165種瀕危或受威脅物種，其中80種屬於瀕危物種，85種屬於受威脅物種。在這165種物種中，有66種是屬於境外物種（亦即該物種存在的區域為美國管轄範圍外），其中有40種屬於瀕危物種，26種屬於受威脅物種。

〈海洋哺乳類保護法〉（Marine Mammal Protection Act, MMPA）

為回應科學家與公眾對於某些海洋哺乳類因人類活動造成顯著減少的關切，美國國會於1972年通過了〈海洋哺乳類保護法〉。該法建立了一套國家政策，用以避免海洋哺乳類及其族群數量減少至該物種在生態系已無法顯現顯著功能標準之下，也是美國第一部授權以生態系為基礎之措施進行海洋資源管理之法律。

在該法下，所有的海洋哺乳類都受到保護。同時，部分海洋哺乳類也受到〈瀕危物種法〉及〈瀕危野生動植物國際貿易公約〉（Convention on International Trade in Endangered Species of Wild Fauna and Flora，簡稱CITES或是華盛頓公約）之保護。

目前有3個聯邦機關負責該法之執行。NMFS主要負責鯨魚、海豚等海洋哺乳類之保護；FWS則是負責海象、北極熊等物種之保護；海洋哺乳類委員會（Marine Mammal Commission）則是針對聯邦政府之相關政策提供獨立及以科學為基礎之監督。此外，美國農業部下的動植物健康檢查署（Animal and Plant Health Inspection Service）則是負責管理在公共展演設施（如水族館或動物園）之海洋哺乳類。

圖片來源／Pride Advertising Agency Ltd.

〈海岸地區管理法〉（Coastal Zone Management Act, CZMA）

美國國會於1972年通過了〈海岸地區管理法〉，主要是認知到海岸地區持續發展所帶來的相關挑戰及問題。該法提供了管理國家海岸資源之法源，包括五大湖區，其目標為「在可能的條件下，保存、保護、發展及恢復或增進國家海岸地區之資源」。該法之主管機關為NOAA下之海岸管理辦公室（Office for Coastal Management）。

該法包含了一個聯邦政府與州政府一致性的法條，亦即要求聯邦政府在採行相關行動時，需與州政府所通過管理計畫中之執法政策一致。此外，〈海岸地區管理法〉概述出3種國家計畫，包括國家海岸地區管理計畫（National Coastal Zone Management Program）、國家河口研究保留系統（National Estuarine Research Reserve System）、以及海岸與河口陸地保育計畫（Coastal and Estuarine Land Conservation Program, CELCP）。第一種計畫主要目標在於透過州及屬地之海岸管理計畫平衡陸地與水域之使用競爭；第二種計畫則是成為野外實驗室，提供河口及人類如何影響河口等更佳的瞭解；第三種計畫則是提供州政府與地方政府相關預算，以購入受威脅之海岸及河口土地等。

圖說／ESA認定之瀕危物種
圖片來源／NOAA Fisheries
https://www.fisheries.noaa.gov/species-directory/threatened-endangered

The Key to Ocean Conservation: Taking Action by Accumulating Experience and Knowledge!

Translated by Linguitronics
Keywords: Sustainable Ocean, MPAs, NOAA, eDNA

Minister of the Ocean Affairs Council: Chung-Wei Lee

Committing to a sustainable ocean is the direction towards which the world should strive. The United States has decades of experience in ocean policies, resources management, and species conservation. In this issue, we will share with readers the ocean experiences of advanced countries, looking specifically at the United States.

The US National Oceanic and Atmospheric Administration (NOAA) is the leading agency for ocean policy in the United States. The agency focuses on atmospheric and oceanic changes, and maintains and manages oceanic and coastal resources. Besides introducing the NOAA and related organizations, we will focus on the industrial aspects of the NOAA's latest issue of the Report on the U.S. Ocean and Great Lakes Economy. This issue analyzes the United States' currently high labor rate in the ocean economy, and its high capabilities in responding to economic fluctuations, which possesses more diverse combinations. On the aspect of laws and regulations, we provide the NOAA regulations for ocean fishery management, species preservation, and coastal zone management.

Marine protected areas (MPAs) is a widely accepted and important management method in preserving ocean biodiversity and reducing negative impacts from such things as ocean development, overfishing, and climate change on the ocean environment. The first issue of this journal reports on the promotion and progress of Aichi Target 11 (In 2020, at least 17% of land and inland waters, and 10% of coastal and marine areas protected) in recent years. This issues' "Special Report" introduces the establishment of the Marine Protected Area system by the United States to preserve biodiversity hot spots, shipwreck ruins of historical value, and important fisheries resources. In 2008, the United States set up its integrated National System of Marine Protected Areas; its complete framework can be used for our reference. In "Latest News", we introduce the research progress on environmental DNA (eDNA) technologies in the world. With micro DNA extracted from marine organisms in environmental samples such as seawater or sediment, we are able to analyze organisms that appear in the sea area without hurting the organisms. This new method of preserving the ocean by improving scientific technologies even has the potential of being developed into marine ecological research in which the public can participate.

Besides sharing the experience of the United States, the "International Issues" report will introduce the Our Ocean Conference, the 6th conference since its initiation by US Secretary of State, Kerry, in 2014. The conference focuses on sharing experiences and making pledges to preserve the ocean with the cooperation of the industries, governments, and academic institutions of various countries. In the 2019 conference, Taiwan participants called for support of the WTO's pledge to reduce subsidies for IUU fisheries, exhibiting our determination of maintaining the ocean environment together!

Marine Protected Areas and the National System of MPAs of the US

Chung-Ling Chen (Professor, National Cheng Kung University)
Keywords: MPAs, US NOAA, National system of MPAs

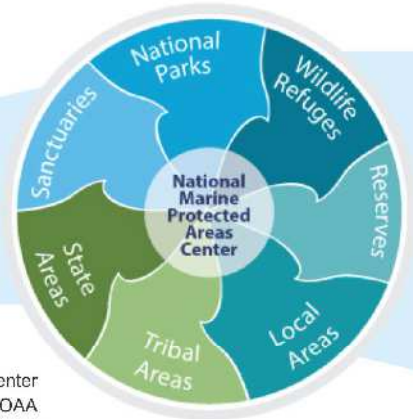
Marine Protected Areas (MPAs) have long been used as important marine resource conservation and management tools. In the US, more than 1,700 MPAs have been established by more than 100 legal authorities, each with its own legal footing and purpose. In order to strengthen the management effectiveness of existing MPAs as well as foster regional MPA networks and collaboration, the US government built a National System of MPAs in 2008, showing an introduction of the integrated management to the existing sectoral management of MPAs. This system represents diverse marine ecosystems and natural and culture resources in the US.

Overview of the US MPAs

The United States has a total of 30 States and 5 Territories (Guam, American Samoa, Northern Mariana Islands, Puerto Rico, and US Virgin Islands) bordering the sea with the coastline reaching about 13,600 kilometers, including the coast of the Great Lakes. With the world's largest Exclusive Economic Zone, the coastal, marine and Great Lakes waters of the US support an incredible diversity and wealth of life. In order to ensure the long-term health of these ecosystems and the sustainable use of marine resources, MPAs serve as an important management tool. They are mainly established at the Federal and State levels of governments by a variety of agencies including parks, fisheries, wildlife, national resource, and historic resource departments, among others.

The terms used to denote MPAs are different, including national parks, wildlife refuges and national marine sanctuaries. The objectives of MPAs are diverse, ranging from conservation of biodiversity hotspots, to preservation of sunken historic vessels, to protection of spawning aggregations important to commercial and recreational fisheries. Similarly, the level of protection provided by the MPAs ranges from fully protected or no-take marine reserves to sites allowing multiple uses, including fishing, recreational, and industrial uses.

At the Federal level, three main authorities are in charge of establishment and management of MPAs, which are: 1. NOAA, Department of Commerce (DOC); 2. National Park Service (NPS), Department of the Interior (DOI); 3. Fish and Wildlife Service (FWS), DOI.



US National MPA Center
Image by NOAA
https://marineprotectedareas.noaa.gov/aboutmpas/mpacenter/

According to the National Marine Sanctuaries Act, NOAA Office of Marine Sanctuaries have established 14 national marine sanctuaries. One of them is Florida Keys National Marine Sanctuary. Within its boundaries lie spectacular coral reefs, seagrass beds, and shipwrecks. This sanctuary allows for multiple uses and is a famous tourist and diving site. In addition, NOAA Office for Coastal Management, based on the Coastal Zone Management Act, have designated 29 National Estuaries Research Reserves (NERRs). These Reserves serve as natural field laboratories and are for the purposes of protection, research, training and education. The level of protection is the highest, compared to other MPA types. The total area covered by NERRs is about 13 thousand acres of estuaries.

Geographic distribution of National Estuarine Research Reserves
Image by NOAA
https://coast.noaa.gov/nerrs/

The National Park Act authorizes the NPS to establish national parks, some of which are located on the coast or offshore islands. For example, Channel Islands National Park, situated off the coast of California, covers 5 islands and the waters of 3 nautical miles from each island's coast. Its area overlaps with the area of Channel Islands National Marine Sanctuary. But, the sea area of the latter extends up to 6 nautical miles from the island' coast. This park, co-managed by NOAA and NPS, provides spectacular kelp forests, coral reefs, seals, and sea birds.

Channel Islands National Marine Sanctuary provides kelp forests, sea birds and other natural resources
Image by Chung-Ling Chen

A number of laws and regulations pave the way for the FWS to establish wildlife refuges, including the Refuge Administration Act, National Wildlife Refuge Volunteer Improvement Act, Executive Order 12996, Refuge Recreation Act, among others. Some of them are located along estuaries, wetlands or barrier islands to protect the habitat of wildlife. The refugees make up the largest National Wildlife Refuge System in the US, consisting of 568 sites with a combined total area of more than 150 million acres. This system provides habitat for over 700 species of birds, 220 species of mammals, 250 reptile and amphibian species and more than 1,000 species of fish.

In addition of the above, the US President, authorized by the Antiquities Act, can declare historic landmarks or structures that are situated upon lands or controlled by the Government of the US to be national monuments. For example, the Papahānaumokuākea National Monument, the largest MPA in the US, was established by the Proclamation 8031 declared by the President George Bush in June 15, 2006. This MPA covers 1.5 million square kilometers, hosting abundant coral reefs and 7,000 species of marine life. It is administered jointly by four co-trustees with their own portioned management responsibilities: the DOC (NOAA), the DOI (FWS), the State of Hawaii, and the Office of Hawaiian Affairs.

At the level of State governments, several agencies are in charge of designating and managing MPAs, including State Park, Nature Reserve, Natural Area Reserve, and Wildlife Management Area, among others. For example, Cape Henlopen State Park, Delaware, offers beaches, sand dunes, maritime forests, trails, bunkers and other natural and cultural treasures. Hearst San Simeon State Park, California, protects habitat for elephant seals and is a famous tourist spot attracting visitors to watch elephant seals onshore.

Hearst San Simeon State Park protects habitat of elephant seals
Image by Chung-Ling Chen

The National System of MPAs

Recognizing the importance of MPAs in conserving marine resources as well as strengthening the connection between MPAs and the management capacity, the President Bill Clinton issued the Executive Order 13158 of May 26, 2000, which directs the Department of Commerce and the Department of the Interior, in consultation with other federal agencies, to develop a National System of Marine Protected Areas (national system). The Order specifies that this is a national and not a federal system and requires consultations with all states, tribes, Regional Fishery Management Councils, and other entities. The Order further specifies that the national system be scientifically based and comprehensive, and that it represents the diverse marine ecosystems of the US and the nation's natural and cultural resources. The Order also calls for a framework for a National System of MPAs and establishes the National MPA Center within NOAA to develop the system and coordinate its subsequent implementation.

However, it should be noted that neither the national system nor the Order establish any new legal authorities to designate, manage, or change MAPs, nor do they alter any existing federal, state, local, or tribal MPA laws or programs. Each MPA that participates in the national system will continue to be independently managed by its respective entity, as will any new MPAs that are established by their respective authorities.

The national system was established in 2008. Its main content is described below.

- Definition of MPA: any area of the marine environment that has been reserved by Federal, State, territorial, tribal or local laws of regulations to provide lasting protection for part or all of the natural and cultural resources therein.
- Classification system of MPA: five functional characteristics are used to describe any MPA, including 1. conservation focus (natural heritage, cultural heritage, sustainable production), 2. level of protection (uniform multiple-use, zoned multiple-use, zoned multiple-use with not-take areas, no-take, no impact, no access), 3. permanence of protection (permanent, conditional, temporary), 4. constancy of protection (year-round, seasonal, rotating), 5. scale of protection (ecosystem, focal resource).
- Building the national system: federal agencies work with other partners to identify, nominate and including existing MPAs meeting the criteria into the national system. As of March 2014, there are 437 sites in the national system, accounting for about one quarter of existing MPAs (1,700 sites). Participating in the national system does not constrain the management entity from changing its management of the MPA. The entity would still have the ability, within its own authorities, to modify levels of protection, the size of the MPA, or make other changes. In addition, MPAs included on the List of the national system may be removed at any time by the managing entity or the MPA Center for reasons: the MPA ceases to exist, the MPA nor longer meets the criteria, or the managing entity requests removal.
- Eligibility criteria for the national system: to be eligible for nomination to the national system, existing MPAs must meet three (four for cultural sites) criteria: 1. meet the definition criteria of an MPA, 2. have a management plan, 3. support at least one conservative objective, 4. cultural heritage MPAs also must conform to criteria for including sites on the National Register of Historic Places, or be considered important by Indian Tribes, Alaska Natives, Native Hawaiians, and Pacific Islanders. Eligible MPAs, meeting the above criteria, are nominated and reviewed through specific processes and decisions are made on the inclusion of MPAs in the national system.
- Tracking, reporting and evaluation: the MPA Center will report on progress biennially, and monitor and evaluate management effectiveness of the national system.

Table /Federal agencies, laws and terms of MPAs

Federal agencies	Law	Term of MPAs
NOAA Office for Coastal Management	Coastal Zone Management Act	National Estuarine Research Reserve
NOAA Office of Marine Sanctuaries	National Marine Sanctuaries Act	National Marine Sanctuary
National Park Service	National Park Act	National Park, National Seashore
Fish and Wildlife Service	Refuge Administration Act National Wildlife Refuge Volunteer Improvement Act of 2010 Executive Order 12996 Refuge Recreation Act	National Wildlife Refuge
Others (NOAA, NPS, FWS etc.)	Antiquities Act*	National Monument

* This Act authorizes the President to declare historic landmarks or structures to be national monuments
Source / Chung-Ling Chen

Commitment to the Ocean: Our Ocean Conference

Julia Hsiang-Wen Huang (Director-general of the Ocean Conservation Administration, Ocean Affairs Council)
Translated by Linguitronics
Keywords: Our Ocean, sustainable fishery, ocean acidification, marine pollution

Committing to a sustainable ocean is the direction towards which the world should strive. This article introduces the Our Ocean Conference, an event which is in its 6th year. The event highlights the world's dedication to ocean conservation, sharing of experience, providing opinions, and efforts in taking action.

Group photo at the Our Ocean Conference (2019)
Image by Utenriksdepartementet UD Flickr (CC BY-NC-ND 2.0)
https://www.flickr.com/photos/utenriksdept/48947031352/

Introduction

Our Ocean Conference is not an international organization and does not have a secretariat. In spite of this, it receives high participation from ocean communities from all over the world, not to mention its high capabilities in fund raising and execution, and seamless cooperation with industry, government and academia. In the past 6 years, we have seen the focus on and changes to the issues of concern, and in the process, we are able to feel the passion people have for the ocean. How is this achieved?

It all began with the initiative of US Secretary of State John Kerry in 2014. As the Secretary of State, he was very concerned about the ocean and feared its destruction, as there had always been too much talk and too little action. Therefore, he made a call to convene the first conference in Washington D.C., which was attended by representatives from more than 90 countries. There were generous donations from private foundations, such as the Leonardo DiCaprio Foundation, and concerns for global warming

from island leaders like the President of Kiribati were heartwarming. Everyone involved worked together, focusing their attention on topics like sustainable fisheries, ocean acidification, and marine pollution. USD800 million in investment and designation of 3 million square kilometers of marine protected areas were pledged to maintain the ocean environment.

The love for the ocean gradually spread to Valparaíso, Chile in 2015, Washington D.C. in 2016, Malta, EU in 2017, Bali, Indonesia in 2018, and Oslo, Norway in 2019. The 7th conference will be held in Palau in August 2020. Now, let us look at the assets we have accumulated over the past 6 years.

The core and characteristics of the conference

Since the inception of the conference, Secretary of State Kerry has been emphasizing its objectives, which are to "gather experience, share science, provide opinions, and take action." Hence, the conference does not have long speeches discussing principle, but focuses on action. The 3 words used in the conference in Oslo, Norway, are most precise: Learning, Sharing, and Acting.

Different from the format of normal seminars or international conferences, the Our Ocean Conference arranges renowned scholars or high-ranking officials (from presidents and heirs to the throne to department heads) to set the background of the topic for each section of the selected areas of action. It is then followed by seminars where important members of the government, non-governmental organizations, or corporate representatives and CEOs, share their experiences and exchange opinions. During the session, commitments of some countries or organizations (normally limited to 1 minute) are shown. The schedule is compact, encouraging a coherent and logical process.

With such tight schedule, there is no time for discussion during the formal agenda. To grasp the opportunities for exchange, participating representatives conduct peripheral bilateral meetings, and there are also exhibition areas and side meetings for organizations to promote their philosophies to the public.

The highlight of the conference is openness. Hence, you can still find the discussions from the 6 conferences available on the Internet today. The European Union conference also arranged simultaneous interpretation in several languages. In addition, due to the limits of the number of people to go on stage, and the limited time, Norway made special arrangements for people making pledges to pre-record a short video outside the venue, and then upload it, so that they are able to speak freely.

Looking at the arrangement of past conferences, we notice that in order to strike a balance, the host countries invite representatives from industry, government, and academia from various continents, for discussion sessions on the same topic. Besides striking a balance, we can still experience their local cultures, such as Indonesia's tropical atmosphere and Norway's northern marine style.

Civil representatives attending the conference include non-governmental organizations, foundations, or corporations, who play important roles in promotion. Many foundations care about the environment and are willing to commit to large amounts of funding and investment in new ventures. In the Norway conference, Ocean Bottle successfully obtained startup funding because of its young CEO's participation in past conferences. The Norway conference thus arranged several startups to share their new products or ideas, in the aim of gaining recognition and obtaining initial funding from other enterprises.

In the past two years, following the movement associated with the Swedish environmentalist Greta Thunberg, we saw Isabel Wijsen from Indonesia's Bye Bye Plastic Bags, and Norway's Penelope Lea,

appealing to high-ranking officials to take resolute action. The Our Ocean Youth Leadership Summit began after Daniela V. Fernandez attended the conference; funding was obtained from Secretary of State Kerry and corporations to establish the Sustainable Ocean Alliance (https://www.soalliance.org). The Youth Leadership Summit has been held since 2016. Outstanding young people are selected from applicants all over the world, and their travel expenses to the conference are covered. The summit invites prominent figures from various domains to share the key works of ocean conservation with these young people. For example, the Norway conference invited the First Lady of Palau to share Palau's experience in ocean conservation and encouraged participants to engage in the discussion. During the conference, Fernandez expressed hopes that the commitments made by the representatives of the conference can be expedited; actions such as deep sea mining, which will damage the ocean, can be stopped, and the various fields can set up scholarships to encourage young leaders in proposing innovative ideas.

Areas of action

There were a total of 9 discussion topics covered in the past conferences, including 4 fixed topics: climate change (topic was ocean acidification in the past few years), sustainable fisheries, marine pollution (with focus on ocean waste plastic) and marine protected areas. Other topics include maritime security and blue economy. The remaining 3 topics, which are attention given to coastal communities, capacity building, and scientific research, were less mentioned or incorporated into other previous topics (as shown in the table).

Sustainable fisheries have always been a focus because fisheries have economic value and are a source of food for millions of people. More than 50 million people, especially in many developing countries, rely on fisheries for a living. As a result, the sustainability of fishery resources faces extremely harsh challenges. The conference focuses on how to reduce overfishing and combat IUU fishing, strengthen regional fishery organizations, value scientific assessment to establish fisheries management policies, fully utilize various tools and suitable disciplinary measures, and implement supervision. In addition, making use of media to raise awareness of ocean conservation is very important, and initiatives by civil societies also aid in establishing a bridge between them.

The core issue of marine pollution is marine debris. Lots of representative mentioned the 8 million tons of plastic rubbish flowing into the ocean every year, and the prediction that the amount of marine debris may exceed that of fish by 2050. The well-known scholar of marine debris research, Dr. Jenna Jambeck, has participated in various discussions at the conference, and has promoted ways of reducing plastic. More and more enterprises have committed to reducing the use of plastic products or increasing the proportion of recycling and reuse.

The topic of climate change began as ocean acidification. In response to the 2019 IPCC5 report, more than 80% of funds from the Norway conference are for improving the situation resulting from climate change, which includes making use of offshore wind farm to reduce GHG emissions and increasing the use of renewable energy.

Marine protected areas are considered important methods in improving the marine environment as well as an important indicator of Goal 14 of the Sustainable Development Goals (SDG14). This includes the marine protected areas of "Papahānaumokuākea Marine National Monument" off the coast of Hawaii announced in the 1st conference in the United States, and the designation of the seas surrounding Easter Island as the world's 3rd largest marine protected area in the 2nd conference held in Chile. The announcement, management, and results of marine protected areas have become the focus of inspection each year.

The newly proposed maritime security and blue economy highlight the importance of the sustainability of the ocean industries.

Table / "Our Ocean Conference" discussion topics

Year		2014	2015	2016	2017	2018	2019
Date		6/16-17	10/5-6	9/15-16	10/5-6	10/29-30	10/23-24
Location		Washington D.C., United States	Chile	Washington D.C., United States	Malta, European Union	Bali, Indonesia	Oslo, Norway
Participating countries		>90	>50				>100
Initiatives			>80	>136	437	305	374
Pledged Amount		> USD1.8 billion	>USD2.1 billion	> USD5.24 billion	EURO7.2 billion	USD10.7 billion	USD63.8 billion
Declaration of area of marine protected areas		> 3 million square kilometers	> 1.9 million square kilometers	4 million square kilometers	2.5 million square kilometers	14 million square kilometers	
Topic	1 Ocean acidification ("climate change" after 2016)	V	V	V	V	V	V
	2 Sustainable fisheries	V	V	V	V	V	V
	3 Marine pollution	V	V	V	V	V	V
	4 Marine protected areas		V	V	V	V	V
	5 Capacity building		V	V			
	6 Support coastal communities		V	V			
	7 Marine research			V			
	8 Maritime security			V	V	V	V
	9 Blue economy				V	V	V

Compiled by Julia Hsiang-Wen Huang

NGO's initiatives and actions

Global NGOs related to ocean affairs, including World Wildlife Fund (WWF), Ocean Conservancy, Global Ghost Gear Initiative (GGGI), and Global Fishing Watch (GFW), make use of this conference to expand their influence and find partners for cooperation. For example, GGGI cooperated with Indonesian communities in promoting real-name fishing gear. The Alliance to End Plastic Waste (AEPW) cooperated with more than 40 companies in promoting waste management. The Monterey Bay Aquarium cooperated with Vietnam and the Philippines in establishing sustainable shrimp industry and blue crab fisheries alliance, among others, which are all success cases of international cooperation. Information transparency is also an initiative of many NGOs. GFW, EJF, and the public sector feel that information transparency (such as the AIS vessel tracking data) will be a useful tool in reducing illegal fisheries, including human rights issues.

Corporate social responsibilities have not been forgotten. Many large corporations have adopted stricter measures in ocean waste issues. For example, Adidas recycles and reuses ocean waste, Nestlé hopes to use 100% recyclable packaging, and IKEA, HP, Coca-Cola, and others have responded with recycling methods. The Marine Stewardship Council (MSC) promotes sustainable products through scientific certification procedures, and has produced fruitful results. It has since accumulated 400 fishery partners, representing 12 million tons, or 16%, of the world's catch. Also, nations such as Japan and China have shown rapid market growth.

Bloomberg Philanthropies has been engaged in this event since the 1st conference initiated by Secretary of State Kerry, and has invested more than USD100 million in protecting corals and fisheries over its 6 years of participation. It has helped to protect 4.25 million square miles of ocean, and participated in GFW in the aim to facilitate 20 countries in joining the network.

Conclusion

The significance of the conference is the cooperation between industry, government, and academia. From the attending representatives, we can see scientific research and actual results provided by scientists and organizations, which can be used as the basis for policymaking. The governments are willing to make management commitments, and together support civil societies, regardless of whether they are industries, social enterprises, or local communities, and to truly achieve the objectives of protecting the ocean through fund investment, technological research, and implementation.

In spite of this, though the conference is not an international organization, it is quite political and Taiwan has relatively limited participation. Taiwan's representatives usually participated as experts or members of civic organizations. For my own part, I participated in the 2nd, 5th, and 6th conferences as a professor of National Taiwan Ocean University, and was able to exchange views with representatives from other countries. As for commitments, during the 2017 conference in Malta, in response to the organizer, the European Union, who concerns about Taiwan's sustainable fisheries management, representative from the Overseas Fisheries Development Council of the Republic of China (OFDC) pledged that "in order to strengthen the management of distant water fisheries, Taiwan is willing to invest USD77.5 million in a 5-year project to fight illegal fisheries, strengthen electronic monitoring and reporting, and implement port state measures." In 2019, under the initiative of the United States, we supported the WTO's commitment to reducing subsidies to IUU fisheries.

However, regardless of participation, the ocean is a common asset of all human beings. What our generation ought to seriously consider is making a serious commitment to the ocean and carrying it out. Lastly, I'd like to quote from the speech of Oceana's advisor, Alexandra Cousteau, during the Norway conference:

"In the decades that have passed, I've watched the place I loved as a child filled with ghosts. Coral reefs have disappeared. Fisheries have shrunk. ...Communities have lost their livelihoods. And ocean conservation and restoration remained underfunded and largely ignored. Our window for creating the change we need rebuild our oceans is shrinking. We are out of time, and so I thank you for your commitments and your ambition here at this conference. My children will be my age by 2050. They are eight and four today. And as the fourth generation of ocean conservation in my family, they might be the generation of my family that write the obituary for the ocean, so I employ you to think of your children with every decision that you make. Think about how your decisions will impact their lives and let them be the ultimate beneficiaries of the work that you do."

Alexandra Cousteau delivering her speech
Image by Utenriksdepartementet UD Flickr (CC BY-NC-ND 2.0)
https://www.flickr.com/photos/utenriksdept/48986076517/

Latest NOAA Report on the U.S. Ocean and Great Lakes Economy

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Translated by Linguitronics
Keywords: NOAA, coastal management, ocean economy, blue economy

The National Ocean Economics Program (NOEP) is the core research activity of the Center for the Blue Economy at the Middlebury Institute of International Studies at Monterey, and is funded by the National Oceanic and Atmospheric Administration's Office (NOAA) of the U.S. Department of Commerce. The NOEP compiles, analyzes, and announce data about the ocean economy, and provides accurate and timely estimates on changes in ocean and coastal-based economic values.

The NOAA defines "Ocean Economy" based on the State of the U.S. Ocean and Coastal Economies 2016 Report published by the NOEP, as follows: 1. industry whose activities are explicitly tied to the ocean; or 2. which is partially related to the ocean and is located in a shore-adjacent region. The ocean economy has 6 major sectors, comprising 23 related industries, as shown in Table 1.

Table 1/Ocean Economy Sectors and Industries

Sector	Industry
Construction	Marine Related Construction
Living Resources	Fish Hatcheries & Aquaculture
	Fishing
	Seafood Markets
	Seafood Processing
Minerals	Oil & Gas Exploration & Production
	Sand and Gravel Mining
Ship & Boat Building	Boat Building & Repair
	Ship Building & Repair
Tourism & Recreation	Amusement & Recreation Services
	Boat Dealers
	Eating & Drinking Places
	Hotels & Lodging Places
	Marinas
	RV Parks & Campgrounds
	Scenic Water Tours
	Sporting Goods
	Zoos, Aquaria
Transportation	Deep Sea Freight
	Marine Passenger Transportation
	Marine Transportation Services
	Search & Navigation Equipment
	Warehousing

Source / NOEP (2016)

The NOAA published the NOAA Report on the U.S. Ocean and Great Lakes Economy in 2019, and this report is an update of State of the U.S. Ocean and Coastal Economies published by the NOEP in 2016. The ocean economy data in 2016 report presents information of 2010 and 2013, and the 2019 report updates the data to 2016. That is to say, the economic information of U.S. Ocean economy is updated every 3 years. The following are the 5 key points of U.S. ocean economy in 2016:

The Importance of Ocean Economy

In 2016, there were 154,000 establishments in the U.S. ocean economy, which represented 3.3 million job opportunities and contributed to 2.3% of the country's labor participation. Ocean economy's economic output was USD304 billion, contributing to 1.6% of the country's economic growth. Though the proportion may seem very small, the importance of ocean economy cannot be underestimated. For example, in terms of hired labor, the combined hired labor of 2.9 million people from 3 industries- agricultural production, telecommunications and construction - was lower than the 3.3 million people hired in the ocean economy.

Resilience of the Ocean Economy

Ocean economy is more capable in responding to economic fluctuations compared to other industries. Take employment, for example: compared to the financial crisis which began in 2007, employment in ocean economy increased by 14.5% in 2016, while U.S. employment only increased by 4.8% for the same period. In terms of GDP, we can also see the flexibility of development in ocean economy, where its total output increased by 18.8% (after price adjustment) in 2016, far higher than the overall economic growth of 10.7%. Due to the economic downturn in 2016, among the 6 major ocean economic sectors, only 2 sectors, Living Resources and Tourism & Recreation, saw an increase in employment and economic growth.

Diversity of Ocean Economy Composition

The contribution of ocean economy to the economy varies. For example, the labor-intensive Tourism & Recreation sector contributed to 72% of employment to the entire ocean economy in 2016, but the sector's output contribution was comparatively lower (40.9%). On the other hand, the Mineral Extraction sector, a capital-intensive industry, contributed only 4.1% to the entire ocean economy's employment, but had a high economic growth contribution of 26.4% to the entire ocean economy, second only to the labor-intensive Tourism & Recreation sector.

The importance of jobs related to ocean

There is a huge difference in terms of salary level in ocean economy. In 2016, the annual salary for Mineral Extraction sector reached $153,000, and most of the staff were offshore oil platform workers or engineers, geologist, draftsman, etc., who support the exploration activities. On the other hand, the annual salary of Tourism and Recreation was comparatively lower, at about $25,000, mainly because majority of the workers from this sector are part-time workers, and are mainly students or those who have just started working. For the Living Resources sector, the average annual salary for Fishing was $45,000, which is far lower than the average annual salary in the U.S. of $54,000. Apart from the two jobs mentioned above, which have lower salaries, the annual salaries of the other 4 sectors are higher than the country's overall annual salary level.

Overall performance of ocean economic sectors varies

As mentioned above, the difference in labor or capital investment, or the difference in job attributes, constitute high flexibility for industries in various ocean economic sectors in response to economic situation. The following details the performance of the 6 sectors in 2016:

I. Marine Construction

This sector only comprises ocean trench construction, coastline maintenance, pier construction, etc., and does not include construction of oil exploration platforms. The sector contributed to a relatively small proportion of the ocean economy, with 1.4% in employment and 2.1% in output. Its average annual salary was $72,000, second only to Mineral Extraction sector but much higher than the country's average annual salary of $54,000. As this sector does not include construction in the private oil and gas industry, and is mainly funded by the government, more than half of its output and employment are from Florida, Texas, California, and Louisiana.

II. Living Resources

Likewise, this sector did not have a high contribution to ocean economy, with 2.7% in employment and 3.7% in output, and its average annual salary was only higher than that of Tourism and Recreation. However, it is just as important as agriculture, providing the entire country with seafood and fisheries. Seafood Processing is the largest industry in this sector, contributing as much as 40% of employment and output for the sector. An important characteristic of this sector is that its industrial development relies on a sound marine ecosystem. Secondly, it possesses cultural significance, where the fishing industry plays an important part in community identity and social connection. Another important characteristic of this sector is that many workers are from self employed small companies, and the ratio is nearly half.

The importance of Marine Transportation sector is second only to Tourism & Recreation and Mineral Extraction sectors
Image by NOAA's National Ocean Service
https://www.flickr.com/photos/usoceangov/32780186561/

III. Mineral Extraction

The sector's most important industry is oil & gas exploration & production, and is mainly concentrated in the Gulf of Mexico. Oil & gas exploration and production in Texas contributed to more than 80% of the country's output. As the industry is a capital-intensive industry, the sector's contribution to the ocean economy's employment was relatively lower, at 4.1%. Its high production technological and capital thresholds contributed to its high output, which was 26.4% of the ocean economy.

IV. Ship and Boat Building and Repair

This sector had quite a high contribution to the ocean economy's employment, which was about 4.8%, but a low contribution of 5.8% in terms of output. Its average annual salary was $67,000, higher than the country's average annual salary. Ship building and repair is the core industry of this sector, where its employment and output accounted for 80% of the sector. Due to the increase in production costs over the years, the sector is vulnerable to the overall economic situation. Its main production bases are Virginia and Washington.

V. Tourism and Recreation

This sector has the most companies and employment in the ocean economy, contributing to 72.7% of employment and 40.9% of total output in the ocean economy. The main characteristic of this sector is that its industry activities are seasonal. The majority of its labor force are students who work part-time, and thus the comparatively lower salary. Also, as many facilities are free public facilities, and the related industries such as the hotel industry only include those which are near the ocean, the sector's market value is underestimated. The sector's core industry is hotels and lodging places, with Florida and California contributing to one-third of employment and total output to the sector.

VI. Marine Transportation

The importance of this sector is second only to two sectors, Tourism & Recreation and Mineral Extraction, contributing respectively to 14.3% of employment and 21.2% of output to the overall ocean economy, with an average annual salary of $70,000. Warehousing is a labor-intensive industry, contributing to more than half of the sector's employment. California is a place of strategic importance for Marine Transportation, contributing to one quarter of employment and output to the sector.

Table 2/The Ocean Economy and U.S. GDP 2016

Industry	Actual value		Growth rate (%)	
	Employment (10 thousand)	GDP(billion)	Employment	GDP
Marine Construction	4.5	6.4	1.2	-0.4
Living Resources	8.8	11.3	41.4	42.2
Mineral Extraction	13.2	80	-15.9	-17.6
Ship & Boat Building and Repair	15.8	17.5	-1.7	-6.4
Tourism & Recreation	236.8	124	3.2	0.6
Marine Transportation	46.7	64.3	2.9	-0.8
Total	325.8	304	2.7	-6.7

Source / NOAA (2019)

Introduction to the National Oceanic and Atmospheric Administration and Line Offices

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Keywords: NOAA, NESDIS, NMFS, NOS, NWS, OMAO, OAR

This article introduces the National Oceanic and Atmospheric Administration (NOAA) and six line offices.

Organization of NOAA

National Oceanic and Atmospheric Administration (NOAA), an agency within the Department of Commerce, was established in 1970 from bring three agencies together: U.S. Coast and Geodetic Survey, Weather Bureau, and Commission of Fish and Fisheries. NOAA includes staff offices of general counsel, communications, education, the federal coordinator for meteorology, international affairs, and legislative and Intergovernmental affairs. In addition to these offices, NOAA includes six main line offices which respond for providing services and research in fields of environmental satellite, marine fisheries, oceanic environment, weather, and marine and aviation operations. In 2020, NOAA is celebrating its 50 years of science, service and stewardship as shown in the following figure.

NOAA is celebrating 50 years of science, service and stewardship
Source / NOAA
https://oceanservice.noaa.gov/

NOAA's mission

NOAA's goal is to "enrich life through science; therefore, science is the foundation for all NOAA does". NOAA's tasks span from the surface of the sun to the depths of the ocean. NOAA's missions include "Science, Service and Stewardship" based on the three major parts: 1. to understand and predict changes in climate, weather, oceans and coasts; 2. to share that knowledge and information with others; and 3. to conserve and manage coastal and marine ecosystems and resources.

NOAA's first mission "Science" is to systematically study the structure and behavior of the ocean, atmosphere, and related ecosystems, to perform integration of research and analysis, conducting observations and monitoring, and environmental modeling. General issues include: 1. studying oceans and atmosphere, and the application of this knowledge to such issues as the causes and consequences of climate change, 2. investigating the physical dynamics of high-impact weather events, 3. discovering the dynamics of complex ecosystems and biodiversity, and 4. developing the ability to model and predict the future states of these systems. Science provides the foundation for the service and stewardship elements of NOAA's mission. The second mission "Service" is to communicate the research, data, information, and knowledge for use by the Nation's businesses, communities, and people's daily lives. NOAA provides services such as climate predictions and projections, weather and water reports, forecasts and warnings, nautical charts and navigational information, and the continuous delivery of a range of Earth observations and scientific data sets for use by public, private, and academic sectors. The last mission is "Stewardship", arming to protect people and the environment. NOAA has the direct authority to regulate and sustain marine fisheries and their ecosystems, protect endangered marine species, protect and restore habitats and ecosystems, conserve marine sanctuaries and other protected places, respond to environmental emergencies, and aid in disaster recovery. The figure shown below illustrates the spans of NOAA's missions.

NOAA's mission of science, service and stewardship spans from the surface of the sun to the depths of the ocean
Source / NOAA
https://www.noaa.gov

NOAA's line offices

The six line offices of NOAA and their missions are:

I. National Environmental Satellite, Data, and Information Service (NESDIS):

NESDIS provides secure and timely access to global environmental data and information from satellites and other sources to promote and protect the Nation's security, environment, economy, and quality of life.

II. National Marine Fisheries Service (NMFS):

NMFS is responsible for the stewardship of the nation's ocean resources and their habitat. NMFS provides vital services for the nation: productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems - all backed by sound science and an ecosystem - based approach to management.

III. National Ocean Service (NOS):

NOS provides data, tools, and services that support coastal economies and their contribution to the national economy. NOS is dedicated to advancing the following priorities: safe and efficient transportation and commerce, preparedness and risk reduction, stewardship, recreation, and tourism. NOS is composed of seven program offices:

[I] Center for Operational Oceanographic Products and Services: This office gathers tide information along US's coasts for over 200 years. It provides water levels, tide and current predictions, and other oceanographic and meteorological conditions. Harmful algal bloom forecasts are also provided.

[II] National Centers for Coastal Ocean Science: At this office, scientists are conducting and supporting the research, monitoring, and assessment needed to help manage coastal ecosystems and society's use of them.

[III] Office of National Geodetic Survey: Responds for the business of the National Geodetic Survey.

[IV] Office for Coastal Management: A top priority of this office is to unify private sector, nonprofit, scientific community, and government efforts to make coastal communities more resilient. Coastal management refers to actions taken to keep residents safe, the economy sound, and natural resources functioning. Within the federal and state partnership programs, federal legislation provides the overarching mandates, and this office oversees implementation and provides technical assistance.

[V] Office of Coast Survey: This office collects, manages, and compiles the data and information necessary to maintain the national suite of nautical charts.

[VI] Office of National Marine Sanctuaries: Responds for preserving and protecting US's most valuable underwater places.

[VII] Office of Response and Restoration: It is tasked with providing the science and information needed to support the U.S. Coast Guard during spills and in coordinating with federal, state, and tribal natural resource trustees to restore coastal resources damaged by those spills.

IV. National Weather Service (NWS):

NWS provides weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

V. Office of Marine and Aviation Operations (OMAO):

OMAO manages and operates NOAA's fleet of 16 research and survey ships and nine aircraft. OMAO also manages the NOAA diving program, NOAA small boat program and NOAA aviation safety program.

VI. Office of Oceanic & Atmospheric Research (OAR):

OAR responds for NOAA research program and provides the research foundation for understanding the complex systems that support greater understanding our planet. OAR enables better forecasts, earlier warnings for natural disasters. Their mission is to provide unbiased science to better manage the environment, nationally, and globally.

Scuba divers removing derelict net from reef
Image by Dr. Dwayne Meadows, NOAA / NMFS / OPR
https://www.flickr.com/photos/noaaphotolib/5103120876/

Marine Ecological Survey Breakthrough - International Development Trends in Environmental DNA Technologies

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Translated by Linguitronics
Keywords: environmental DNA, marine ecological survey, ecological conservation, biodiversity

From a pail of water collected from the sea, we are able to know what organisms have recently visited the sea area. Environmental DNA (eDNA) technologies can significantly speed up the marine ecological survey, and there is even the potential to develop it into marine ecological research in which the public can participate.

eDNA schematic
Drawing / Yi-Hsuan Chen

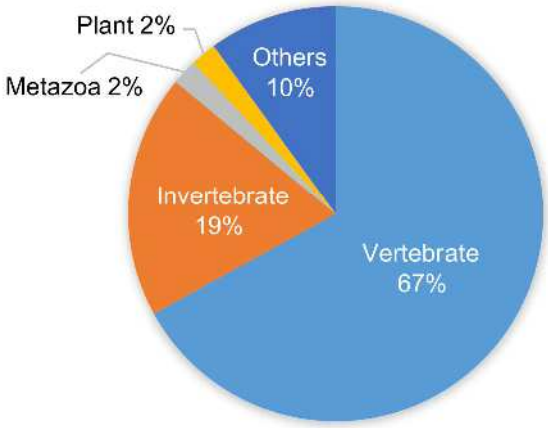
Introduction to Environmental DNA

During the course of the life and death of organisms, they naturally leave behind skin, hair, and scale which contain cellular debris or cell-free DNA (deoxyribonucleic acid) into the environment. DNA extracted from environmental samples such as water or sediment is known as eDNA.

Generally speaking, eDNA is on the micro-scale, and will degrade naturally over time. Compared to sediment, the content of eDNA from water samples can be easily diluted, hence extracting eDNA from a water sample is not easy. With the rapid development of biotechnology in recent years, we are able to make use of the DNA replication technology, Polymerase Chain Reaction (PCR), to massively amplify DNA within a short period of time. And with technologies such as Metabarcoding or Next Generation Sequencing (NGS), we can concurrently analyze the gene fragments of various species. Therefore, we can make observing traces of marine organisms from just a pail of water possible.

Experts believe that the development of emerging biotechnologies such as eDNA will open up a new chapter in marine ecological conservation. In marine conservation, the long-term changes of biodiversity in the ecosystem are important base data. General traditional survey methods include scuba diving, sediment sampling, and net sampling, but each has its own limitations. Besides costing great amounts of manpower and funding, there are problems such as climate conditions, sampling time, concealed behavior and morphological identification of the organism. The main advantage of eDNA method is that only analysis of water or sediment sample is required, without the limitations of tissue sample collection. Also, it reduces damage to the organism during sample collection.

According to current eDNA research, the main target species in aquatic environment are vertebrates, where majority are fishes; for invertebrates, the majority are mollusks, followed by crustaceans (Tsuji et al., 2019). Take research in fish for example, a study headed by the Natural History Museum and Institute in Chiba, Japan, has developed a universal PCR primer known as MiFish, which has successfully identified more than 230 subtropical marine species (Miya et al., 2015).



Proportion of species of aquatic eDNA research between 2008 and 2018
Source / Tsuji, S., Takahara, T., Doi, H., Shibata, N., & Yamanaka, H. "The detection of aquatic macroorganisms using environmental DNA analysis—A review of methods for collection, extraction, and detection, " Environmental DNA 1, no. 2 (2019): 99-108

International research trends

I. From closed ecosystem to open ecosystem

eDNA originated in soil microbiology. Different from land, the flowing characteristics of water makes detection even more challenging. Aquatic eDNA research began in the calm and enclosed freshwater lake ecosystem. The openness of the ocean ecosystem environment makes it easily affected by factors that dilute eDNA content such as waves, tides, and currents. Hence, scientists improved on the experimental methods through water sample collection, filtering method, and extraction reagent, and breakthroughs have been made in the technologies (Tsuji et al., 2019).

II. From single species to community composition

How did scientists progress from identifying a single species to analyzing the composition of a variety of species in a community from a water sample? During the 1960s, Sanger sequencing enabled us to analyze DNA genetic code; ecologists would take the tissue samples of a single organism for DNA barcoding to obtain the target gene sequence. The laboratory process was time consuming and required much manpower and funding. Moreover, the community composition in the environment is too complex that we were unable to categorize organisms by DNA samples from the water in the past.

Later, with the development of biotechnology, DNA sequencing methods became significantly faster and relatively cheaper. NGS method enables us to read large amounts of short fragments in high speed for sequencing, and it can even be applied to Whole Genome Sequencing (WGS). If this advancement can be extended to the marine ecological survey, we would be able to break through the complexity problem in community composition of organisms in the environment. Quickly identifying the types of fishes, crustaceans, or corals from the eDNA within a pail of sea water would no longer be a dream.

Current eDNA research has shown significant, breakthrough results. The following are current applications in marine conservation research:

[I] Species distribution: eDNA technologies can track the distribution of specific species, such as exotic species, target protected species, indicator species, and others. At the junction of North Sea and Baltic, Danish scientists made use of eDNA method and discovered subtropical sardines which are rarely recorded by traditional survey methods, and believed that their appearance is related to the warming climate (Thomsen et al., 2012). By use of eDNA technologies, we can understand the appearance, distribution, and migration pattern of marine organisms. It provides more integral information in removing exotic species, establishing conservation strategies and ecological monitoring.

[II] Community composition: In a long-term ecological survey in U.S. National Marine Protected Areas, various traditional survey methods and eDNA technologies are concurrently adopted in investigating the composition of organism communities in the protected areas. A total of 80 species have been discovered. Among the survey methods, eDNA identified the most extensive number of species. It is worth noting that the community composition results analyzed by eDNA showed that the difference between 2016 and 2017 coincides with the changes in oceanographic conditions (For example: upwelling and ocean stratification) (Closek et al., 2019). This shows that besides improving long-term ecological monitoring in marine protected areas, eDNA technologies also help us in analyzing the relationship between community composition and environmental change.

III. From academic research to civic participation

Along with the evolution of biotechnology, eDNA research is no longer limited to academia, as shown by increasing participation by citizen scientists. U.S. Rockefeller University is currently developing "Go Fish eDNA", a simple and fast screening tool. Identifying a single species from every water sample only requires USD15, and USD8 is charged for identifying each additional species (National Geographic, 2018. Retrieved from https://reurl.cc/W4eWMZ, Feb. 11, 2020). This method can be operated without a professional molecular biology laboratory, which significantly reduces research costs.

Also, the Australian government has invested more than AUD 1 billion in its National Landcare Program. For one of its sub-projects, EnviroDNA, they invited citizen scientists to participate in investigating farm dam wildlife biodiversity. Farm owners and other citizen scientists help by collecting water samples and sending them to laboratories for analysis. Surprisingly, they discovered that the platypus, an endangered species, was present (EnviroDNA, 2019. Retrieved from https://www.envirodna.com/, Feb. 11, 2020). What is special about this project is that through project participation, the general public are able to understand the importance of environmental sustainability of farm dams on biodiversity.

Challenges of technological research and development

Despite the various advantages of eDNA technologies, there are still limitations, as it is unable to completely replace traditional ecological surveys.

Firstly, when conducting PCR, specific primers are required, whose function is similar to that of a scissors, where the target gene fragment is cut and then replicated and amplified. However, the primer currently being used in eDNA is not universal. As most species still lack a suitable primer at present, and with the problem of low resolution, there is difficulty in accurately identifying species.

Secondly, the existing genetic database is incomplete. The species lack of research or with complex evolutionary history still exist difficulty in molecular identification and categorization. Take fish for example, the gene sequencing data of non-commercial fishes is comparatively less complete.

Theoretically speaking, eDNA content is directly proportional with biomass. However, current technologies remain questions to infer the organism's population size, body size, and age structure from eDNA information. As such, we still have to rely on traditional survey methods, such as trawl sampling or diving. Hence, the ideal way is to conduct research using existing ecological surveys together with eDNA technologies, gradually enrich the local genetic database, and develop suitable primers for eDNA research. It could provide more comprehensive information of ecosystem and apply in long-term ecological monitoring program.

Schematic of eDNA experimental procedures
Drawing / Marine Ecology and Conservation Research Center, National Academy of Marine Research

Conclusion

Taiwan is located at the north of the Coral Triangle, with high marine biodiversity. It has already discovered and registered 13,000 types of marine organisms (Shao, 2020. Retrieved from http://fishdb.sinica.edu.tw, Feb. 12, 2020). Apart from commercial fishes, we lack long-term and integrated studies on the life history, geographical distribution, and population structure of the majority of marine organisms around Taiwan. Without proper understanding, it is difficult to assess the impact of environmental changes and efficiency of conservation policies.

Considering the potential benefits from the convenience and rapid analyzation of eDNA, we recommend that future marine ecological surveys be conducted by implementing traditional survey methods together with eDNA technologies. The foundation for achieving this goal is formed by enriching the genetic database; on this foundation is added the design of suitable primers and developing of eDNA survey methods applicable for long-term ecological investigation, which can even be incorporated into seawater quality evaluation in near future.

With the continuous development of biotechnology, eDNA technologies may reduce cost and increase efficiency for extensive and integrated marine ecological monitoring and research. Civic participation can even be included, so as to raise ocean literacy, which will help in Taiwan's marine ecological conservation and the sustainable development of our ocean.

Further reading

"eDNA Expands Species Surveys to Capture a More Complete Picture," NOAA Fisheries West Coast Region, Dec. 19, 2018, https://www.fisheries.noaa.gov/feature-story/edna-expands-species-surveys-capture-more-complete-picture (Jan. 3, 2020).

Introduction to Laws Administrated by the United States National Oceanic and Atmospheric Administration

Shih-Ming Kao (Associate Professor, National Sun Yat-sen University)
Keywords: National Oceanic and Atmospheric Administration (NOAA), Magnuson-Stevens Act (MSA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), Coastal Zone Management Act (CZMA)

This article will introduce laws administered by the United States National Oceanic and Atmospheric Administration (NOAA).

Magnuson-Stevens Act (MSA)

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, MSA) is the primary law governing marine fisheries management in U.S. federal waters. First passed in 1976, the MSA fosters long-term biological and economic sustainability of our nation's marine fisheries. Key objectives of the MSA are to prevent overfishing, rebuild overfished stocks, increase long-term economic and social benefits, and ensure a safe and sustainable supply of seafood. The competent authority of the MSA is the National Marine Fisheries Service (NMFS), NOAA.

Before the MSA, international waters began at just 12 miles from shore and were fished by unregulated foreign fleets. The 1976 law extended U.S. jurisdiction to 200 nautical miles and established eight regional fishery management councils with representation from the coastal states and fishery stakeholders. These councils develop fishery management plans that comply with the MSA's conservation and management requirements that promote sustainable fisheries management.

Congress has twice made significant revisions to the MSA. First revision was in 1996 in response of the passage of the Sustainable Fisheries Act. Primary revisions include strengthening requirements to prevent overfishing and rebuild overfished fisheries; setting standards for fishery management plans to specify objective and measureable criteria for determining stock status; adding three new national standards to address fishing vessel safety, fishing communities, and bycatch; and introducing fish habitat as a key component in fisheries management. Second revision was in 2007 in response of the adoption of the MSA Reauthorization Act. Key revisions include establishing annual catch limits; promoting market-based conservation and management strategies; strengthening the role of science in fisheries management; and enhancing international cooperation by addressing illegal, unregulated, and unreported (IUU) fishing-related issues.

Endangered Species Act (ESA)

Endangered Species Act (ESA) was passed by the United States Congress in 1973. Recognizing that the natural heritage of the United States was of esthetic, ecological, educational, recreational, and scientific value to our nation and its people, it was understood that, without protection, many of United States' native plants and animals would become extinct. National Marine Fisheries Service (NMFS), NOAA and the U.S. Fish and Wildlife Service (FWS) share responsibility for implementing the ESA. NMFS is responsible for species in maritime areas, and the FWS is responsible for most terrestrial and freshwater species.

Under the ESA, the federal government has the responsibility to protect:

I. Endangered species: species that are in danger of extinction throughout all or a significant portion of their range;
II. Threatened species: species that are likely to become endangered in the foreseeable future;
III. Critical habitat: specific areas that are within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection.

Currently NMFS has listed over 165 endangered and threatened marine species, among which 80 are endangered and 85 are threatened species. Among these 165 species, 66 are foreign species (meaning that these species occur only in areas beyond U.S. jurisdiction), among which 40 are endangered and 26 threatened species.

Marine Mammal Protection Act (MMPA)

The United States Congress passed the Marine Mammal Protection Act (MMPA) in 1972 in response to increasing concerns among scientists and the public that significant declines in some species of marine mammals were caused by human activities. The MMPA establishes a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part, and is the first legislation to mandate an ecosystem-based approach to marine resource management.

All marine mammals are protected under the MMPA. Some are also protected under the Endangered Species Act and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, or also known as the Washington Convention).

Three federal entities share responsibility for implementing the MMPA. The NMFS, NOAA is responsible for the protection of marine mammals such as whales and dolphins; U.S. FWS is responsible for the protection of species such as walrus and polar bears; the Marine Mammal Commission provides independent, science-based oversight for relevant policies of federal agencies. In addition, the Animal and Plant Health Inspection Service, a part of the Department of Agriculture, is responsible for regulations managing marine mammals at public display facilities (i.e., aquaria and zoos).

Image by Pride Advertising Agency Ltd.

Coastal Zone Management Act (CZMA)

The U.S. Congress recognized the importance of meeting the challenge of continued growth in the coastal zone by passing the Coastal Zone Management Act (CZMA) in 1972. The CZMA provides for the management of the nation's coastal resources, including the Great Lakes. The goal is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The Office for Coastal Management, NOAA is the competent authority for the CZMA.

Under the CZMA, there is a state-federal consistency provision that requires federal actions undertaken by federal agencies be consistent with enforceable policies of approved state management plans. In addition, the CZMA outlines three national programs, the National Coastal Zone Management Program, the National Estuarine Research Reserve System, and the Coastal and Estuarine Land Conservation Program (CELCP). The National Coastal Zone Management Program aims to balance competing land and water issues through state and territorial coastal management programs; the Reserves System serve as field laboratories that provide a greater understanding of estuaries and how humans impact them; and the CELCP provides matching funds to state and local governments to purchase threatened coastal and estuarine lands or obtain conservation easements.

ESA Endangered species
Image by NOAA Fisheries
https://www.fisheries.noaa.gov/species-directory/threatened-endangered

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