李明安教授—衛星遙測及環境生態永續發展研究室

本研究室主題包括海洋衛星遙測、海洋生態動力(Global Ocean Ecosystem Dynamics)及環境變遷對漁業調適與永續發展之研究。近年來全球氣候變遷對於海洋環境及生態變動的影響倍受注目，如何迅速、大範圍並且持續進行海洋環境的監測為海洋生態研究的重要課題。由於科技日益精進，透過衛星遙測技術已可即時探測大範圍海洋表面溫度、葉綠素濃度及海洋環境資訊。本研究室長期致力於衛星遙測資料及人員技術之培訓方面，暨應用與解明許多重要水產資源海洋學與重要經濟物種(鮪、烏魚、燈火漁業等)漁況預報之可行性，並逐漸發展成為本校重點研究室之一。

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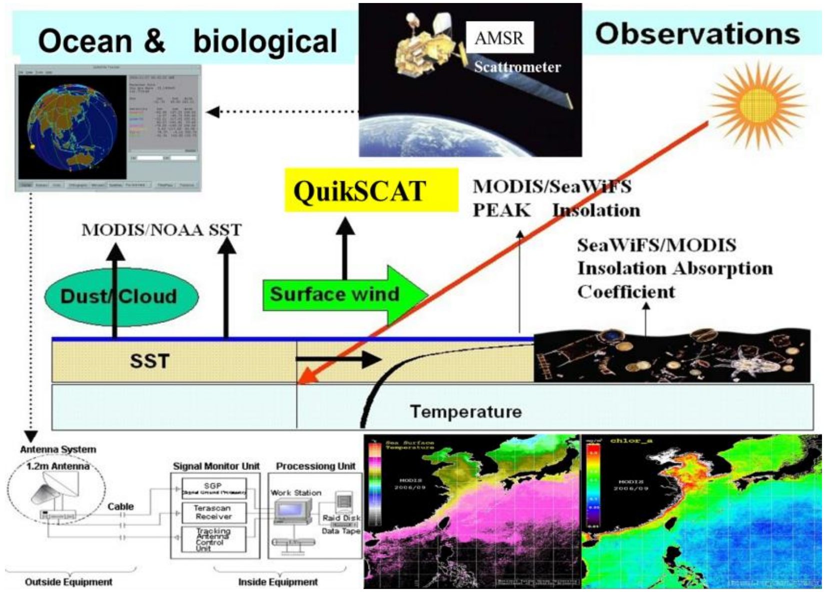
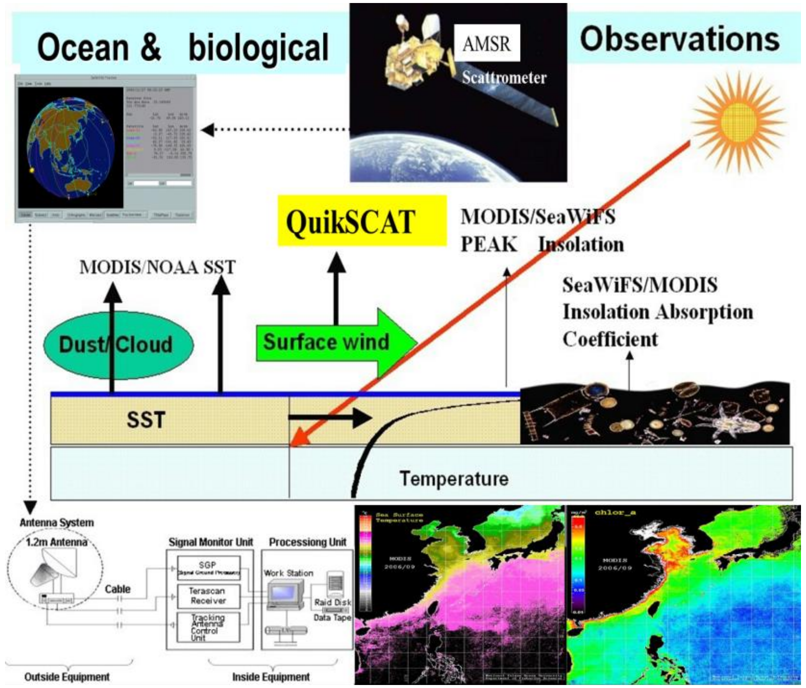
前項技術能力也擴展應用在環境生態暨社會生態系統之永續發展方面，除邀請基礎浮游性橈腳類、仔稚魚、中表層與底棲生物專家、整合及發展其與水文環境變動關係之生態系動力特性(如台灣淺灘)外，亦嘗試以Future Earth Coast思惟結合社會-生態系統模式，透過不同層級與跨領域專家探討共有資源永續利用與互動溝通之思維，也藉由Trade-off znalysis與AHP等方式，建立跨層級之調適治理與永續發展模式的方法或示範案例。



Remote sensing and ecological sustainable development laboratory

The research topics include two parts for the remote sensing application, global ocean ecosystem dynamics and its association with fishery vulnerability and sustainable development strategy. The former one is focus on the remote sensing technique development with the observation on extreme environment, and its application on the ichthyoplankton community, pelagic species habitat suitability and microhabitat ecosystem associated with the hydrological condition possibly influenced by climate variability.

The latter was tried to investigate the marine/coastal ecosystems and fisheries resources as well as to coastal communities that depend on these systems for food and livelihoods. The integrated social-ecological vulnerability and consensus with the development of community were adopted to promoting and delivering the knowledge of climate change associated with the utility, protection, and adaption technology strategy, and then providing information to policy-makers for sustainability and adaptation governance of fishery community resilience in the marine/coastal ecosystem.



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1996~2000: Professor
1991~1995: Associate Professor

Remote Sens. **2020**, *12*, 2515; doi:10.3390/rs12162515

remote sensing

Article

Multisatellite-Based Feeding Habitat Suitability Modeling of Albacore Tuna in the Southern Atlantic Ocean

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多衛星資料應用於南大西洋長鰭鮪攝食棲地適合度模式

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重要研究成果

- 南大西洋海域是我國長鰭鮪延繩釣漁業重要漁場之一。本研究以多衛星資料及棲地適合度經驗模式解析長鰭鮪索餌棲地適合度模式。
- 本研究證實以海表水溫與葉綠素之算術平均經驗模式是一適切的南大西洋長鰭鮪索餌期(4-8月)棲地適合度推估方法，結果亦證實海表水溫16.5–19.5°C及海表葉綠素濃度0.11–0.33 mg/m^3，是研判長鰭鮪索餌棲地的主要環境因子。此一結果有助於遠洋漁民找尋漁場且降低作業成本外，亦可做為區域管理組織以生態系為基礎之資源管理政策之參考資訊。

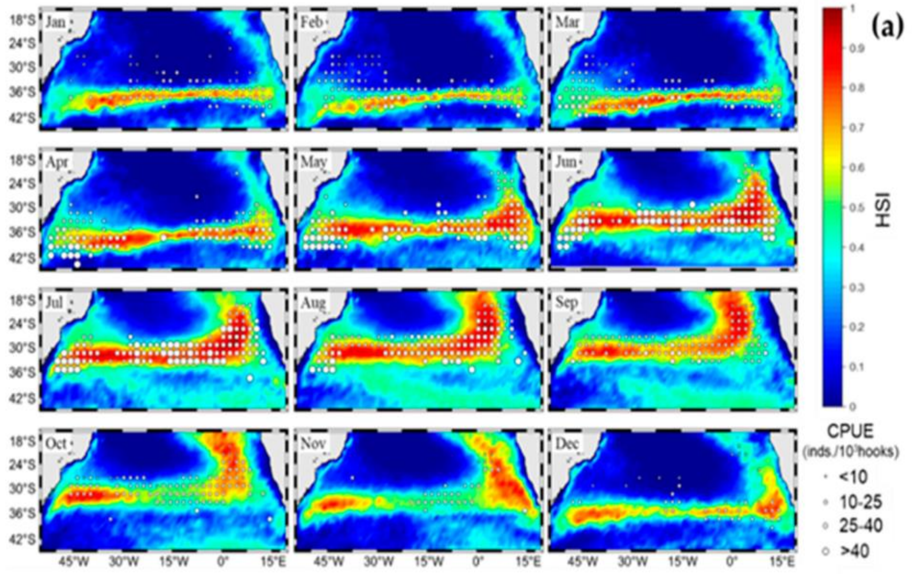

Figure 6. Monthly HSI predicted maps and albacore standardized CPUE using an AMM model with SST and SSC data,

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Deep-Sea Research Part II

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Ontogenetic habitat differences in *Benthosema pterotum* during summer in the shelf region of the southern East China Sea

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東海南部海域夏季不同發育階段七星底燈魚棲地環境之差異特性

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3. 台灣地球觀測學會

重要研究成果

- 七星底燈魚為全球海洋資源量最豐富之燈籠魚科魚種，因其晝夜垂直洄游行為影響著海洋食物網間的能量流轉與傳遞。本研究嘗試以泛加成模式解析不同發育階段之七星底燈魚在東海南部陸棚水域的時空間分布特性及其最適棲息環境參數。
- 本研究證實該魚種之密度與分布會受到水溫、鹽度、葉綠素濃度及浮游動物之生物量的影響；隨著發育與成長，其分布位置會由台灣北部及陸棚中部水域逐漸往長江出海口南面、沿岸水域及陸棚邊緣水域移動的情況，其棲地分布與餌料供應等生存策略有關。

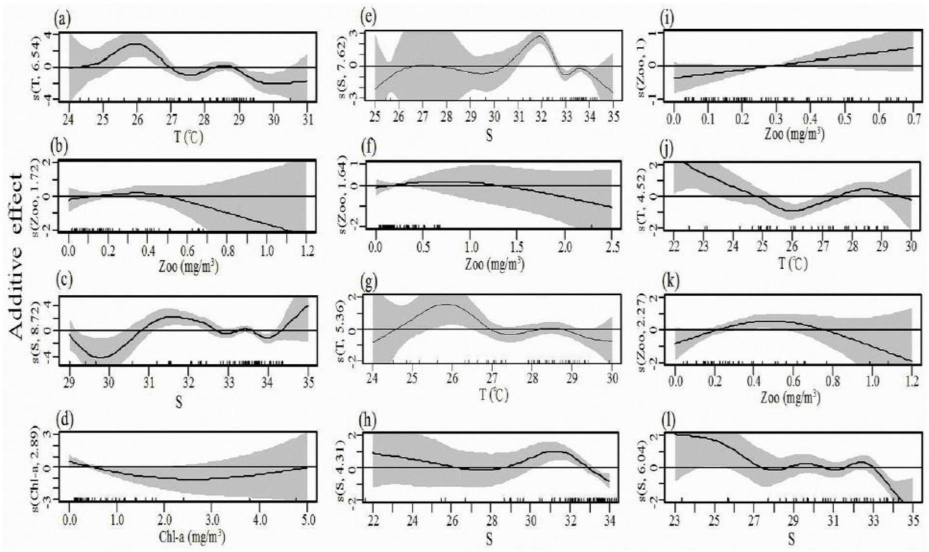

Fig. 7. Smoothed curves depicting the effects of environmental factors for different developmental stages of *B. pterotum* density present during surveys from 2006 to 2017 surveys in the generalized additive models: preflexion larvae (a, b, c, and d), flexion larvae (e, f, and g), postflexion larvae (h, i), and juveniles (j, k, l). Shaded areas indicate the 95% confidence intervals. The tick marks along the x-axis represent the *in situ* values. Estimated degrees of freedom and the additive effect of each factor on different developmental stages of *B. pterotum* density are displayed on the y-axis. Statistical information on the GAM is provided in Table 2.

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Contents lists available at ScienceDirect

Deep-Sea Research Part II

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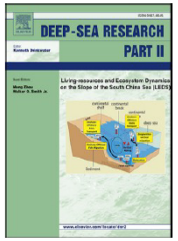

Reproductive biology of the narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the central Taiwan Strait, western Pacific

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台灣海峽中部水域土魠魚之再生產生物學

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重要研究成果

- 土魠魚是我國重要經濟魚種之一，但其再生產生物學研究十分缺乏。本研究首次以台灣海峽中部水域之1031尾土魠魚樣本解明其再生產生物學。
- 本研究發現本海域土魠魚之性比為0.55，雌雄性50%的性成熟尾叉體長分別為68.0 and 68.4 cm，另每年3-6月發現有水卵暨卵母細胞顯示，台灣海峽為其產卵場，3-8月為產卵期，屬批次產卵，大約每6.5天可產卵一次，平均單次孕卵數BF 為91,117至2,077,581顆卵，其與體長FL之關係為$BF=0.0007\times FL^{3.999}$ ($p<0.0001$)。此一生物學特性對其漁業管理與保育策略之規畫有極大幫助。

Table 4
Potential *S. commerson* spawning and spawning seasons reported by various studies.

Author	Sampling area	Spawning season	Peak season	Base on
This study	Taiwan Strait	March to August	March to May	Mature females (by histological techniques, GSI, and diameter oocyte).
Devaraj (1983)	North Indian Ocean	January to September	April to May	Mature females (by histology, GSI, and diameter oocyte.).
McPherson (1993)	Queensland waters	August to February	October to November	Mature females (by histology, and GSI).
Claereboudt et al. (2005)	Sultanate of Oman	February to July	May to June	Mature females (by histology, and GSI).
Grandcourt et al. (2005)	South Arabian Gulf	April to August	–	Mature females (by histology, and GSI).
Mackie et al. (2005)	Kimberly	August to November	September	Mature females (by histology, and GSI).
	Pilbara	October to January	October to January	
Kaymaram et al. (2010)	Persian Gulf & Oman sea	March to September	June to September	Mature females (by GSI).

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重要研究成果

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https://doi.org/10.1080/01431161.2019.1666317

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Empirical habitat suitability model for immature albacore tuna in the North Pacific Ocean obtained using multisatellite remote sensing data

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多衛星資料應用於北太平洋未成熟長鰭鮪棲地適合度模式

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- 北太平洋海域是我國長鰭鮪延繩釣漁業重要漁場。本研究以2009-2016年多衛星資料及棲地適合度經驗模式解析未成熟長鰭鮪棲地適合度模式。
- 本研究證實北太平洋長鰭鮪漁期(11-次年3月)主要分佈在25-40°N，算術平均經驗模式是適切的棲地適合度推估方法，且海表水溫17–21°C、海表高度0.24-0.84m、混合層深度15-100m、前一月海表葉綠素濃度0.07–0.29mg/m^{3}及海表渦流動能0.0001–0.0031m^{2}s^{-2}，是研判長鰭鮪棲地之環境因子的最適範圍。此一結果有助於區域管理組織推動以生態系為基礎之資源管理政策的參考。

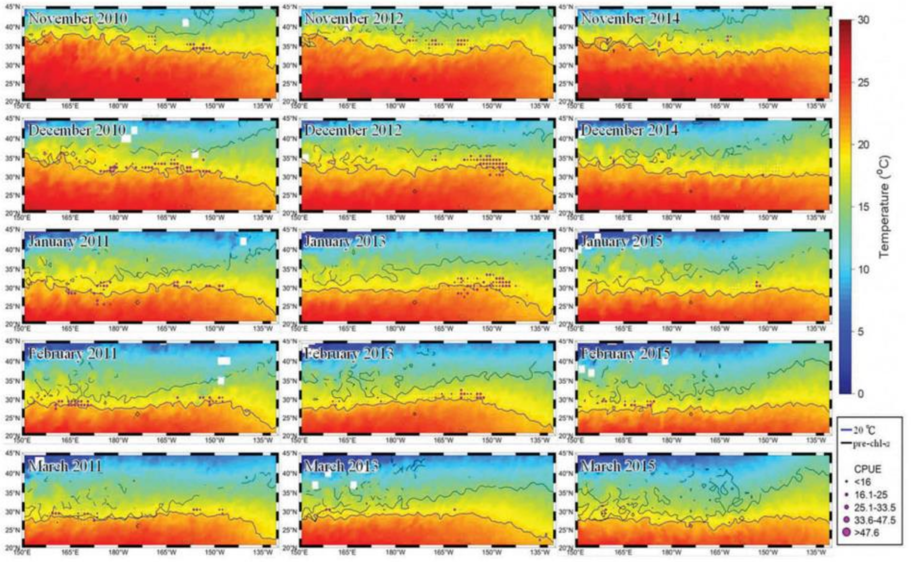

Figure 9. Spatial distribution of the albacore CPUE related to the SST and SSC-lag from november to march in 2010, 2012, and 2014. The blue line is the 20°C isotherm SST, and the black line represent the 0.2 mg m^{-3} isopleth of the SSC-lag in the time delay of one month.

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remote sensing MDPI

Article

Satellite Observations of Typhoon-Induced Sea Surface Temperature Variability in the Upwelling Region off Northeastern Taiwan

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衛星觀測颱風誘發台灣東北部湧昇海域之海表水溫變異

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4. 國立中山大學海洋事務研究所

重要研究成果

- 本研究以18次颱風通過前後(一周)之海表水溫與葉綠素資料觀察湧昇區(24.5–25°N,122–122.5°E)的水文環境變動特性。
- 研究成果發現隨著颱風路徑不同、黑潮水與地形效應對湧昇區之水文環境變動有所不同，其中颱風誘發明顯湧昇現象時，海表水溫降低約2-4℃且海表葉綠素濃度增加0.5~2mg/m³，但也有海表水溫增溫約1.5~3℃的情形，其原因與台灣海峽西南季風的風壓強度及延時與黑潮水和台灣海峽水的海水傳輸改變對湧昇強弱等因素有關。

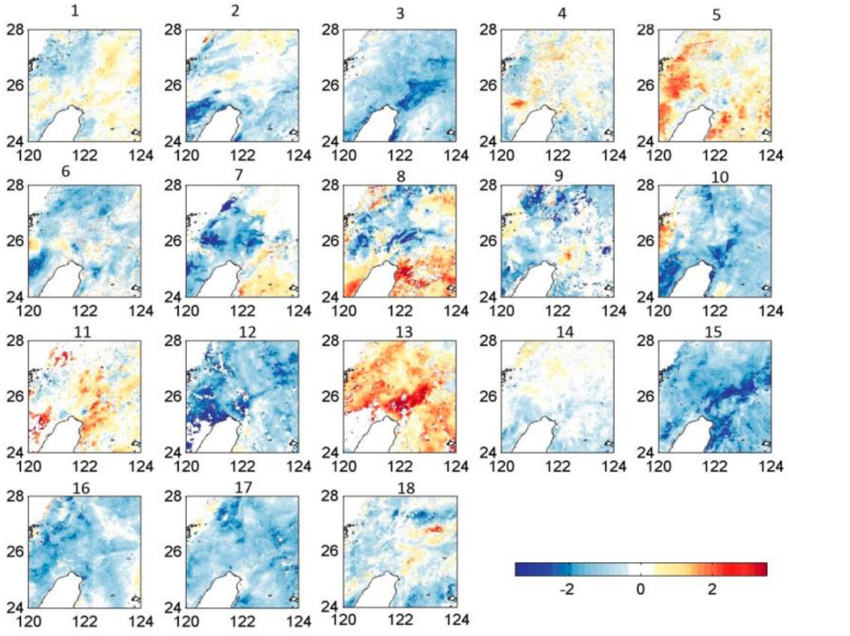

Figure 4. Difference between poststorm and prestorm sea surface temperatures (°C, one-week composite images) for the 18 typhoons shown in Figure 2.

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Terr. Atmos. Ocean. Sci., Vol. 32, No. 2, 241-260, April 2021

doi: 10.3319/TAO.2020.12.04.01

Composition and spatiotemporal distribution of ichthyoplankton on the continental shelf of the southern East China Sea

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東海南部陸棚海域仔稚魚組成暨時空間分布之研究

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2. 國立臺灣海洋大學海洋中心

重要研究成果

- 本研究透過衛星遙測及現場實測資料，以分析冬季時期之仔稚魚組成與環境變動關聯性。
- 結果發現，隨著時間的推移，黑潮鋒面與湧升流之強弱及位置會有所變化；而仔稚魚的豐度及組成等皆存在顯著差異，此與成魚產卵季節及棲地環境有關；當冬季黑潮入侵東海南部水域時，會將大洋性魚類帶入近岸水域；強烈的黑潮鋒面仍是分隔沿岸性與大洋性仔稚魚分布的屏障作用；部分大洋性物種仔稚魚可能發生跨鋒面傳輸的現象，此一機制應與其垂直洄游行為有關。

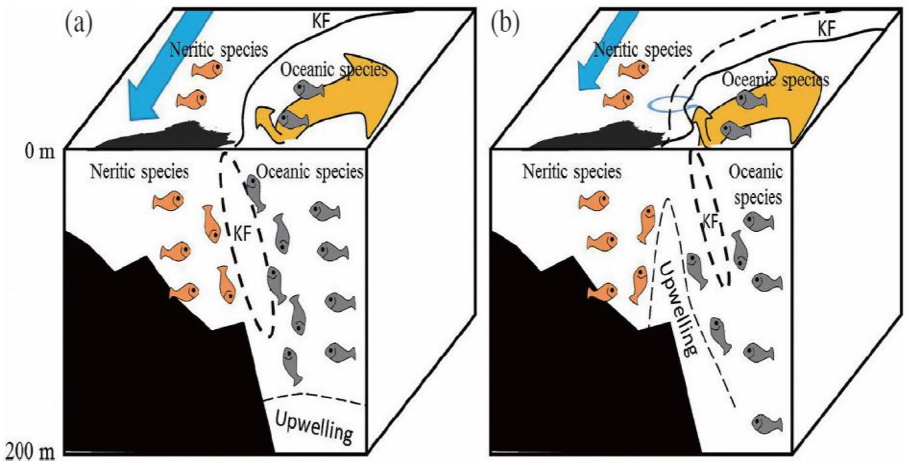

Fig. 8. Illustration of the relationship between the distribution and spread of fish larvae and variation of the Kuroshio Front and upwelling; (a) Kuroshio Front intrusion and (b) Kuroshio Front recession on the continental shelf of the southern East China Sea.

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https://doi.org/10.1007/s12562-020-01489-z

ORIGINAL ARTICLE

Environment

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Interannual variability of larval fish assemblages associated with water masses in winter in the Taiwan Strait during 2007–2013

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台灣海峽2007~2013年冬季仔稚魚群集與水團之年間變動

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重要研究成果

- 台灣海峽是連接東海與南海的通道，其仔稚魚群集極易受到水團推移而改變，故仔稚魚群集與水團推移之關係受到生物海洋與漁業專家的關注。
- 本研究證實仔稚魚可概分為黑潮群及大陸沿岸群兩類。此兩類群集似以黑潮與大陸沿岸水形成的鋒面區為界，除七星底燈魚和帶魚屬是冬季廣泛分布種類外，兩類群集組成則分別以**Diaphus B**與海鰗鰍屬以及底棲蝦虎與鮋科為主。亦即冬季溫鹽結構特性是左右仔稚魚群集結構的主控因子。此一結果有助於了解海峽冬季之長期生態系動力結構特性。

Table 2 Within-group similarity percentage (species contributions) detected using SIMPER for larval fish cluster groups in the TS

Year	K	K2	M	M2
2007	Avg. similarity: 15.41%	Avg. similarity: 16.70%	Avg. similarity: 97.75%	Avg. similarity: 47.47%
	Trichiurus spp. (26.77%)	*Lestidium* spp. (100%)	Triglidae (100%)	Callionymidae (100%)
	Diaphus B (12.50%)			
2008	Avg. similarity: 28.67%		Avg. similarity: 21.46%	
	Diaphus B (27.77%)		Scorpaenidae (36.52%)	
	Bregmaceros spp. (12.84%)		*Trichiurus* spp. (24.10%)	
2009	Avg. similarity: 23.05%		Avg. similarity: 31.68%	
	Diaphus B (27.67%)		*Benthosema pterotum* (76.03%)	
	Bregmaceros spp. (17.72%)		*Encrasicholina heteroloba* (16.06%)	
2010	Avg. similarity: 22.80%		Avg. similarity: 16.71%	Avg. similarity: 39.60%
	Diaphus B (26.17%)		Scorpaenidae (64.08%)	*Bregmaceros* spp. (50.25%)
	Bregmaceros spp. (23.31%)		*Notoscopelus* spp. (17.27%)	Gobiidae (49.75%)
2011	Avg. similarity: 17.32%		Avg. similarity: 41.68%	
	Bregmaceros spp. (45.01%)		*Engraulis japonicus* (95.69%)	
	Sigmops gracilis (12.54%)			
2012	Avg. similarity: 18.24%		Avg. similarity: 23.12%	
	Bregmaceros spp. (47.40%)		Gobiidae (60.84%)	
	Bothidae (6.01%)		*Trichiurus* spp. (19.52%)	
2013	Avg. similarity: 21.46%		Avg. similarity: 45.83%	Avg. similarity: 47.02%
	Diaphus B (30.01%)		*Bregmaceros* spp. (67.94%)	Gobiidae (90.43%)
	Benthosema pterotum (18.56%)		*Engraulis japonicas* (32.06%)	

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重要研究成果

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Article

Predicting Skipjack Tuna Fishing Grounds in the Western and Central Pacific Ocean Based on High-Spatial-Temporal-Resolution Satellite Data

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高解析衛星資料應用於中西太平洋鰹鮪漁場預測模式

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- 中西太平洋海域是我國鰹鮪圍網漁業重要漁場之一。本研究以高解析衛星資料及棲地適合度經驗模式建立鰹鮪漁場預報模式。
- 本研究證實以幾何平均經驗模式是一適切的鰹鮪圍網棲地適合度推估方法，結果亦證實海表水溫>29.6°C、水溫鋒面0.01~0.11°C/km、海表高度0.6-0.71m、海表鹽度34.29-35.28psu、混合層深度<10.81m及海表葉綠素濃度0.03–0.04mg/m^3, 是鰹鮪漁場的最適環境範圍。此一結果有助於圍網業者找尋漁場且降低作業成本外，亦可做為區域管理組織以生態系為基礎之資源管理政策參考。

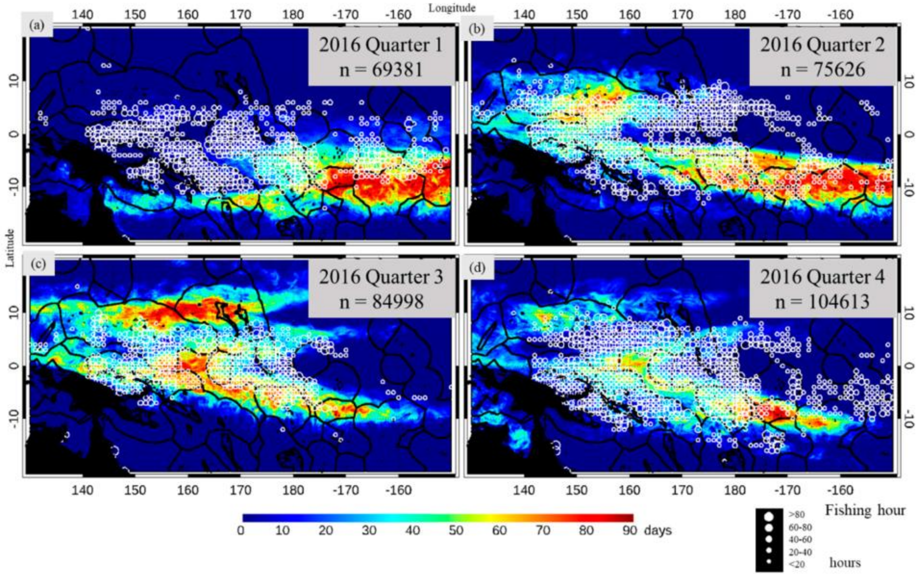

Figure 5. Monthly HSI predicted maps and albacore standardized CPUE using an AMM model with SST and SSC data,

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重要研究成果

- 南印度洋海域是我國長鰭鮪延繩釣漁業重要漁場之一。本研究以衛星水溫水色資料及棲地適合度經驗模式解析長鰭鮪索餌棲地適合度模式。
- 本研究證實以海表水溫與葉綠素之算術平均經驗模式是一適切的南印度洋長鰭鮪索餌期(4-8月)棲地適合度推估方法，結果亦證實海表水溫16.5–18.5℃及前二個月海表葉綠素濃度0.07–0.09 mg/m^3，是研判長鰭鮪索餌棲地的主要環境因子之最適範圍。此一結果有助於遠洋漁民找尋漁場且降低作業成本外，亦可做為區域管理組織以生態系為基礎之資源管理政策之參考資訊。

remote sensing

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Article

Habitat Suitability Modeling for the Feeding Ground of Immature Albacore in the Southern Indian Ocean Using Satellite-Derived Sea Surface Temperature and Chlorophyll Data

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衛星水溫水色資料於南印度洋長鰭鮪攝食棲地適合度模式

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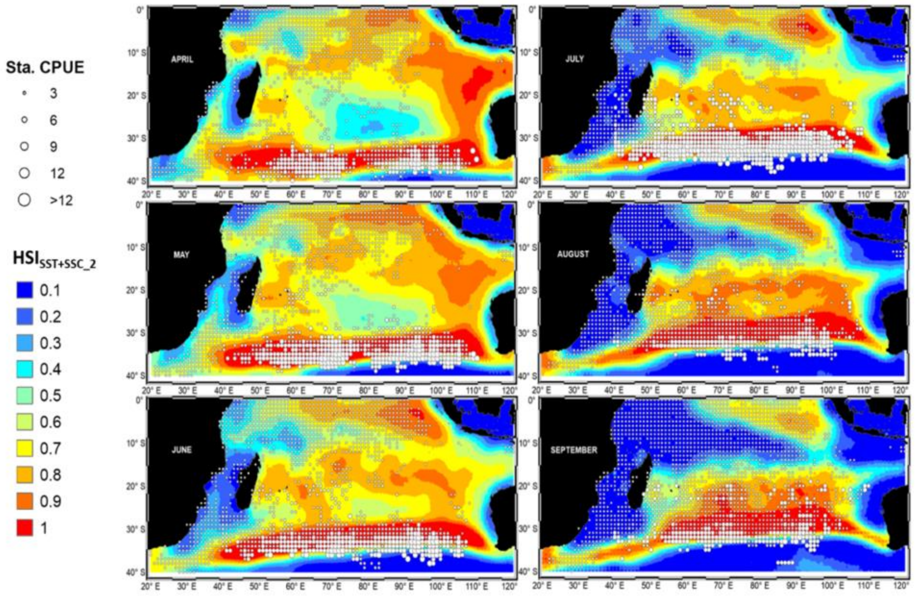

Figure 6. Monthly *HSI* predicted maps and albacore *CPUE* using an arithmetic mean model with SST and SSC_2 data.