



# 自然與科技的絕妙平衡

## Balance Between Nature and Technology

Canaveral National Seashore and  
Merritt Island National Wildlife Refuge, Florida, U.S.A.

美國佛羅里達州卡納維爾國家公園及邁雷特島保護區

**相**較於優勝美地、黃石公園那氣勢磅礴的壯麗山巔，本期要介紹的美國佛羅里達州卡納維爾國家公園及邁雷特島保護區，則是月映沼澤日出海涯的廣闊水域。這是個以濕地生態為主的國家公園，在全球飽受極端氣候之苦的現今，有其重要的時代意義。

曾列為世界歷史景點、國際水棲保護區及國際重要沼澤地的邁雷特島保護區，堪稱鳥類的天堂。位於佛羅里達洲南方的它，有著獨特的淺水沼澤生態系，而卡納維爾國家公園則是屬於美國海岸類型的國家公園，其沙灘海岸，是美國大西洋海岸最長且保持最原始面貌的海岸線。

In comparison with the picturesque scenery and spectacular terrain of Yosemite National Park and Yellowstone National Park, Canaveral National Seashore (CNS) and Merritt Island National Wildlife Refuge (MINWR) of Florida, U.S.A., exhibit extensive bodies of waters from swamps to seashores. The area mainly consists of a wetland ecosystem and plays a significant role during a time of extreme global weather conditions.

MINWR was previously known as a World Heritage Site, an International Biosphere Reserve, a Wetland of International Importance and a renowned paradise for birds with a unique shallow-water swamp ecosystem. CNS is a coastal national seashore whose sandy shore is the longest and the most primitive-looking in the Atlantic coast of U.S.

1960年美國國家航空和太空總署在緊臨美國空軍基地邊，買了邁雷特島北邊大半個土地做為火箭發射的空間，後來為了紀念甘迺迪總統而改名為甘迺迪太空中心。

為什麼保護區會談到火箭發射呢？甘迺迪太空中心、邁雷特島保護區及卡納維爾國家公園同樣位在佛羅里達州印地安河濕地範圍，印地安地河名稱是「河」，但是沒有明顯的源頭及河口，真正說來是廣大片的沼澤地，被邁雷特島分隔為二，北為蚊子湖（潟湖），而印地安河就在卡納維爾角與香蕉河會合流入大西洋，邁雷特島保護區及卡納維爾國家公園就位在甘迺迪太空中心的北側，保護了印地安河北邊及蚊子湖的沼地區域。雖屬三個不同的使用分區，但是由於科技的發展，將三個截然不同的土地利用緊扣在一起。此與台灣新成立的第八座國家公園、以濕地動植物為保育重點的台江國家公園極為相似。

就在台江國家公園管理處成立之際，國家公園組林玲科長應美國國務院之邀，代表台灣國家公園進行深度參訪，終於得以窺其全貌。邁雷特島保護區及卡納維爾國家公園成立的背景與發展，亦與台江國家公園有異曲同工之妙，在同一個濕地上承載著科技業、農業、工商業等不同的使用，也同樣都是在地方自發性的提議設立。其經營管理上的經驗，值得我們學習與借鏡。

### 人類活動於保育之前

其實，邁雷特島保護區及卡納維爾國家公園的土地並不屬於國家公園署及漁業署所有，大部分土地都屬於甘迺迪太空中心的資產。

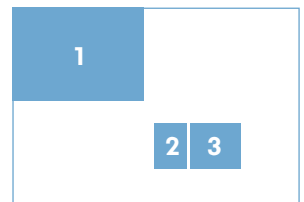
In 1960, National Aeronautics and Space Administration (NASA) acquired a substantial land portion of the north of Merritt Island, adjacent to US Air Force's Cape Canaveral Air Force Station as a space shuttle launching site. This area was later named "John F. Kennedy Space Center" (KSC) in remembrance of President J.F. Kennedy.

What is the connection between a protected area and space shuttle launch? KSC, MINWR and CNS are located in the wetlands of Indian River. This massive mangrove swamp is separated by Merritt Island and bordered by Mosquito Lagoon on the north. Indian River flows across the meeting point of Banana River and Cape Canaveral before entering the Atlantic Ocean. Both MINWR and CNS are located in the north of KSC and serve to protect the mangrove swamps of Mosquito Lagoon and the Indian River north. Each area zone serves its own purpose, but all 3 area zones are bound by technological development. This area resembles Taiwan's Taijiang National Park, with the same focus on wetland wildlife conservation.

After the establishment of Taijiang National Park, Ling Lin, Section Chief of National Parks Division, on behalf of National Parks of Taiwan, was invited by the U.S. Department of State for an in-depth visit and research to obtain a complete picture of the entire development. The development and background of MINWR and CNS are similar to those of Taijiang National Park in many aspects: a multi-purpose wetland features technological, agricultural, commercial and industrial usages; local groups take the initiative to build the region.

### Human Activities Prior to the Start of Land Conservation

In fact, the lands of MINWR and CNS were not under the management of the U.S. National Park Service or National Marine Fisheries Service, but KSC.



1. 園區的地景風貌與周邊條件與台灣台江國家公園極為相似 / 林玲攝

The landscape and the periphery of Canaveral National Seashore are highly similar to those of Taijiang National Park. / by Ling Lin.

2. 在美國國務院的邀請下，台灣與美國的國家公園經營管理有實際交流的機會。Sam (圖左) 及 John (圖右) 深入的導覽解說，讓參訪內容更為豐富多元 / 林玲提供



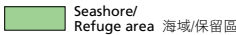
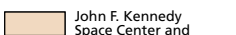
At the invitation of the U.S. State Department, the management of Taiwan's national parks gets to make more exchanges with their U.S. counterparts. The guide by Sam (left) and John (right) makes the visit more fruitful. / Photo provided by Ling Lin.

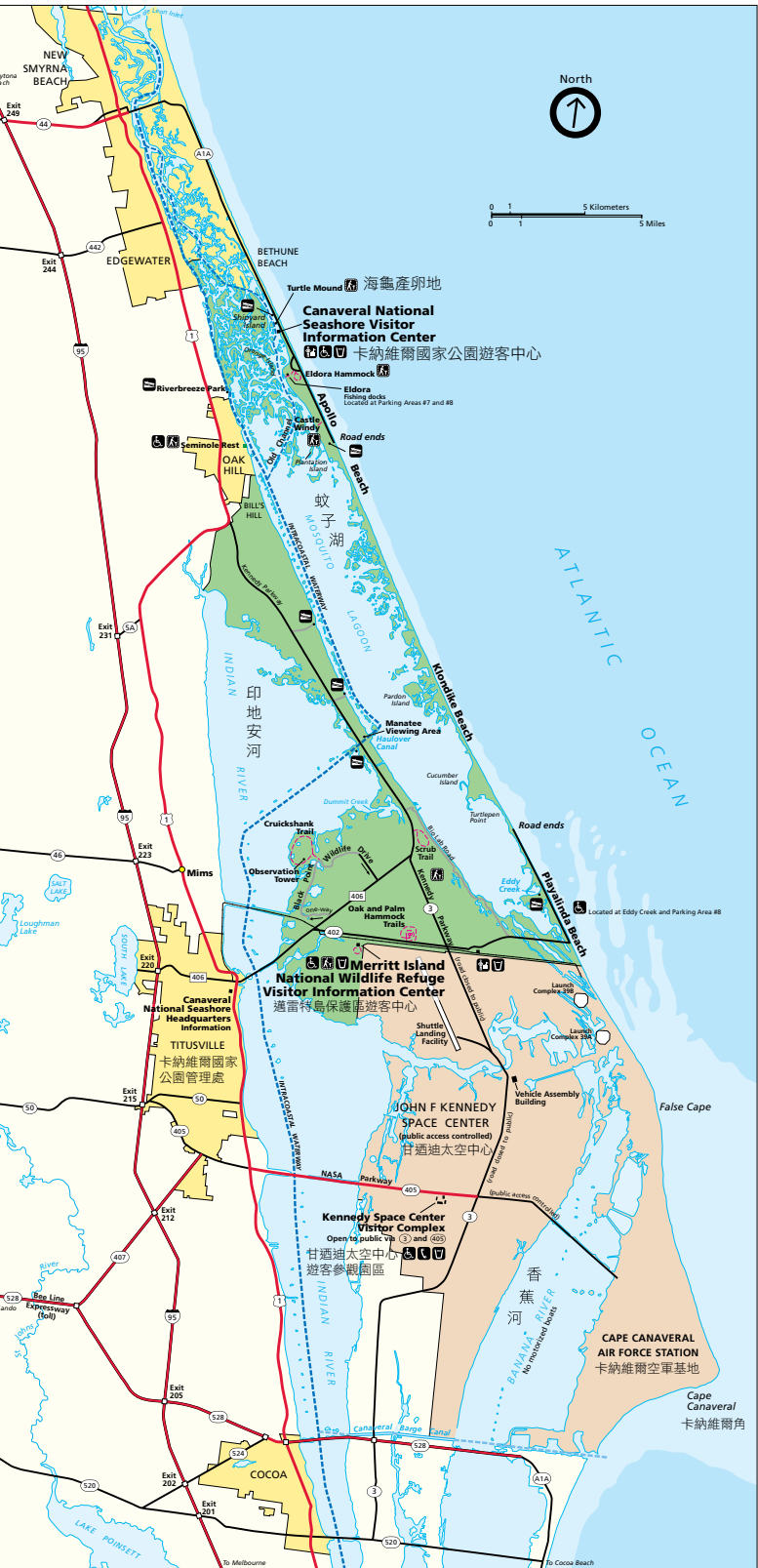
3. 毗鄰國家公園的甘迺迪太空中心是土地的擁有者，為了落實環境永續而捐出土地。在科技發展之外，也兼顧生態平衡。圖為人與自然和諧相處的典範 / 林玲攝

Kennedy Space Center that adjoins the park owns the land and donates it to ensure environmental sustainability. It sets a good example of pursuing technological development while looking after ecological conservation. / by Ling Lin.





-  Unpaved road 道路
-  Trail 小徑
-  Seashore/Refuge area 海域/保留區
-  John F. Kennedy Space Center and Cape Canaveral AFS—access controlled 甘迺迪太空中心管制區域



1960年在 NASA 購買了邁雷特島北邊絕大部分的土地作為火箭測試與發射之場所之後，因實際使用的範圍有限，當時有一位鳥類學家、博物學家、環保教師及攝影師—艾倫克魯查克積極推動與遊說下，讓 NASA 及漁業署達成了協議，在1963年將 NASA 北側部分還沒有使用的土地設立為野生動物保護區。他的熱情與決心，影響了政府與居民，讓當地的原生動植物得以保存下來；到了1975年，更為了維護大西洋岸最原始的海岸線，在美國國會推動之下，成立卡納維爾國家公園，讓國家公園與保護區相互串連，對於生態保育及環境維護具有莫大助益。

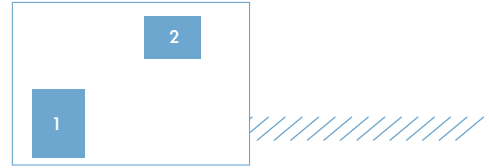
拉姆薩爾公約對於濕地的利用是以「明智利用」為最高原則，所謂濕地的明智利用就透過生態系統的方法達到永續利用的目的，同時保育及維持生態系統穩定的關鍵地區。這說明了濕地保護，必須兼顧人類與自然之間的平衡，在印地安河濕地上的活動誠屬最佳範例。

當年，NASA 買下這片土地時，工作人員一直苦於蚊子之擾，因此，他們請來生物學家控制沼澤區，讓濕地的水保持在流動狀態，蚊子較不易產卵，為了讓沼澤的水保持流動，將面積較大的沼澤細分為面積較小的水域，其間以約三米寬的土堤分隔之，同時在土堤下方埋設涵管，控制水的流動。只要蚊子產卵季節一到，便將土堤下之涵管打開，讓水經由涵管流通；非蚊子產卵季時，則關閉土堤，讓沼澤地恢復原本的樣貌。

NASA acquired a greater part of northern Merritt Island in 1960 as a space shuttle testing and launching complex. The lack of extensive land development in the region has inspired Allan D. Cruickshank, an ornithologist, naturalist, environmental protection teacher and photographer, to become actively involved in convincing National Marine Fisheries Service to enter an agreement with NASA. By 1963, NASA has converted the unused northern section into a wildlife protected area. Canaveral National Seashore was created in 1975 by an act of U.S. Congress to conserve the primitive barrier beach in the Atlantic coastal area. The established link between a national park and refuge leads to a huge step toward ecosystem conservation and environmental protection.

The Ramsar Convention regards “wise use” as the highest principle for utilizing wetlands. In other words, sustainable utilization can be achieved through the use of the ecosystem. The human activities on the Indian River wetlands are best to explain the importance of wetland conservation and the balance between human and nature.

Mosquitoes were a huge nuisance to NASA employees. To solve such problem, biologists were hired to conduct mosquito control of the swamp region. Retaining running water in the wetlands helps reduce the likelihood of mosquitoes laying eggs. To ensure running water on the wetland, swamps with a larger land portion were divided into smaller areas to create tributaries and further separated by 3-m-wide soil levees. Culvert pipes were buried underneath the soil levees to control running water during mosquito breeding season. Once the breeding season ends, the levees would be closed to maintain the original look of the swamp.



1. 佛州卡納維爾國家公園及邁雷特島保護區地圖 /MINWR 提供  
Map of Canaveral National Seashore and Merritt Island National Wildlife Refuge. / by MINWR
2. 生物學家為讓濕地蚊子不易產卵，設計了土堤與涵管來控制水的流動，蚊子產卵季時將涵管打開，讓水流通；非蚊子產卵季時則關閉土堤，讓沼澤地恢復原本的樣貌。圖為控制水流的關門 / 林玲攝  
Biologists use dikes and culverts to control the flow of water so as to deter mosquitoes from laying eggs. During the breeding seasons they open the culverts for a smooth flow of water and close them during non-breeding seasons. The picture shows the gate that controls the water flow. / by Ling Lin.

兼顧人類生活與自然生態的設計，確實有效控制住蚊子大量繁殖的問題。不過，當蚊子不再造成困擾時，人為開發就開始進來，原本即以舒適氣候與美麗海景的區域頓時湧入更多人潮，成為最受歡迎的度假中心和養老天堂。

### 困境仍須尋解決之道

人為活動一頻繁，伴隨而來的便是生態破壞及環境污染。保護區的魚獲量較1950年減少約50%，主要原因有三：第一是全球皆有的過漁問題，由於人類食用需求增加，導致過度捕撈，造成漁獲量大幅減少；第二是水質污染，最明顯的現象是這裡的居民對當地捕撈的魚貨敬而遠之，購買時皆挑選外地來的魚種，表示居民對當地的水質不具有信心；第三是棲地破壞，因大量建築港口和海堤，以及棲地劣化，破壞了動植物原有的棲息環境，使得物種減少或消失。

目前美國環保署已建立重要幼魚及貝類監測機制，希望可藉此保護並復育魚貝類物種；排放至潟湖的污水防制計畫亦於1996年開始實施。然而，棲地破壞也造成海草床的消失。6呎是海草床最理想的環境，但現今已有超過170,000公畝的湖區深度低於6呎，不少區域甚至低至3呎；數據亦顯示，1986年海草床總面積約為84,000公畝，現已較二十年前少了將近20%。所幸IRLNEP、SWIM及地方政府共同合作進行水質淨化，區內已有部分海草床正逐漸恢復。

在1950至1970年間，約有75%的濕地及紅樹林，同樣因破壞而改變。實施棲地劣化，雖能於蚊子產卵季時控制其數量，但也讓將近40,000公畝的濕地變成控制蚊子的蓄水池，使得原生濕地植物消失。目前已將70%的水池與沼澤地相通，盡量讓小區域與大沼澤

This particular design certainly puts human life and the natural ecosystem into consideration, effectively minimizing the mass breeding of mosquitoes. Afterwards, human development started to emerge, and the area soon turned into a popular holiday resort and retirement destination.

### Solution Required for a Problem

With the increase of human activities comes the ecosystem destruction and environmental pollution.

The fish stock of the protected area was decreased by approximately 50% compared to the 1950s due to the following reasons: First, the increase in human food consumption has led to overfishing and a significant depletion in fish stock. Second, water pollution is so serious that local residents refuse to buy locally caught fish, but prefer fish varieties from abroad. Third, the destruction of the natural habitat. Massive harbor and sea levee constructions, along with the disintegration of the natural habitat result in the reduction and extinction of species. The destruction of the natural habitat already caused the disappearance of rocky-algal reef, which grows best at 6 ft. under the sea surface. However, more than 170,000 ares of lake regions are below the depth of 6 ft., or even below 3fts. According to the statistics, the total area size of rocky-algal reef was 84,000 ares in 1986, whereas the current land size is 20% less than 20 years ago. Thanks to the works of IRLNEP, SWIM and the local governments helping to purify the water, a certain number of rocky-algae reefs of the region have gradually been restored.

Between the periods of 1950 to 1970, about 75% of wetlands and mangrove forests were destroyed and changed. The launching of habitat disintegration has effectively reduced the mosquito pollution during the breeding season but turned some 40,000 ares of wetlands into a mosquito control reservoir. This marked the extinction of indigenous wetland plants. 70% of the reservoir is now connected to the swamps to revive the wetland plants.



區串連，加強水的流動，讓濕地植物得以生存。

在國家公園內，還有另一件棘手的外來物種問題，其中尤以野豬最為嚴重。針對非原生的動植物物種，管理處現今僅能以捕捉及移除方式來處理，避免因大範圍撲殺而損及園內的原生物種。

### 源於人工的自然

經由這回的親自參訪，以及美國政府和當地非政府組織(NGO)的全程陪同與解說，林玲才得知，原來沼澤地國家公園和邁雷特島野生動物保護區內的水位和潮汐皆由人為控制，並不算是一個天然的園區。

雖然心中不免想問，人為控制算是自然嗎？是否真的只有人為才有辦法保護原生動植物？但無論如何，太空中心對生態保護的良善立意是絕對值得肯定的。人類有心與自然共存，而人工做法是他們與國家公園管理署、漁業署和環保署就現今狀況，所研擬出來的解決之道。

況且，若不是甘迺迪太空中心完整授權；國家公園署進行海岸景觀保護；環保署監控水質與污水防治；還有漁業署保育自然資源及施行漁獲限捕，南佛羅里達也不可能擁有一個如此完整的淺水沼澤生態系。

卡納維爾國家公園管理處代理處長 Sam 及保育研究組長 John 告訴林玲，為了維持國家公園區內的景觀，國家公園區內非常致力於減低人類行為對自然環境的影響，廣大的園區內不但禁止打獵，並限制車輛通行；曾被海嘯淹沒導致植物損毀的沿岸沙丘，現正以自然工法進行原生植物復育；對於海龜產卵地的調查監測以不干擾為原則；更有一條長達

The migration of alien species, particularly the wild boars, is another trouble in the area, in which the Administration could only hunt down or remove the alien fauna and flora species to avoid harming the native species in the area.

### Man-made Nature

After the visit, along with complete escorted tour and information provided by U.S. government and the local NGOs, Lin realized that water levels and tides of CNS swamps and MINWR are the works of man-made mechanical manipulation. Hence, the Seashore and the Refuge cannot be categorized as a natural site.

People would wonder: Can the man-made mechanical manipulation be considered part of nature? Is it the only way to protect the indigenous fauna and flora? Nevertheless, as humans are determined to coexist with nature, the man-made operation is the only suitable solution that was researched and established by U.S. National Park Service, Marine Fisheries Service and U.S. Environmental Protection Agency based upon the current situation.

Southern Florida would not be able to enjoy a perfect shallow-water swamp ecosystem without complete authorization of KSC, the help of National Park Service working on the coastal terrain protection, Environmental Protection Agency on monitoring water quality, as well as Marine Fisheries Service on protecting natural resources and setting limits on fish stock.

Sam, Acting Chief of CNS Administration and John, Chief Researcher of Conservation, have informed Lin that, in order to maintain the terrain of the area, CNS is committed to minimizing the impact of human activities on natural environment, and natural methods are currently implemented to restore the indigenous plants of the coastal sand dunes that were previously flooded and destroyed by the tsunami. There is a 25-km road without electricity and water supply. And the only buildings along the road are green toilets that only rely on natural light.



海岸邊是赤蠟龜及綠蠟龜重要產卵地，洞口都設有沙網防止浣熊偷蛋。圖組為解說員為林玲課長示範該物種計數研究的流程 / 林玲攝  
The seacoast is an important place for Loggerhead Turtles and Green Turtles to lay eggs. Sand screens are placed at the mouth of a cave to prevent the racoons from stealing the eggs. The pictures show the process of species counting research. / by Ling Lin.



位於佛羅里達州南方的卡納維爾國家公園，有著獨特的淺水沼澤生態系，保持最原始的海岸線面貌 / 林玲攝  
Canaveral National Seashore at the south of Florida has unique shallow-water swamps and retains the most pristine look of the coastline.  
/ by Ling Lin.

25 公里的道路，完全不提供水電，就連沿途唯一的建築——環保廁所，也一樣是倚藉自然光源。

### 參考與借鏡

有效控制水資源，讓水質和水位接近自然循環狀態，是卡納維爾國家園和邁雷特保護區的最大挑戰。

而這，也讓我們思及同樣位處於低窪地區的河口及四平等地，相信在不久的將來，水質的監測與管理亦會成為台江的重要課題，宜及早開始著手規劃。

台灣的台江國家公園和印地安河沼澤的保護區皆位於都市近郊，不論是觀光休閒或城鄉發展，都會對生態環境造成一定的壓力。因此，若能從他們的經驗之中學習，盡量避免過度的人為干擾，在保護生態之時，亦兼顧遊憩功能；思考如何與相關的政府單位及民間組織合作，共同攜手進行研究、調查、監測與維護，未來的台江，一定可以和印地安沼澤地一樣，展現人類與自然和平共存的美好景致。🇺🇸

### A Reference Source and Example

The greatest challenge for CNS and MINWR is to effectively control the water resource to ensure the water quality and water levels resemble those of the natural water cycle.

This also reminds us of the similar low-lying areas like Hekou, Siping, etc. We believe Taijiang National Park will also encounter the same important issues of monitoring and controlling water quality in the near future. It would be best to start water planning as early as possible.

Taijiang National Park of Taiwan and Wildlife Refuge of Indian River swamps are both located at the suburbs. Either tourism and recreational development, or urban and rural development will cause an impact on the ecosystem and environment. Taiwan should learn from the U.S.'s experience and avoid excessive man-made disturbances. It is important to promote collaboration between related government agencies and private organizations to launch research, inspections, monitoring and conservation so that the peaceful coexistence of man and Nature will certainly come to reality in the future of Taijiang National Park. 🇺🇸



### 林玲博士簡介 Profile of Ling Lin, Ph. D

國立臺灣大學地理環境資源學博士班畢。曾服務於太魯閣國家公園管理處，現為營建署國家公園組科長。本次獲美國國務院及美國在台協會邀請，參訪國家公園，進行深度交流。

Ph.D. in Geography at National Taiwan University. She had served at the Taroko National Park Headquarters and is currently Section Chief of the National Parks Division of CPAMI. She was invited by the U.S. State Department and the American Institute in Taiwan to pay visits to national parks in the U.S. and make in-depth exchanges.