海洋調查和探測技術

2022/02/16

施義哲

海洋調查和探測技術 Ocean Survey and Exploration Technique

■ 課程:海洋調查和探測技術概述

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教室:水利系館4650

● 時間: PM 14:10-17:00

■ 課程概述:

■ 21世紀是以海洋為發展重點的世紀,海洋資源的開發及利用、海洋環境的安全及保護,已成為各沿海國經濟發展與科技競爭的重點。為因應新的情勢和新的挑戰,各國皆投入海洋研究與發展海洋技術,爭取海洋競爭的契機與主導地位。國際海洋的競爭實質上是海洋科技技術的競爭,是國家整體國力的競爭。面對國際日益複雜的政經情勢,海洋的調查與探測技術,發展海洋科技技術,邁向海洋、走進海洋,建設海洋國家已是我國的既定目標。本課程提供學生未來海洋技術發展策略研究,相關的海洋規劃與計畫的制定提供重要的概念。

課程內容:

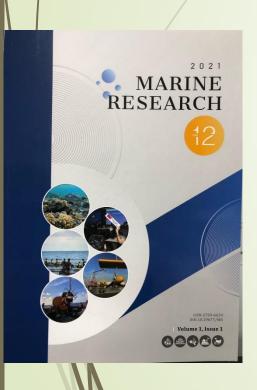
- ▶ 第一週:課程介紹;海洋調查和探測技術概述
- ▶ 第二週:海洋探測新高科技的需求與發展
- 第三週:主要海洋國家的海洋科技計畫與發展略(美、加、歐盟)
- 第四週:主要海洋國家的海洋科技計畫與發展略(日本、韓國、新加坡)
- 第五週:國外海洋科技技術發展-海洋環境監測技術介紹
- 第六週:國外海洋科技技術發展-海洋油氣與礦產 資源探勘
- 第七週:國外海洋科技技術發展-海洋生物資源開發利用技術
- 第八週:國外海洋科技技術發展-無人載具技術開發與應用

- ●第九週:海洋再生能源開發利用技術
- ●第十週:特種船舶設計與建造技術
- ●第十一週:我國海洋科技發展介紹
- ●第十二週:海洋環境監測技術
- ●第十三週:海洋環境監測技術與應用
- ▶ 第十四週:海岸地區環境遙測原理與應用
- ●第十五週:學期報告及簡報
- ●第十六週:學期報告及簡報
- ●第十七週:我國海洋科技計畫的趨勢介紹與分析
- ●第十八週:我國海洋科技計畫的趨勢發展與未來

評量方式

- ▶ 學期表現 25%
- ■課堂出席 35 %
- ▶學期報告+簡報+簡報提問 40 %

授課資料



▶海洋探索期刊文章

■ 國家海洋研究院致力於海洋政策、資源、文化、科學、產業、工程跨學科領域之學術研究,以「整合國家海 洋研究量能、開拓海洋研究視野」為辦刊宗旨,爰發行專業期刊「海洋探索」,英文名稱為Marine Research。於109年發行試刊號。

本期刊可於官網首頁【主題網站】超連結期刊專屬網站,每篇文章可至<mark>期刊專屬網站</mark>瀏覽下載,並同步於<mark>華 藝線上圖書館</mark>(Airiti Library)及<u>HyRead ebook</u>服務平台同時登載《海洋探索》期刊全文,以開放存取(Open Access)方式供讀者免費閱讀下載。

http://marres.namr.gov.tw/

Ocean White Papers

▶各國白皮書與聯合國秘書長海洋與海洋法報告書

U.S. Ocean Action Plan

The Bush Administration's

Response to the U.S. Commission on Ocean Police

- Selections -

White Paper on the Oceans and Ocean Policy in Japan

2021



Ocean Policy Research Institute, Sasakawa Peace Foundation

United Nations

General Assembly

A/75/70

Distr.: General 16 March 2020

海洋委員會編譯案。

Seventy-fifth session Item 76 (a) of the preliminary list* Oceans and the law of the sea

Oceans and the law of the sea

Report of the Secretary-General

Summary

In paragraph 352 of its resolution 74/19, the General Asse United Nations Open-ended Informal Consultative Process on C the Sea would focus its discussions at its twenty-first meeting or rise and its impacts". The present report was prepared pursuan resolution 74/19 with a view to facilitating discussions on the top submitted to the Assembly for consideration at its seventy-fit States parties to the United Nations Convention on the Law o article 319 of the Convention.

2019 年聯合國秘書長海洋與海洋法報告書。

(海洋科學與永續發展)

《摘要、分析、建議》

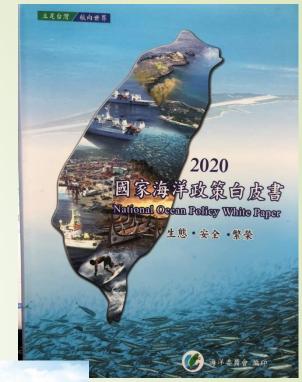
編譯者:蔡季廷副教授

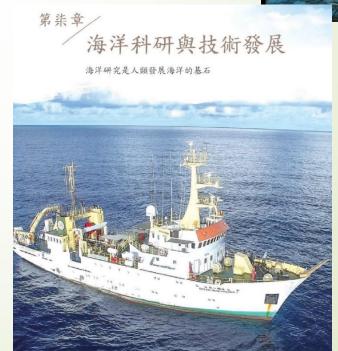
研究助理:胡方維碩士、程惠

2020 海洋政策白皮書

- ■第柒章 海洋科研與技術發展
- ■第一節 整合海洋科研資訊
- 第二節 完善海洋基礎調查
- ●第三節 引領海洋產業升級
- https://www.oac.gov.tw/ch/home.jsp?id=232&parentpath=0,2







國家海洋研究院同仁們講座 (題目暫定)

▶姓名:余采倫博士

日期:3/2

預計講授時數:2.5小時

講授主題:海洋化學調查技術與應用

姓名:王博賢博士

日期:3/16

預計講授時數:2.5小時

講授主題:海洋生地化調查技術與應用

●姓名:賴堅戊博士

日期:3/23

預計講授時數:2.5小時

講授主題:海洋雷達遙測及其產出應用

●姓名:陳麗雯博士

日期:4/13

預計講授時數:2.5小時

講授主題:海洋地質地物探勘應用

■姓名:傅科憲博士

日期:X/X

預計講授時數:2.5小時

講授主題:海洋物理現場觀測技術與應用

國家海洋研究院研究團隊能量



水文模擬團隊



自主開發與建立海洋觀測、數值模擬之數位孿 生技術(Digital Twin)

地形底質團隊



全面普查並發展資料分析技術應用於海底構造 演化與海底資源探勘之 研究

資料庫團隊



自主維運海洋資料中心及 全國海洋資料庫,海洋資 料品管及分析100%

生態調查團隊



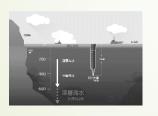
精進環境變遷與人為活動 對海洋生物影響之研究、 提供水質分析技術及諮詢

洋流能團隊



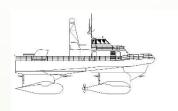
研發防蝕技術、建置海 洋能示範電廠及國際海 洋能測試場,將海洋綠 能關鍵技術本土化

深層水團隊



建置深層海水科技研發平台,有效銜接至下游的產業應用,提升產品價值

船模團隊



自主進行船模各項試驗 ,建立試驗與實海測試 關連數據庫,強化研發 專業人才

海政文化團隊



以SDG為基礎,發展海 洋政策及文化資產庫整 合應用、研究及公眾參 與海洋永續發展機制

海洋人培團隊



完善海洋產業、海 洋執法、海洋保育 專業技術人力之訓 練與發證



西北太平洋海洋預測系集模式研究

廖建明 主任、 陳沛宏 助理研究員 國家海洋研究院 海洋產業及工程研究中心

研究目的 本研究以長期追報模擬HYCOM (HYbird Coordinate Ocean Model)模式應用於西北太平洋模擬結果,討論聖嬰與反聖嬰現象時期之大氣特性 與驅動HYCOM模式產出相對應之西北太平洋海洋狀態、分析校驗西北太平洋與台灣附近海域於聖嬰與反聖嬰現象條件下之海洋變動特性。另一方面,以中央氣象 局大氣系集預測架構為基礎·發展HYCOM模式系集預測程序·驗證系集模式資料後續應用之合理性·做為未來局地系集轉換卡爾曼濾波器(Local Ensemble Transform Kalman Filter. LETKF)資料同化技術發展依據。

研究方法 為探討西北太平洋與台灣附近海域於聖嬰與反聖嬰現象之 海洋變動特性·本研究採用TWPb0.08格網及美國國家環境預報中心(The National Centers for Environmental Prediction, NCEP)全球預報模式作為 HYCOM海面大氣邊界資料(表1)·進行27年模擬時間長度(1994年1月至2021 年1月)的長期追報模擬。另在系集預測模式的合理性分析上,則以中央氣象局 WRF區域系集預測模式(WRFEN)20組系集預報成員做為海面大氣邊界條件 進行模式測試。

表1	長期追報模擬使用	的海面邊界與測	訓試的格網資訊	表
產品	格網	海面大氣邊界資料		
模式/資料庫	TWPb0.08	NCEP CFSR	NCEP CFSv2	NCEP/NCAR Reanalysis2
範圍	98.95~148.88E 1.99~40.94N	Global	Global	Global
空間解析度(度)	0.08	0.3125	0.2045	1.87
格網數	625x538x41	1152x576	1760x880	192x84
漁即放件	CI PO OS	Control	7.00	

本研究以當今最常用於監測熱帶太平洋聖嬰指標ONI (Oceanic Nino Index)來定義聖嬰年期。故本研究之聖嬰期為1997年 6月至1998年5月、反聖嬰期自2007年6月至2008年5月、正常年為 2005年6月至2006年5月間。從長期追報結果顯示(圖1)、聖嬰年冬季 至隔年春季間、台灣附近海域至南海之海面溫度異常值偏高、反聖嬰 年冬季之大陸至越南沿岸海域海面溫度異常值偏低。海面高度異常值 偏高處在反聖嬰年時出現在北緯10度左右、聖嬰年向南移動至北緯5 流速增強、北側亦有流速增強現象、而反聖嬰年時因東北季風增強、 大陸沿岸流流速亦增強。經與衛星測高資料驗證,本研究選用的 TWPb0.08格網能合理描述黑潮流動所造成的局部變化·顯示模式結 果能合理反應海面大氣資料的變化特性。

HYCOM系集預報模式之海面鹽度、溫度、高度與流速等系集平 均與標準差變化顯示、標準差隨預報時間增加亦呈變大趨勢、顯示大 氣預報歧異度會反映於TWPb0.08系集成員預報結果。海面溫度系集 平均與NOAA OI SST資料庫之比較顯示(圖2),海面溫度差距約在攝 氏正負0.5度間,某些小區域之溫度差距可達攝氏2度,如台灣海峽內

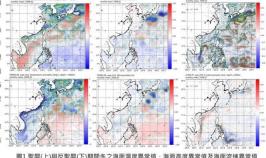
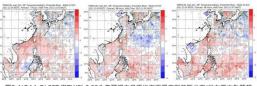
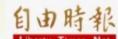


圖1 聖嬰(上)與反聖嬰(下)期間冬之海面溫度異常值、海面高度異常值及海面流速異常值



0-24小時、預報48-72小時及96-108小時)

本研究完成HYCOM模式長期追報及西北太平洋區域海洋系集預報模擬開發與驗證,後續將朝向更高解析度或巢狀區域模式測試、引入潮汐變化、持續每日預 報作業驗證、與單點測站資料之驗證、系集預報驗證、LETKF資料同化技術、海氣偶合模式發展等工作。



即時 熱門 政治 社會 生活 健康 國際 地方 蒐奇 影音 財經 娛樂

中研院環變中心 攜手國海院研發關鍵技術



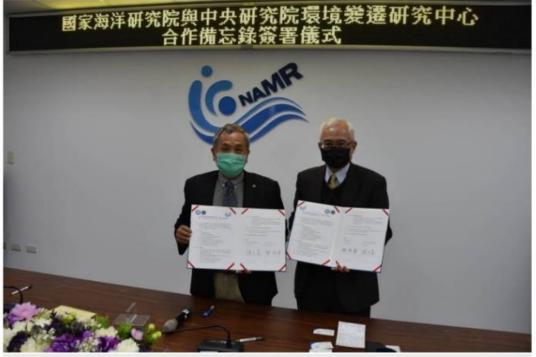












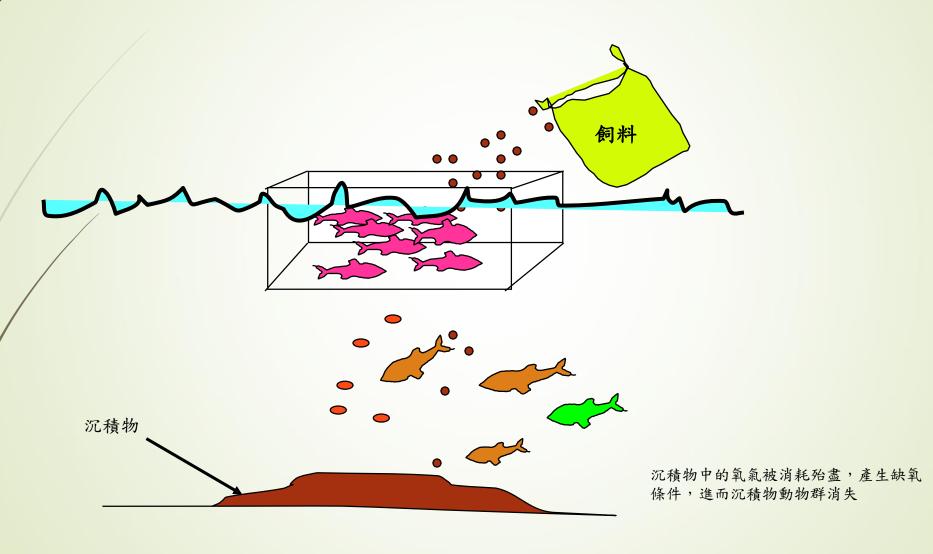
邱永芳(左)和陳于高(右)簽署合作備忘錄。(國家海洋研究院提供)

2022/02/14 16:17

[記者洪定宏/高雄報導]中央研究院環境變遷研究中心主任陳于高,今天與國家海洋研究院院長邱 永芳簽署合作備忘錄,攜手研發海洋關鍵技術。中研院環變中心現有超過20位研究人員,以及大約 150位博士後研究員與研究助理,是台灣最具規模的環境科學研究機構。

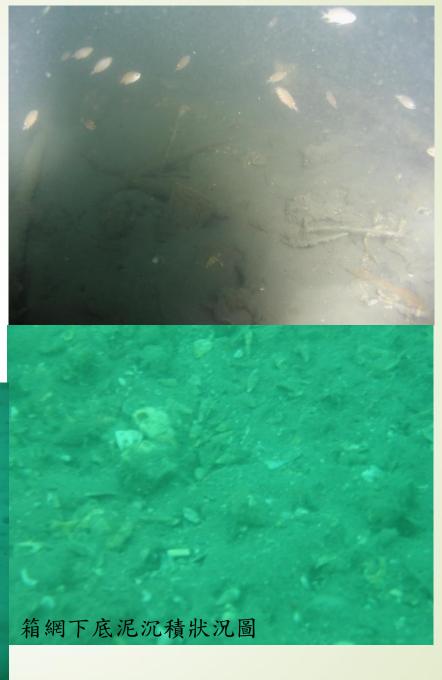
國海院強調,雙方將整合研究資源,應用在海洋環境監測及調查、海洋科學關鍵技術研發、海洋資料 處理及數值模擬預報技術發展研究、海洋污染防治監測與技術開發、海洋產業前緣科技研發先期規劃 和研究、合作參與國際研究調查計畫及加入國際研究組織,以及海洋科學環境教育、政策及產業推

養殖環境情況



環境監測

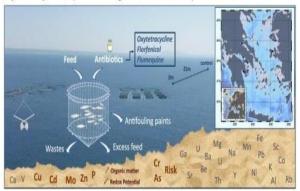




Fish farming, metals and antibiotics in the Eastern Mediterranean Sea: Is there a threat to sediment wildlife?

Science of the Total Environment (IF 7.963) Pub Date: 2020-10-08, DOI: 10.1016/j.scitotenv.2020.142843

Ioanna Kalantzi, Andreu Rico, Kyriaki Mylona, Spiros A. Pergantis, Manolis Tsapakis



Chemical residues released from aquaculture farms may persist in the environment and may pose adverse ecological effects. The aim of this study was to assess the pollution status of marine sediments underneath or close to aquaculture farms in the Eastern Mediterranean Sea, the factors that affect the elemental distribution, and the exceedance of environmental quality standards and factors. To this end, surface sediment samples were collected (underneath fish cages, at 25 m distance and from a reference station) from 48 fish farms in Greece with variable environmental and geochemical characteristics. The content of 29 metals and major and trace elements, and three antibiotics (oxytetracycline, florfenicol, and flumeguine), was determined in the sediment samples. Most of the elements found in the sediments originated from geological sources and their concentrations were close to Earth' s Crust content. Below and close to fish farm cages, the sediment was enriched with P, Cu, Zn, Mo, and Cd mainly due to the aquaculture biosolid deposition, and changes in environmental conditions (increased organic matter, low redox potential). Cr and As were found to exceed twice the upper threshold limit of the available sediment quality guidelines in 13.5% and 7.3% of sampling stations, respectively. The potential ecological risk of V, Cr, Mn, Co, Ni, Cu, Zn, As and Pb was found to be low in the sediment close to fish cages except for Cd, which may pose a moderate to considerable risk in 12.5% of sampled fish farms. However, the estimated risks for this metal may be influenced by the high background levels found in the investigated areas. This study also shows that the occurrence of antibiotics in sediments below fish farms in the Eastern Mediterranean Sea is very sparse (i.e., only flumeguine was found in two farms) and concentration levels are relatively low.



Sediment Characteristics under and Around Cobia Cage Farms at Penghu, Taiwan, As Visualized By Redox Potential and Sulfide Content Profiles Using GIS as Documentation Tool

mmary

Redox potential is a frequently used measurement in studies under and around marine cage farms to assess the environmental status of marine aquaculture. This study presents an application of a geographic information system (CIS) to document sediment geochemical measures in cobia aquaculture in order to assess the condition of the benthic environment using the Chu-Wan marine fish farm as a case study. The objectives of the study was to combine GIS presentation with chemical measures as an important and innovative methodology in marine aquaculture environmental management. The results show a real distribution patterns for both redox potential and sulfide content in relation to position of the farm and the current pattern.

Introduction

In 2007, Taiwan produced over 1.49 million tonnes (MT) of fish, valued at NTD\$ 94.8 billion (US\$ 2.9 billion), according to the Fisheries Year Book 2007 (Fisheries Agency, Council of Agriculture, Taiwan) [1]. Finite resources and the land-based expansion of Taiwanese culture have caused environmental degradation. Therefore, the Taiwanese government has supported the development of offshore fish farming as a recent priority for national aquaculture development. Marine cage aquaculture began in the 1970s in the Penghu Archipelago. Among many species of cultured marine fish, cobia has become a popular species for cage aquaculture because of its fast growth rate and comparatively low production cost. Cobia is a finish species with emerging global potential for mariculture, and it has been the subject of research on spawning and grow-out since the early 1990s [21].

Marine aquaculture may also cause environmental degradation from feces, uneaten feed and use of chemicals if the local carrying capacity is exceeded [3]. The most important benthic impact relates to the formation of anoxic sediments [4-6] which can be easily monitored. Both sediment condition and waste accumulation are good indicators for detecting the environmental condition at aquaculture sites, Beveridge [7] revealed that environmental deterioration because of high organic matter concentrations in the sediments may affect the health of farmed fish and hence profitability. Waste and waste-makes quality management for marine aquaculture in other countries has not only focused on the release limitations of organic matter, and nutrients [8-11] but also on chemicals [12,13] used on the farms regardless wherever into estuaries or near shore coastal waters [14,15]. This investigation uses an environmental monitoring program to understand and assess the environmental impact of cobia farming.

The distribution patterns of redox and sulfide concentrations

Research Article

Volume 4 Issue 6 - 2016

Chao-Kai Yangi, Wen-Yan Chiaui and Yi-Che

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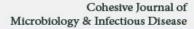
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were mapped and presented at Penghu. Results show that the redox potential values at <-100 mV and high sulfide concentrations ranged from 306 to 1800 uM in sediments were clearly dominant in the feeding zone of aquaculture operations. Positive redox potential values and low sulfide concentrations < 300 µM were observed at the north direction nearby the crossing bridge that is away from the aquaculture site and upstream of the current flow inside the Inner Islets. Some sampling sites at the outward sites, that were 200 meters, 500 meters away from the aquaculture operations, had <-100mV. These suggest the wastes from the aquaculture sites were driven with the current and dispersed toward the outside inner islets [16]. Summerfelt et al. [17] reported that an ORP of 375-525 mV was required to reach the mean daily ozone concentration necessary to obtain full-flow disinfection in freshwater RAS. For southern rock lobster larvae, survival was higher and bacterial contamination was lower when the ORP was between 330 and 500 mV [17,18]. With moderate ozonation corresponding to an ORP value of 250 mV in a low exchange freshwater RAS, rainbow trout showed improved performance compared to a system without ozonation [19,20].

A Geographic Information System (GIS) contains powerful tools for processing spatial reference data and can be used to organize and present spatial data as part of effective environmental management planning [21]. Furthermore, buffering is one of the proximity techniques in GIS [22], Buffer applications studies of the impact zones of amphibian species [23], riparian zones for non-point-source pollution [24], and water quality monitoring

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Opinion

Integrated GIS and AHP for Marine Aquaculture Site Selection in Penghu

Established the Environmental Monitoring **Program Indicators to Prevent Disease Infection** and Promote Sustainable Development



Cove in Taiwan

Research Article

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Abstract

Marine cage culture has been developed quickly in recent years from land-based operation transfer to marine cage culture by government policy in Taiwan. Therefore, the suitable site selection is an important premised and key factor for successful marine cage culture and sustainable development in the future. Especially, it's greatly influences economic viability by determining capital outlay and affecting running costs, production and mortality. Hence, the decision factors such as climate factors, geographic environmental factors, bio-environmental factors and social-economic factors are more important for site selection. This study use AHP (analytic hierarchy process) to evaluate the criteria weight for site selection. From AHP analysis, the weights of suitability of the four Geographic Information System (GIS) grid themes were 0.322, 0.410, 0.127 and 0.141, respectively. The result shows that the geographic environmental factors are the most important factors in selection suitable marine culture sits in Penghu cove in Taiwan. At the meanwhile, by using ArcMap, a GIS software package, a suitable map was made based on the selected grid themes. The suitable sites for marine cage culture development identified on the individual GIS grid themes, the GIS software and AHP method can be integrated to select objectively the optimal sites for marine cage culture development.

Keywords: Aquaculture: Site selection; GIS; AHP; Tatwan

Introduction

In recent years, there has been a dramatic proliferation of research concerned with fishery resources degradation in the world. As regard to solve the fisheries problem now is promoting to marine cage culture instead the land-based culture in recent decade in Taiwan. Therefore surge of research on marine cage culture has given us new opportunities and challenges. There are many criteria, guideline and essential factor for selection marine site for aquaculture in coastal zone. Such as reported that water flow, volume availability, water quality, access and location of utilities, topography of site, slope of land and legislation concerning water rights, study operate suitable site selection for oyster farm and further studies indicated that three site categories of cage site selection criteria there were physic-chemistry condition, site cage system, and profitability. Many studies have focused on the weighted liner combination method using the pairwise comparison. Weights indicate the relative importance of one variable with respect to the others and depend on expert knowledge, mostly. But it doesn't suitable for everywhere in the world. Even in a small number of countries, shows wide variations. While some of these criteria are obviously arbitrary or tentative, others are based on local environmental conditions and land use patterns. Other than the nature and composition of expected emissions or discharges from the farm, the pattern of water exchange and the bottom dynamic conditions in the area have to be considered. In the guidelines for site approvals, the environmental sensitivity has referred to as an important factor. Different areas may respond differently to the same nutrient dose [1].

With the rapid development of marine case culture that creates a growing need for coastal zone environment analyses, a complex task need one useful tools for kinds of analysis is the GIS. GIS are information tools with the capacity to store, analyse and display special data. The general usefulness of the methodology of using GIS for aquaculture site selection has been explored and is now becoming established. For example, it was reported that applied the GIS with biophysical and social-economic characteristics for planning the aquaculture site spatial decision. Data also point out that the individual investor interested in aquaculture development requires spatial information particularly at the time of site selection from among a range of alternative locations with different biophysical and social-economic characteristics. It mentioned that the bathymetry, current, shelter and water quality variations were used to determine suitability site by PC-based GIS for coastal salmonid cage culture. Furthermore, although GIS uses in marine aquaculture planning began a decade ago, as more advanced GIS techniques were made available and motivated by the needs of environmental research and management, GIS marine applications included subjects as varied as sediment dynamics and bathymetry changes, artificial reefs site selection, or coastal hazards [2]. This article adopts the AHP method and using GIS, for a technological transfer project of marine cage culture site selection in Penghu cove, Taiwan.

On the other hand, the good water quality requirement of the site selection is also the first considerations for the proposed facility. With regard to the inflowing water, every agua cultural endeavour is critically depending on a good water supply. During site selection this is the very first factor to be taken into account. Considering, the many physical, chemical and biological parameters that can influence water quality. Biophysical characteristics may include criteria pertinent to water quality (e.g. temperature, dissolved oxygen, alkalinity, salinity, turbidity, and pollutant concentrations), water quantity (e.g. volume and seasonal profiles of availability) and climate (e.g. rainfall distribution, air temperature, wind speed and relative humidity). Socio-economic characteristics that may be considered in aquaculture development

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Introduction

Marine aquaculture may also cause environmental degradation from feces, uneaten feed and use of chemicals if the local carrying capacity is exceeded [1]. The most important benthic impact relates to the formation of anoxic sediments [2-4] which can be easily monitored. Both sediment condition and waste accumulation are good indicators for detecting the environmental condition at aquaculture sites. Beveridge [5] revealed that environmental deterioration because of high organic matter concentrations in the sediments may affect the health of farmed fish and hence profitability. Waste and waste-makes quality management for marine aquaculture in other countries has not only focused on the release limitations of organic matter, and nutrients [6-8] but also on chemicals [9] used on the farms regardless wherever into estuaries or nearshore coastal waters [10,11]. This investigation uses an environmental monitoring program to understand and assess the environmental impact of marine farming.

Environmental monitoring program ratings for the near-field effects from trace metals in sediments [12]. Waste management for marine aquaculture in other countries has focused on the release of organic matter, nutrients, and chemicals directly from the farms into estuaries and coastal waters. Finfish farms need more extensive programs for the management of waste than shellfish farms, because finfish provide exogenous food sources [10]. Redox potential is useful as an indicator of the degree of microbial activity in organically-enriched sediments [13,14]. Here we used an EMP to determine and assess the environmental impact of farming.

Environmental monitoring program

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Currently there are very limited approaches for assessing the impacts of aquaculture on sediment with the exception of the environmental monitoring program (EMP), implemented by the Department of the Environment, New Brunswick, Canada. EMP is based on sediment redox potential, sulfide concentrations, and video transects data for monitoring environmental effects of salmon aquaculture operations [15]. The impacts are considered unacceptable when sediments become anoxic. There is a need for the development of more sensitive tools and methods for detecting environmental effects of aquaculture and for determining what constitutes acceptable and unacceptable impacts. Other sediment chemistry indicators of environmental effects would assist in assessing the sustainability of aquaculture operations. The environmental monitoring program (EMP) approach was adopted to evaluate the marine environmental impact of cobia marine aquaculture environmental management [16,17]. The EMP ratings were assessed by the diver on site following the guidelines defined by the Department of Environment and Local Government of New Brunswick, Canada [15], Redox potential in core samples was measured with a Fisher Scientific Co., USA. AP-63 (PH/MV/Temp/ lon), using methods described by Wildish et al. [18] The sulfide probes were calibrated just before use on each sampling day by checking against freshly prepared Na2SE9H₂O solutions at three concentrations (10µM, 100µM and 1000µM). Sediment samples were mixed immediately after collection with sulfide antioxidant buffer (SOAB from Fisher Science Co.) (1:1v/v). Sulfide levels were recorded in millivolts (mV) when the reading stabilized. These methods were confirmed experimentally [16-18].

The study shows that assessment of the marine environment at aquaculture sites requires a tool beyond the environmental monitoring program (EMP) rating. The sediment chemistry response to changes in environmental conditions at the aquaculture sites clearly result in differences from natural background sediment levels. Those changes make the modeling approach feasible in this study and useful for interpreting the impact of the aquaculture activities to the environment. This approach provides an effective means for assessing the environmental conditions based on sediment chemistry, and consequently in establishing regulatory guidelines to establish baseline information, such as marine environmental quality, sediment remediation or degradation in relation to the aquaculture conditions...







Geographic information system applied to measuring benthic environmental impact with chemical measures on mariculture at Penghu Islet in Taiwan

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ABSTRACT

Cobia, Rachycentron canadum, is currently grown by marine aquaculture in Taiwan, particularly on Penghu Islet. Although the effect of marine aquaculture on the environment has been the subject of many studies, an understanding of its environmental impact has yet to be attained, and the continuing expansion of cage farming has caused noticeable ecological declines. Nevertheless, useful tools to measure this environmental degradation are scant. The results of this study suggest that the combination of a geographic information system (GIS) with redox potential and sulfide measurements can be used to definitively assess the condition of the benthic environment near cobia aquaculture sites and to help develop environmental monitoring programs. These applications could easily be adopted to assess multiple marine environmental conditions.

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. Introduction

In 2006, Taiwan produced over 1.28 million metric tons (MT) of fish valued at \$85.8 billion New Taiwan dollars (NTD) or \$2.6 billion United States dollars, according to the Fisheries Year Book (2006) (Fisheries Agency, Council of Agriculture). Because of this high demand, the Taiwanese government has supported the development of modern offshore fish farms in recent decades. Originally, marine cage aquaculture began in Taiwan in the 1970s in the Penghu Archipelago (Fig. 1) to provide fish harvests from coastal fisheries. However, finite resources and the land-based expansion of the Taiwanese culture have caused environmental degradation.

Among the many species of cultured marine fish, cobia (Rachycentron canadum) is a finfish species with emerging global potential for maniculture, and it has been the subject of research on spawning and grow-out in Taiwan since the early 1990s. Cobia is a popular species for cage aquaculture because of its fast growth rate, comparatively low production cost, high market value, and good meat quality. A cobia takes only 2 years to grow from juvenile to adult. Adults reach lengths of up to 2 m and weights of 60 kg. In Taiwan, cultured cobia have become popular for domestic consumption and for export mainly to Japan (Liao et al., 2004).

The government has played an important role in the overall development of the cobia culture industry. In the early 1990s, the government recognized the potential of modern cage culture for future industry. Taiwan has around 1,500 marine nets dedicated to cage culture, with 60% of these marine cages (900 cages) found in the Penghu Archipelago; the

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Metal Contaminants Tracer for Modeling Marine Culture Environmental Quality - A Taiwanese Case Study

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ABSTRACT

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The study was undertaken to assess the marine environmental effects from feed and waste associated with marine culture activities in Taiwan. In the meanwhile, the work was undertaken to develop an approach for modelling the changes of sediment chemistry related to the accumulation of marine culture waste. Metal composition of sediment Cu, Zn, Mn, Al, Li (ug/g) and Fe (%) were used to determine the extent of detectable effects around the cage. The concentrations of Al decreased with increased accumulation of Cu at study sites. There is a trend among normalised metals related to normal, hypoxic and anoxic sediment conditions. The trends are useful for detecting and assessing the cumulative effects from aquaculture wastes to the marine environment. Principal components analysis (PCA) was carried out on the metals and to cluster the similarities of the variables to establish for assessing the environmental conditions.

ADDITIONAL INDEX WORDS: Environmental monitoring, metals, pollution monitoring, principal component analysis.

INTRODUCTION

At marine culture sites, the composition of the sediments is altered by the input of aquaculture waste. A better understanding of the changes of sediment chemistry associated with the discharged waste from aquaculture activity would assist in the prediction of impacts and the formulation of aquacultural practices for the sustainable use of the marine environment. There is a need for the development of sensitive tools or methods and data modeling for detecting and mitigating potential environmental effects of aquaculture, and for determining what constitutes acceptable and unacceptable impacts, which remain controversial and thus undecided. An approach to detect whether or not sediment chemistry changes are related to EMP would assist in assessing the sustainability of aquaculture operations.

There are very few studies describing sediment chemistry as it relates to the deposition of wastes from marine aquaculture. Generally, the sources of wastes at aquaculture farms are excess feed, excretory products and chemicals used both in the treatment of diseases, and as disinfectants, antifouling agents and cleansers. Wastes generated by net-pen operations typically include organic matter and nutrients from faeces and uneaten feed pellets, as well as trace metals used in feed ingredients. At aquaculture sites, the composition of the sediments is altered by aquaculture waste. Understanding the changes in sediment chemistry associated

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with the discharged waste from aquaculture activity would assist in the prediction of impacts and in sustainable use of the marine environment. One approach is to use environmental tracers. A tracer is a signature or fingerprint related to the environmental response resulting from the accumulation of enriched organic waste from aquaculture operations around the net-pen. Generally, the tracers could be additives in feed, organic carbon, metals, benthic assemblages, nutrients, medicinal treatments, etc.

In Taiwan, no studies have been carried out on or reported for the biota of cobia and the surrounding area from the perspective of environmental quality to date. The objective of this study is to establish marine environmental quality in support of the carrying capacity of bay of Penghu Islet. This study, Al, Li, Fe, Cu, Mn and Zn, were employed as tracers to assess aquaculture environment conditions in Penghu cobia marine culture sites. Principal component analysis (PCA) was applied to the metal data and used to model the metal from the farming geographical locations. Finally, establish the guideline of total quantity control of marine culture area and as part of integrated coastal zone management for the Bay of Penghu in Taiwan and develop to worldwide in the future.

MATERIALS AND METHODS

Site Background

The Penghu Archipelagos, located in the middle of Taiwan Strait, are a major fishing community, known as the birthplace of cobia (Rachycentron canadum) cage culture. This research was performed in Chu-Wan, the largest marine cage culture site, in the bay of Penghu, which is located near the town of Chu-Wan.

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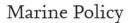
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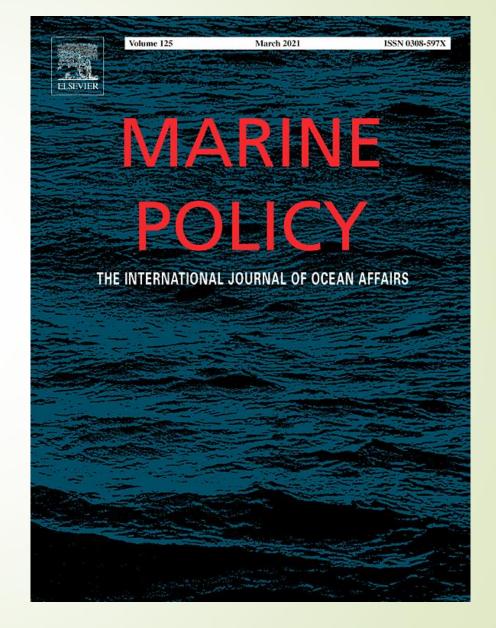
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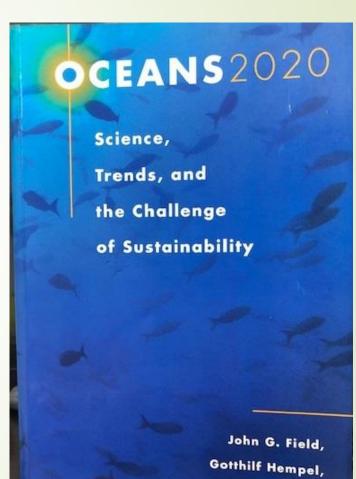
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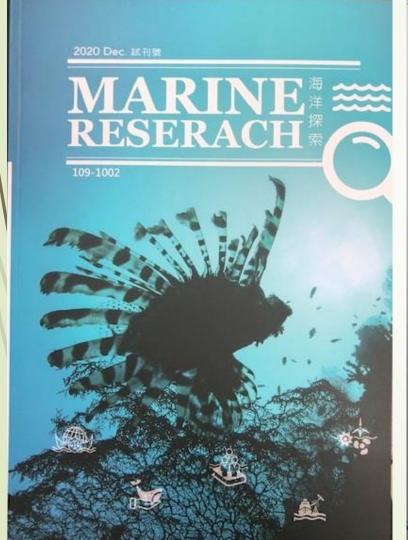
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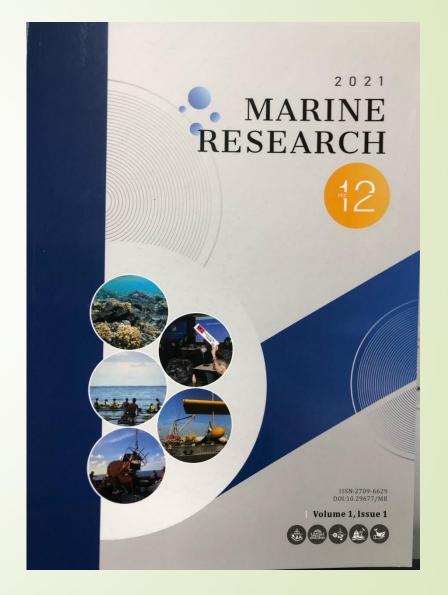
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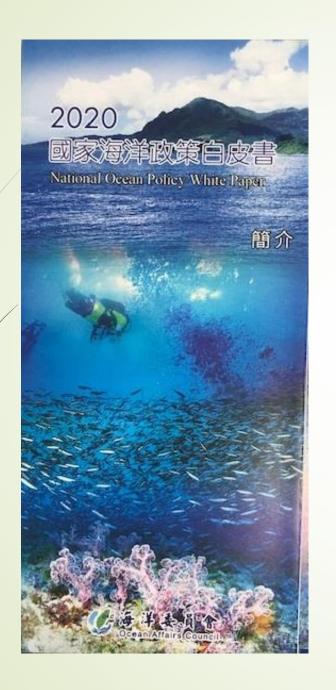


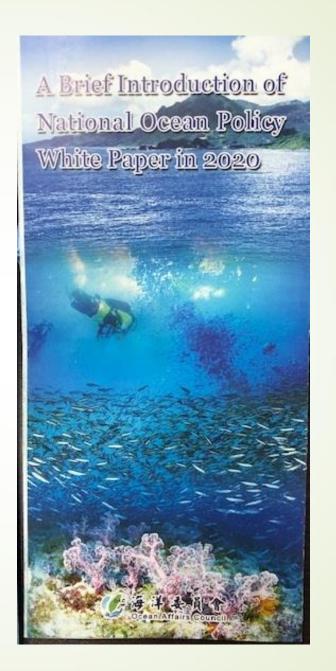
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