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World
Treasure
世界級瑰寶

台灣海域沿岸生態

The Coastal Ecology of Taiwan

台灣面積狹小，人口稠密，雖然擁有天生的豐富自然資源，卻因為數十年來過度的人為開發，而造成海域沿岸生態的破壞與失衡。今日生態保育問題已不容忽視，為了留給後代子孫源源不絕的海洋生物資源，沿岸生態保育正是當下亟需盡快面對的重要課題。

Taiwan is a relatively small island with such a large and burgeoning population of people that land space is ever in short supply. Thankfully, Taiwan's lack of land resources is balanced by a bounty of rich marine resources. Yet, due to a history of unchecked development, the ecology of Taiwan's coastal areas is facing a serious situation of damage and excess. Marine and coastal conservation has finally become an undeniably urgent item on the national agenda, and it is our duty to protect and rehabilitate the natural resources we have inherited from history, preserving them and passing them forward with the original richness intact for future generations.



與海爭地，造成生態貧瘠

台灣四面環海，從深約60公尺的西岸到深約6,000公尺的東岸，地形自沙地、礫石、珊瑚礁到岩岸，擁有諸多不同的海岸棲地，不僅成就了多樣的生態系，更孕育了豐富的物種生態。從蝴蝶王國到蝶魚王國，過去台灣在自然生態上擁有許多傲人的頭銜，然而隨著工商發展、工業污染及沿岸的過度開發，使得西部的海埔地及潮間帶消失殆盡，美麗的海田被人工化的造物所取代，眼前景觀改變事小，影響深遠的則是慘遭破壞的海岸生態。

左 / Left
墾丁船帆石
Chuanfan Rock in Kenting

右 / Right
尺蠖蛾 (陳俊雄 攝)
Geometrid (by Chun-hsiung Chen)

The Damaged Coastal Regions of Taiwan

The perimeter coastline of Taiwan island unfolds in a wide variety of topographies, from beaches of white sand or darker gravel to coral reefs and rocky shores, from the gently sloping west coast, where the shoreline drops only 60 meters to the floor of the South China Sea, to the rugged landscape of the east coast, where slopes plunge 6,000 meters to the ocean floor at the bottom of the Philippine Trench. The wide variety of landscapes has created unique habitats, each supporting its own ecosystem and biology. With its unspoiled natural heritage, Taiwan was once widely known by names like the Butterfly Kingdom, and the Kingdom of Butterfly Fish. However, due to unchecked industrial activities, water pollution, and encroaching coastal development, much of Taiwan's vibrant natural endowment has vanished along with disappearing littoral (inter-tidal) areas and wetlands. These negative environmental effects are not only reflected in natural seashores being replaced by man-made development, but also by more subtle damage to marine life which often happens without obvious visual clues.





以雲林縣為例，雲林為全台海岸使用比例最高的縣市，單就麥寮六輕到離島工業區便已佔據了32公里的海岸線，這將近90%的工業化海岸，讓原本的自然海岸景觀及生態蕩然無存。此外，以淡海新市鎮的垃圾焚化爐及廢水處理廠用地為例，潮間帶的不當使用，使得將近37公頃的潮間帶礫石區，被填海造路所取代。原本淡海是漁產量甚為豐富的區域，在未受破壞之前，預估至少擁有將近1,000種以上的底棲生物，但與海爭地後的今日，海岸美景不再，最令人遺憾的是那早已消逝的海洋生物們。

Take Yunlin County as an example. It is a county on the west coast of Taiwan, about halfway between Taipei and Kaohsiung, and it has the highest development density of its coastal areas in Taiwan. The total coastline of this county stretches 32km. From the No. 6 Naphtha Cracking Project in Mailiao in the north of Yunlin County, to the Offshore Industrial Area in the south, industrial projects cover 90% of available coastline, completely destroying the natural coastal ecology. Similarly, construction of a crematorium disposal facility and a wastewater processing station in a newly developed area near Damshui of Taipei County are inappropriately situated, directly in the inter-tidal zone. In the case of these developments, the marine coastal environment suffered a natural disaster, with less than ten marine species surviving in the 37 hectare gravel inter-tidal area, compared with nearly 1,000 species of benthos living in a comparable area of unspoiled resources. This is just another example of consequences from Taiwan's extended human development of coastal areas, and the victim is always marine life, vanishing quietly from the original beauty of coastal areas.





美麗的珊瑚礁生態被稱為「海洋中的熱帶雨林」

Coral reefs are aptly termed "tropical rainforests of the ocean"

維護海岸生態，從河川開始

海納百川，河川的污染最後終將匯集到大海。海洋雖擁有無比的生命力，但長期的污染累積，仍舊對全球海洋生態帶來不容輕忽的破壞；而海洋的污染更牽涉到一整個地球維生系統的問題，因此，為永保海洋健康及維護海域沿岸生態，得從河川生態保育開始。

早期農業時代，寶島台灣的河川清澈，魚蝦蟹貝豐富，相較於今日各大河川多半受到污染，河水不再清澈見底，水中優游的生物也早已不如往昔。至於河海間洄游的生物如鰻魚、鱸鰻、香魚、蝦虎魚等，也因為河川污染，導致這些洄游生物無法回到出生地。現在雖然到處提倡河川整治，但是有些河川卻以水泥取代原本的砂礫河床，不僅無法涵養地下水源，更會讓河川喪失原有的自淨功能。當然，原本棲息於河床的生物也因棲地改變，而無法恢復過往的生態景致。

Costal Conservation Starts with Rivers

As a general rule, all pollution sources in rivers eventually converge toward the ocean as their final destination. Though it is true that the ocean has vast and incomparable vitality, the long-term accumulation of harmful wastes is taking its toll on ocean ecology. Water pollution causes immeasurable global costs to marine ecosystems. A solution to this problem, a way to return to healthy marine and coastal ecology, begins with the protection and rehabilitation of rivers.

It is a big contrast comparing the major rivers of Taiwan's modern industrial era, heavily polluted and devoid of healthy life, with the river networks of the earlier agricultural age, clear and rich with aquatic organisms. River pollution interferes with the ability of migratory species (both anadromous and catadromous) such as *Anguilliformes*, *Anguilla marmorata*, *Plecoglossus altivelis* and *Nemateleotris decora* to migrate to their breeding grounds. Though river management is a governmental responsibility, some practices cause more problems than they solve. One practice is to pave over sections of gravel river beds with cement. Obviously, this leads to a well-dredged river, easily managed, but a cement river bed destroys the natural habitats and ecosystems, as well as interfering with other important functions of a river, such as water conservation and self-rehabilitation.



雖然全台目前河川整治的工程，仍舊有待加強，海岸的過度人工化也需要另行規劃重整，但值得欣慰的是，近年來陸域的保育活動透過封溪及設置保護區，已讓山林裡的溪河源頭得以維持美好的生態平衡。

綠島經驗，開發與消失

位於台東外海的綠島，四周珊瑚礁環繞，擁有令人癡迷的海底景觀，並曾因其生態豐富而被選為環太平洋地區自然資源生態旅遊典範。但自綠島開放觀光以來，大量觀光客湧入，除了過量食用海裡的魚蝦蟹貝外，遊客下海浮潛更是不忘帶點「紀念品」上岸，這一切均使得當地海洋生態遭到破壞，物種和產量大減。台灣目前的生態旅遊必須要從「飲食」跨越到「鑑賞」的階段，否則台灣永遠只有海鮮文化，沒有海洋文化。現在到綠島潛水，已經見不到從前那番魚群撲面而來的驚人美景，取而代之的是略顯蕭條的海洋風光。

潛水客的不當捕抓行為
The diver's incorrect behavior



There is much that needs to be improved in the river networks of Taiwan. Those areas of our environment that are over-developed need to establish thoughtfully-considered limits on further development. On the other hand, there are already some preliminary accomplishments that deserve praise, such as the closure of certain rivers for rehabilitation purposes, and the establishment of river conservation areas. These helpful actions have begun to yield positive results, bringing selected rivers back into a more balanced ecosystem.

Example of Green Island

Green Island is a small volcanic island surrounded by coral reefs. It is a visually stunning natural environment, a potential showcase example of marine biodiversity. However, since Green Island is a popular travel destination, with large crowds of tourists converging on this tiny location, local fish resources are exploited at a disproportionate rate to feed the demand of busy seafood restaurants. Furthermore, there is much damage caused to the fragile coral reefs by undisciplined tourists while snorkelling and exploring. However, as a matter of fact, the amazing iconic images of snorkelling Taiwanese tourists encountering schools of tropical fish are actually taken from photo archives, as those days are long gone on Green Island. Unless mainstream Taiwan's enjoyment of ocean resources changes from a superficial appetite for seafood and pleasant experiences to a deeper sense of joy and appreciation for marine life, our oceans will never recover.



澎湖 Penghu

過去由於保育觀念宣導不周，以至於漁民過量捕撈漁獲，造成生態不平衡外，也使得許多保育類物種面臨絕種的困境，如綠島當地的椰子蟹，就老是出現在老饕們的餐桌上，而瀕臨滅絕。再者，來到綠島的觀光客大多租用機車環島，不論白天黑夜，總有機車在環島公路上馳騁，乘風而行固然是種享受，但卻因機車橫行，使得那一群群在島上移動著的紫地蟹、紅螯螳臂蟹和寄居蟹，時常發生慘死車輪下的悲劇。

此外，為了配合大量湧入的觀光人潮，民宿旅館興起，水泥工程漸漸在綠島鋪張了起來，不僅吞食了翠綠的山巒，也連帶破壞美麗的珊瑚礁景觀。人類文明的發展，帶來一時的繁榮收穫，但卻也在輕忽保育的同時，連帶造成自然生態的毀滅。若要盡力維護自然生態，最基本的就是要減少人為的介入，管制遊客人數不再增加、禁止捕撈海洋生物，取而代之是海底賞魚之旅，以及籌設生態保護區等，才是恢復綠島海域沿岸生態的不二法則，並且提升綠島成為國際級海洋生態度假島嶼。

Most people demonstrate a lack of depth in their education about environmental and conservational issues affecting our oceans. As a result, thoughtless practices, such as over-fishing, cause an unbalanced ecosystem, with a growing list of endangered species. *Birgus latro* is a good example. This species is under threat of extinction simply because they are such a favoured ingredient for seafood cuisine. As another example, the most popular local transportation for tourists on Green Island is by scooter. While sightseers enjoy their pleasant tour of the island, wandering land crabs such as *Gecarcoidea lalandii*, *Chiromantes haematocheir* and Pagurian are commonly crushed under careless scooter wheels.

To accommodate influxes of tourists, more guest houses are built, and man-made development replaces the natural landscape, sometimes even damaging coral reefs. Modern technology has brought prosperity to humans, but with our short-sighted thinking and lack of good sense about environmental conservation, our progress has come with a devastating toll on the environment. The basic approach to marine conservation goals on Green Island is to decrease the effects of human interference; by controlling the number of visitors, by forbidding the collection or harvesting of local marine life, by establishing conservation areas.



墾丁陸蟹
Cardisoma hirtipes Dana



海岸生態保育，福爾摩沙再現

鄭明修表示，美國總統布希就是以行政命令將夏威夷的北方群島鏈規劃為海洋保護區，這個保護區長2,300公里，面積廣達36萬平方公里；斐濟總統更將30%的海域劃為海洋保護區。台灣的綠島曾在1996年被APEC選為生態旅遊地，可惜政府後續並沒有執行任何生態保育的動作，使得綠島目前仍被列為中度破壞島嶼。鄭明修指出，海洋資源應優先處理救援，只要加強復育，3年的時間便能讓魚群回來。

綠島的經驗，在蘭嶼、墾丁等地也都曾發生過，而曾經出現在台灣海域的稀有物種，如馬蹄鐘螺也已銷聲匿跡數十年；過去曾大量捕捉的觀賞用熱帶魚，時至今日也大多不見蹤跡。近年來，環保意識抬頭，雖然目前保育運動仍舊舉步維艱，但是至少透過一步步的教育宣導及保護區設立，讓生態保育出現了些許新生希望。未來更應積極建立有效管理的海洋保護區及國家公園，加強投入稀有物種的保育及復育，減少河川污染物，加強海岸及漁業管理，珍惜海洋資源，方能讓寶島重返昔日美麗樣貌。

Coastal Ecology of Sanctuary

In a 2006 law passed by President Bush of the United States of America, a large portion of Hawaii was converted to a marine sanctuary. The sanctuary stretches 2,300 km along a chain of islands to the northwest of Hawaii, and covers a total area of 360,000 square km, making it the largest marine park in the world. Also in 2006, the prime minister of the Republic of Fiji converted thirty percent of Fiji's total marine territory into a conservation area. With these two examples, expressed the importance of establishing Green Island as a protected conservation area, adding that Green Island was chosen as an ecotourism destination by APEC in 1996. Unfortunately, there is no current enforcement system to ensure Green Island follows sustainable development practices, and as a result the status of Green Island has been downgraded to "mid-level damaged island". Ming-shiou Jeng further expressed that environmental rehabilitation of Green Island should be the priority at this stage, and it estimated that it will take 3 years of strict enforcement to restore fish communities.

The environmental mistakes of Green Island are not unique, having their counterparts in the experiences of Lanyu Island and the Kenting area. *Teuchus maximus* is a rare marine species that was driven to extinction from Taiwan's waters over the decades. Additionally, many species of tropical fish that are harvested for aquarium purposes are experiencing dramatic declines. However, thanks to recent increases in global environmental consciousness, there is reason for hope, though many obstacles still remain. With the next positive steps of establishing efficiently managed marine national parks and conservation areas, along with rehabilitation and protection of endangered species, reduction of river pollution, enforcement of existing laws for coastal areas, and proper efforts directed at making the fisheries industry sustainable, Taiwan will once again become a showcase of healthy marine resources.



夏威夷 Hawaii



澎湖 Penghu



蘭嶼 Lanyu



墾丁 Kenting

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