



臺灣海廢監測成果與 經驗分享

行政院環境保護署 環管處
108/1/25

簡報大綱

壹 前言

貳 執行成果

- ◆ 海岸廢棄物監測調查
- ◆ 人工智慧影像辨識初步探討

參 後續工作重點

壹、前言

1 緣起

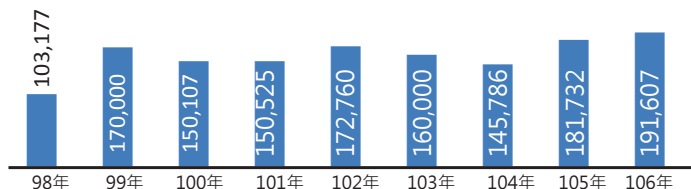
2 目標

- 海洋廢棄物(marine debris)受到世界各國關注且為海洋環境保育重要議題之一。
- 我國推動淨灘多年，每年投入人力約15萬人左右，每年平均清理約5,000公噸垃圾，然海岸環境髒亂問題仍持續存在。



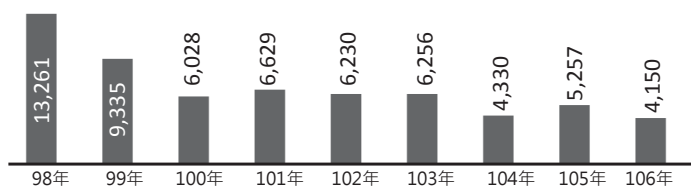
累計動員人數

142萬人次



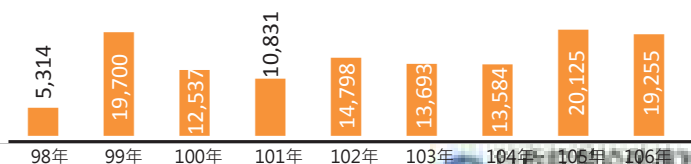
累計清理垃圾量

6萬1,476公噸



累計清理線長度

12萬837公里

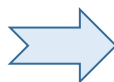


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壹、前言

1 緣起

2 目標



1. 全國海岸到底有多少垃圾
2. 海岸垃圾之分布與組成情形

1. 如何建立合理且節省人力之垃圾量推估方式
2. 如何進行實地驗證

建立資訊整合平台、建立垃圾量推估方式







壹、前言

1 緣起

2 目標

四大目標

-  輔導地方政府、企業、民間團體辦理海岸清潔維護環境教育宣導工作。
-  建置海岸清理維護資料庫及優化海岸認養淨灘系統，並定期公布海岸清潔維護監測環境教育成果。
-  規劃建立海岸廢棄物數量推估方式，及指認待清理海岸。
-  建立海岸清理分類原則及作業程序。



「海岸淨灘認養」系統



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貳、執行成果

方法	海岸廢棄物調查	人工智慧影像辨識
執行單位	環保局	本計畫
執行方式	透過ICC高低密度監測瞭解 1.海廢垃圾組成 2.寶特瓶來源	透過空拍攝影可見光影像以 DNN進行標的辨識
調查目的	垃圾組成及寶特瓶來源	寶特瓶數量計算

• DNN(Deep Neural Networks):深度類神經網路，屬人工智慧範疇具備多層次架構學習能力。



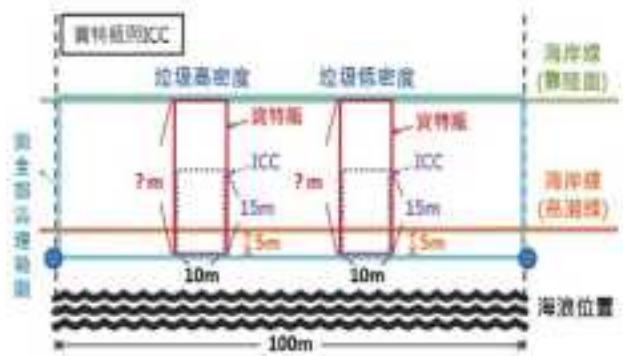
資2-70

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建立海岸廢棄物數量
推估方式

人力



海岸廢棄物監測調查

機械



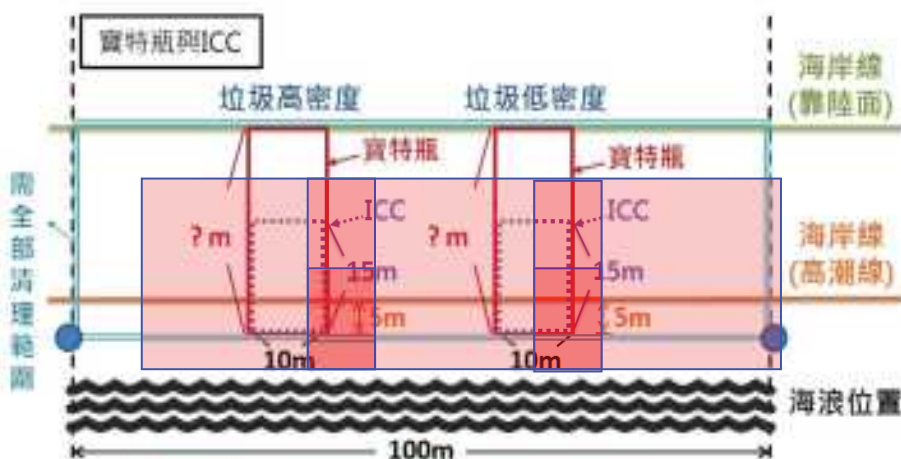
人工智慧影像辨識



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海岸廢棄物監測調查

1 海岸廢棄物調查作業程序



- 實線範圍：實特瓶（高密度與低密度）
 - 虛線範圍：ICC（高密度與低密度）
 - 雙線範圍：監測完成後，需全部淨灘清理的範圍
- 請提供監測區域100m的頭尾GPS座標



訂定海廢調查作業程序，進行全國海岸廢棄物基線資料調查



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海岸廢棄物監測調查

1 海岸廢棄物調查作業程序

調查成果表-ICC

參考臺灣清淨海洋行動聯盟 (簡稱 T.O.C.A) 國際淨灘行動紀錄表，製作 ICC 監測調查成果表

類別	數量	備註
塑膠瓶	1	
塑膠瓶蓋	1	
塑膠袋	1	
紙類	1	
玻璃瓶	1	
其他	1	

ICC 監測類別 共分5大類別20小項

生活垃圾與遊憩行為

- * 寶特瓶
- * 塑膠瓶蓋
- * 吸管
- * 外帶飲料杯
- * 免洗餐具
- * 塑膠(提)袋
- * 食品包裝袋
- * 鐵鋁罐
- * 玻璃瓶
- * 鋁箔包/利樂包
- * 非食物瓶罐容器
- * 其他飲料食物容器

醫療/個人衛生用品

- * 牙刷
- * 針筒、針頭

抽菸

- * 菸蒂
- * 打火機

漁業與休閒釣魚

- * 釣魚用具
- * 漁業浮球/浮筒/漁船防碰墊
- * 漁網與繩子

當地關心的廢棄物

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海岸廢棄物監測調查

1 海岸廢棄物調查作業程序

為確實監測寶特瓶之來源，若該寶特瓶包裝完整，淨灘成果表須確實填妥銷售國家。

調查成果表-寶特瓶

編號	日期	地點	數量	備註
1001	2016/10/15	基隆	1	
1002	2016/10/15	基隆	1	
1003	2016/10/15	基隆	1	
1004	2016/10/15	基隆	1	
1005	2016/10/15	基隆	1	
1006	2016/10/15	基隆	1	
1007	2016/10/15	基隆	1	
1008	2016/10/15	基隆	1	
1009	2016/10/15	基隆	1	
1010	2016/10/15	基隆	1	



藉由監測數據瞭解寶特瓶來源

海岸廢棄物監測調查

2 全國輔導調查成果

監測點分佈

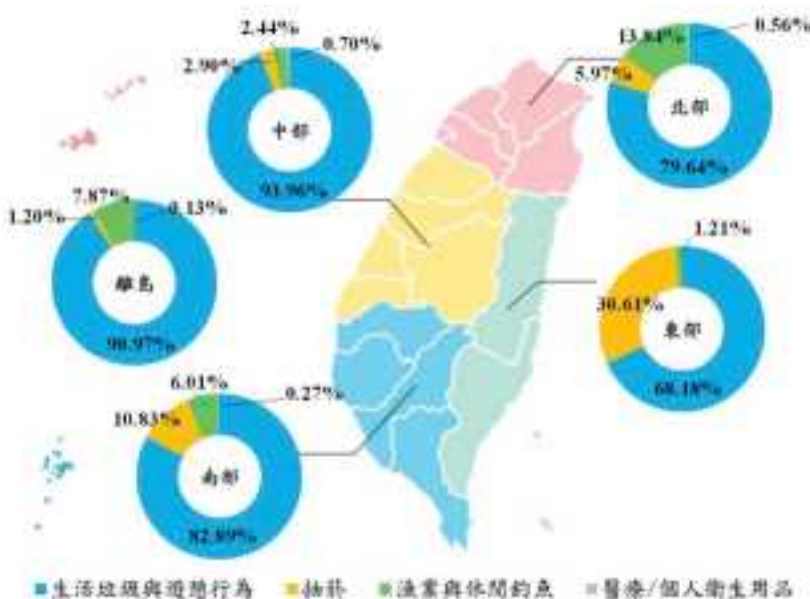


107年各縣市環保局共針對19處海岸線，進行海廢監測(1次/季)

海岸廢棄物監測調查

2 全國輔導調查成果

垃圾組成-分區統計調查成果



	生活垃圾與遊憩行為 (個)	抽菸 (個)	漁業與休閒釣魚 (個)	醫療/個人衛生用品 (個)
北部	2,147	161	373	15
中部	3,079	95	80	23
南部	911	119	66	3
東部	225	101	4	0
離島	3,391	45	294	5

- ❖ 北部：新北、基隆、桃園、新竹縣(市)、宜蘭
- ❖ 中部：苗栗、臺中、彰化、雲林
- ❖ 南部：嘉義縣、臺南、高雄、屏東
- ❖ 東部：花蓮、臺東
- ❖ 離島：金門、連江、澎湖

海岸廢棄物以「生活垃圾與遊憩行為」占最大宗

海岸廢棄物監測調查

2 全國輔導調查成果

垃圾組成-分縣市統計調查成果



海岸廢棄物多以寶特瓶、塑膠製品及漁業用具為主

海岸廢棄物監測調查

2 全國輔導調查成果

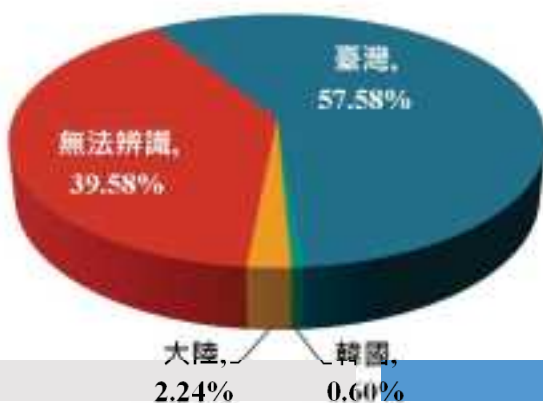
寶特瓶來源-調查成果

	臺灣	大陸	韓國	日本	無法辨識
臺灣本島	2,111	82	22	0	1,451
離島	223	341	1	0	3,306

無法辨識者
占整體寶特瓶的63%

臺灣本島

以我國生產之寶特瓶最多
(57.58%)



離島

以大陸製寶特瓶數量最多
(8.81%)



貳、執行成果

方法	海岸廢棄物調查	人工智慧影像辨識
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執行方式	透過ICC高低密度監測瞭解 1.海廢垃圾組成 2.寶特瓶來源	透過空拍攝影可見光影像以DNN進行標的辨識
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• DNN(Depth Neural Networks):深度類神經網路，屬人工智慧範疇具備多層次架構學習能力。



人工智慧影像辨識初步探討

1 專業設備規格

硬體設備規格



DJI Inspire2

- 30分鐘飛行時間，
- 94 km/hr的飛行速度(抗風能力)
- 7 km信號傳輸能力

符合海岸線遼闊、風速大等特性



MFT 15mm,F/1.7

符合拍攝影像可達地面解析度0.5cm

軟體工具



自動航線規劃app使用 Pix4Dcapture 使用 Pix4Dmapper進行影像拼接



人工智慧影像辨識初步探討

2

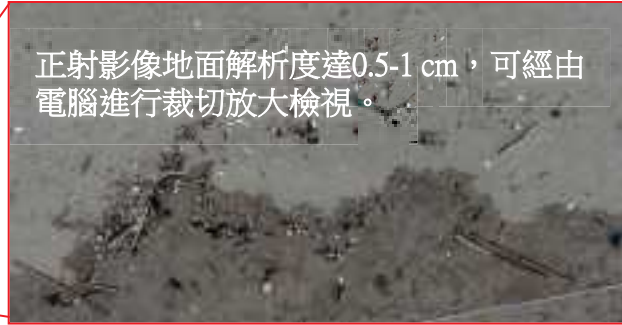
影像收集與訓練

可見光影像收集

正射影像



正射影像地面解析度達0.5-1 cm，可經由電腦進行裁切放大檢視。



影像拼接



透過正射影像進行拼接後，可避免寶特瓶有重複計算之疑慮。

經評估後以**可見光正射影像**做為主要素材收集方法

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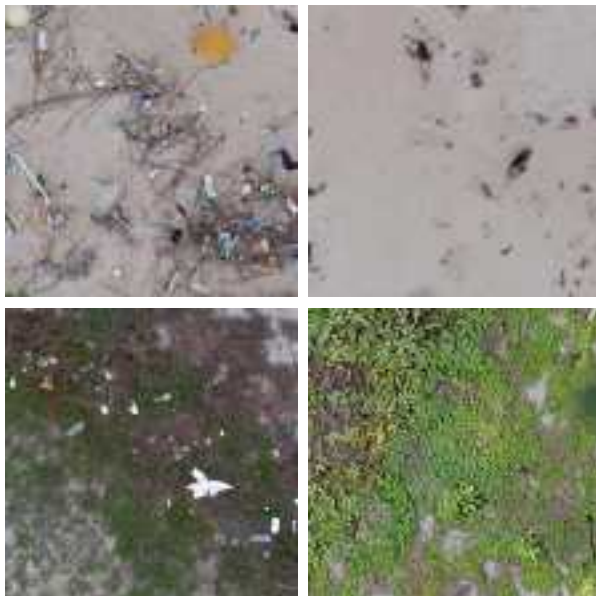
人工智慧影像辨識初步探討

2

影像收集與訓練

DNN訓練與驗證影像

訓練用影像



有寶特瓶之影像

無寶特瓶之影像

驗證用影像



無投入訓練之影像-400張

最終共投入約60,000張影像進行訓練(寶特瓶：非寶特瓶-1：8)

資2-76

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人工智慧影像辨識初步探討

3

實地驗證成果

寶特瓶驗證成果

驗證地點	寶特瓶 實際數量	TP (辨識正確)	FP (辨識錯誤)	FN (未被辨識)	精確率(%) Precision	召回率(%) Recall	平均辨識率 mAP (%)
新北市林口區 頂寮沙灘	26	13	7	13	65	50	57.5
屏東縣琉球鄉 中澳沙灘	23	6	21	17	22	26	24.0
彰化縣線西鄉 番雅溪出海口	29	16	22	13	42	55	48.5

※精確率=TP/(TP+FP)，為偵測到正確的寶特瓶總數／偵測到正確與錯誤的寶特瓶總數。

※召回率=TP/(TP+FN)，為偵測到正確的寶特瓶總數／偵測到正確與未被辨識的寶特瓶總數。

※平均辨識率mAP(%)=(精確率+召回率)/2，為精確率與召回率的平均值。

以林口頂寮沙灘辨識率最佳，推測為場地性質較接近訓練影像，並且干擾物質較少導致。



三場次實地驗證平均辨識率為43.3%

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參、後續工作重點

1. 持續推動海岸廢棄物調查作業

- 107年已針對19個臨海縣市，各挑選1處海岸線，進行海岸廢棄物100m範圍監測調查(1次/季)。未來持續進行海岸廢棄物監測調查作業，並於各縣市擴充監測點位，以利掌握我國海岸線廢棄物組成及各季垃圾量變化。

2. 提升海岸廢棄物垃圾辨識率

- 持續收集國內外AI人工智慧影像辨識所採用之演算法及辨識項目，作為提升AI影像辨識寶特瓶及增加海岸廢棄物辨識項目(如漁網、保麗龍等)之參考依據。



Thanks for
Your Attention



海洋保育·海好有您

-海漂事務介紹-

海洋委員會海洋保育署

2019年1月25日

2018年4月28日 我們在高雄誕生



科學研究為基礎
公開透明為原則
產官學公私合力

潔淨海水
Clean Water

海洋油污污染緊急應變與處理
海洋廢棄物監測調查與清理
鼓勵創新方法處理廢棄漁具

健康棲地
Health Habitat

永續資源
Sustainable Resources

建立海洋保護區平台
面對新能源政策衝擊
桃園藻礁案保護策略

鯨豚海龜緊急救援擱淺處理
海洋生物科學研究合作平台
海洋生物環境永續教育推廣

2019東亞地區海漂對策事務交流會

3

潔淨海水 海漂事務 

我們現在做了...

2019東亞地區海漂對策事務交流會

資2-80

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跨部會單位合作



- 加強船舶廢油污水及港區廢棄物之收受處理
- 評估進一步商討漁具實名制 (漁具標籤) 可行性

2019東亞地區海漂對策事務交流會

瞭解漁港水質概況



2019東亞地區海漂對策事務交流會

與地方政府合作 成立1,877艘環保艦隊



澎湖縣



臺東縣

2019東亞地區海漂對策事務交流會

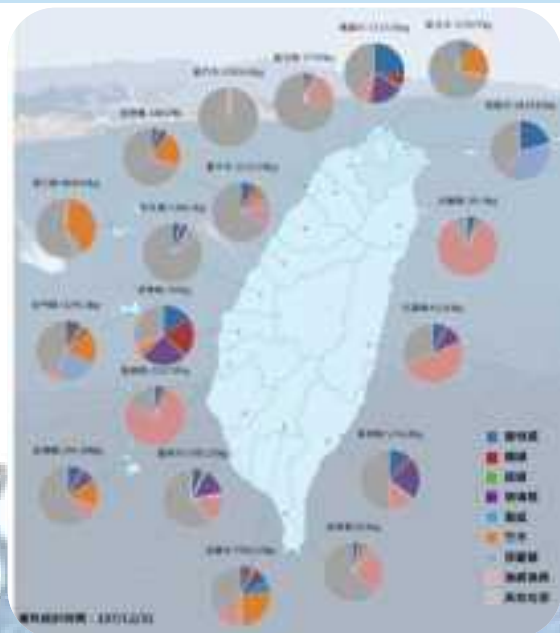
與地方政府合作 清理海洋廢棄物499,564公斤



屏東縣



屏東縣



2019東亞地區海漂對策事務交流會

環境教育宣導推廣



2019東亞地區海漂對策事務交流會

我們接下來還想要...



2019東亞地區海漂對策事務交流會
資2-83



乘船出海

- ◆ 目視調查海面漂流垃圾種類、密度
- ◆ 遙控無人機研究海面漂流垃圾分布



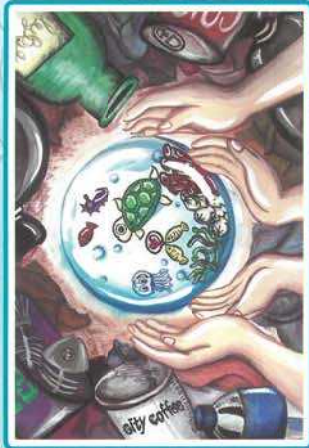
研發調查

- ◆ 養殖漁具替代材料研發及設置示範點
- ◆ 進行海洋生物塑膠微粒調查

Thanks for your attention

OCEAN CONSERVATION

NEEDS YOU



Pei Hsin Junior High School
Luo, Ker-Yun Treasure

The marine ecological system is under severe invasion by marine debris. Everyone in the world should cooperate to protect the only marine treasure jointly.

International Cooperation

The ocean is a continuous water body without border. The protection of marine ecology or management regarding marine pollution problems are transboundary issues that all countries have to work on.

OCA will proactively participate in international organizations and continue to focus on their various agenda related to marine biodiversity. These organizations include Asia-Pacific Economic Cooperation, Ocean and Fisheries Working Group (APEC-OFWG), Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and Agreement on the Conservation of Albatrosses and Petrels (ACAP).

The international exchange of marine conservation affairs brings new knowledge of marine ecology or marine pollution monitoring and treatment to Taiwan. The joint promotion and policy implementation with relevant government sectors increase the planning and coordination of international cooperation and technological exchange, which enhances Taiwan's international visibility on marine conservation. OCA aims to keep marine life living in healthy marine environment and bring sustainable marine resources for the next generation of Taiwan.



Clean Seawater
Sustainable Resource
Healthy Habitat

海洋委員會海洋保育署
 Ocean Conservation Administration
 TEL: (07)332057
 Address: 7F, No. 25, ChengKung 2nd Road, Cianjhen District, Kaohsiung City 80661
 Website: <http://www.oac.gov.tw/GipOpuni/wSite/mp/fmp-oca>
 E-Mail: ocamaster@oac.oac.gov.tw



Ta-Kuan Junior High School
Heu, Fu-Wei

Protect the environment, protect the ocean

The sea turtle swim freely with the whale and dolphin, conveying the image of harmony between the human and the environment. The red net to capture the waste signifies the determination and capacity to protect the ecology.

Vision of Ocean Conservation Administration

On April 28, 2018, a new cabinet-level "Ocean Affairs Council" and its subordinate agency - "Ocean Conservation Administration (OCA)" were founded in Kaohsiung.

OCA mainly comprises three service units, including the comprehensive planning section, marine life conservation section, and marine environmental management section. OCA will apply three basic principles in "objective and continuous science foundation," "information transparency," and "public-private partnership," to review the changes in the marine environment and living resources in Taiwan. Such technologies and public involvement will help to establish the link between marine conservation and people.

Our goal is CHS - "Clean Water," "Health Habitat" and Sustainable Resources. We hope to leave clean seawater and sustainable resources for the next generations of Taiwan, as well as providing a healthy habitat for marine life.

Note: The images show in the text are taken from the winning pieces from the national drawing competition for "2018 Beautiful and Plastic Free Ocean".

Marine Debris

Marine debris pollution is currently one of the most important international environmental issues. Marine debris include the visible and invisible solid wastes washed ashore, or the water produced from marine activities such as derelict fishing gear. "New" items include those garbage wastes that can be seen by casual eyes, or "ghost" plastic wastes that float. OCA will monitor the distribution of marine debris and the impact on ocean environment through the perspective science philosophy.

In February 2018, Environmental Protection Administration and Non-governmental Environmental Organizations (NGO) announced "Clean Marine Debris (Overseas Action Plan)". It is a new initiative of public-private partnership in Taiwan for establishing important marine parks. The key components of marine parks include four aspects of Marine parks, i.e., "Science education", "Recreation and research", "Monitoring and emergency" and "Outreach and public participation".

OCA will proactively conduct cross-sectoral cooperation with NGOs and the Environmental Protection Administration to investigate the composition and distribution of marine debris in Taiwan. OCA also provides environmental protection field with floating trash catches in fishing boats and marine fish. Improves the lake-water quality under the concept of the coastal and estuarine debris management program, in order to reach the goal of "Healthy Blue Ocean".

Seaport City/Village Junior High School
Ching-Chen-Hsin
Marine Life
Marine Life

30 students have visited the school to understand the marine life and the importance of marine life. They have learned about the importance of marine life and the importance of marine life.



Marine Pollution Prevention

The principal sources of marine contamination include sewage treatment, land-based pollution, marine debris, and fishing gear. OCA will monitor the distribution of marine debris and the impact on ocean environment through the perspective science philosophy.

For reduction of marine pollution, OCA will actively cooperate with NGOs and the Environmental Protection Administration to investigate the composition and distribution of marine debris in Taiwan. OCA also provides environmental protection field with floating trash catches in fishing boats and marine fish. Improves the lake-water quality under the concept of the coastal and estuarine debris management program, in order to reach the goal of "Healthy Blue Ocean".

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Marine Life Conservation and Biodiversity Maintenance

Great Coast Administration (OCA) and OCA have been to Ocean Park, and OCA has been to Ocean Park. OCA will monitor the distribution of marine debris and the impact on ocean environment through the perspective science philosophy.

Stable Conservation Act was amended to include the Marine Mammal Conservation Act. OCA will monitor the distribution of marine debris and the impact on ocean environment through the perspective science philosophy.

OCA will proactively conduct cross-sectoral cooperation with NGOs and the Environmental Protection Administration to investigate the composition and distribution of marine debris in Taiwan. OCA also provides environmental protection field with floating trash catches in fishing boats and marine fish. Improves the lake-water quality under the concept of the coastal and estuarine debris management program, in order to reach the goal of "Healthy Blue Ocean".



Yong-Ling Elementary School
Lin-Hsin-Hsin
Marine Life
Marine Life

30 students have visited the school to understand the marine life and the importance of marine life. They have learned about the importance of marine life and the importance of marine life.

Marine Environmental Education

OCA will actively cooperate with NGOs and the Environmental Protection Administration to investigate the composition and distribution of marine debris in Taiwan. OCA also provides environmental protection field with floating trash catches in fishing boats and marine fish. Improves the lake-water quality under the concept of the coastal and estuarine debris management program, in order to reach the goal of "Healthy Blue Ocean".

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Jian-An Elementary School
Lin-Hsin-Hsin
Marine Life
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沖縄リサイクル運動 市民の会



For the Ecological Civil Society

OKINAWA CITIZENS RECYCLING MOVEMENT
沖縄リサイクル運動市民の会

Our organization is a non-profit organization established in 1997. We are committed to promoting recycling and environmental protection in Okinawa. We have been active in various recycling activities and have been recognized by the government and the public. We are currently working on various projects to promote recycling and environmental protection in Okinawa. We are also working on various projects to promote recycling and environmental protection in Okinawa. We are also working on various projects to promote recycling and environmental protection in Okinawa.



What is Recycling Day?

Recycling Day is a day when people bring their own reusable containers and products to work, school, or other public places. It is a day when people can enjoy their favorite foods and drinks without creating any waste. It is a day when people can enjoy their favorite foods and drinks without creating any waste. It is a day when people can enjoy their favorite foods and drinks without creating any waste.

Almost 20,000 people experience

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INTERNATIONAL COOPERATION PROJECT

Recycling-based Social System

Recycling-based social systems are systems that are designed to reduce waste and promote recycling. They are systems that are designed to reduce waste and promote recycling. They are systems that are designed to reduce waste and promote recycling. They are systems that are designed to reduce waste and promote recycling.




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