漁場環境動態與漁具漁法研究室

- 本研究室主要收集多衛星遙測與模式演算水文環境資料結合臺灣遠洋與沿近海漁業漁獲資料，分析探討漁場環境因子與各時間尺度氣候變異指數間之變動關係，以釐清變動周期與關連性，並藉由找尋洄游性魚類潛在棲地位置，探尋海洋環境變遷對於漁場分布的改變，以提出未來建議與研究方向。
- 漁具漁法研究考量近年來海洋資源減少，因此研究方向主要與行為動態與保育相關為主題，如海鳥忌避措施研發、魚類游泳動態與漁具關係、網目選擇性與漁業廢棄物再利用等研究，盼能為漁具漁法與漁業永續利用間找到共存的平衡點。

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研究成果展示

海洋環境變異對臺灣遠洋與沿近岸漁場之影響

(1) 遠洋漁業:印度洋偶極正事件會使得印度洋西側海域表水溫出現異常的高值，黃鰭鮪的釣獲率則會減少，且黃鰭鮪的漁場重心位置也顯示與偶極正負值有相似的變動趨勢，推測原因與適水溫和初級生產力改變有關。

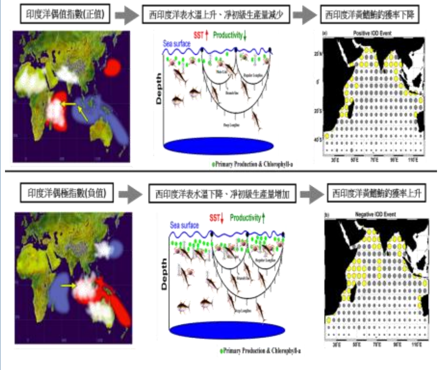


Fig. 1 印度洋海洋環境變動影響黃鰭鮪釣獲率關係圖

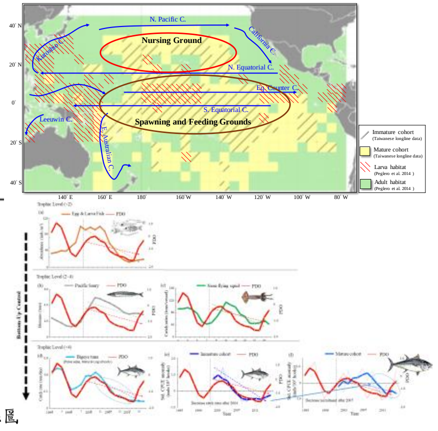


Fig. 2 太平洋大目鮪洄游路徑與生態系統間關

(2) 沿近海漁業:1980年後烏魚的捕獲量呈現逐年下降趨勢，研究顯示太平洋十年震盪等氣候變異指數與烏魚漁獲量具有顯著相關，另外烏魚主要漁獲位置從1977年後開始有明顯向北推移的情形，且漁獲量與表水溫長期變動特性呈現同步反向之變動趨勢，顯示烏魚漁況會受到氣候變遷影響而有所變動。

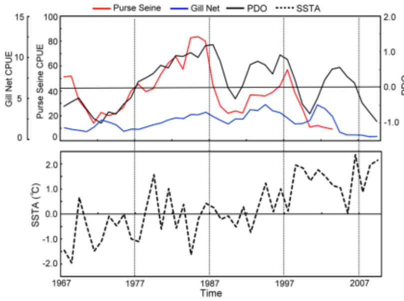


Fig. 3 PDO、SSTA與烏魚CPUE年別變動圖

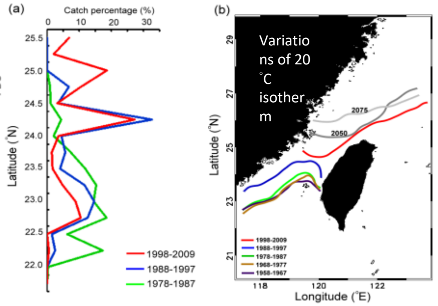


Fig. 4 (a) 烏魚漁場變動與(b) 20°C等溫線位置關係圖

漁具漁法與漁業永續利用研究與調查

(1)海鳥忌避措施研究:

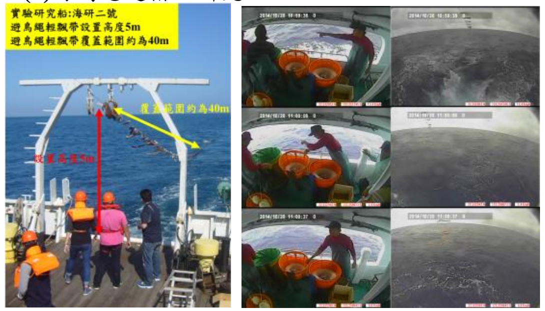


Fig. 5 現場實驗記錄避鳥繩覆蓋與主繩於水面中絞繩之情形

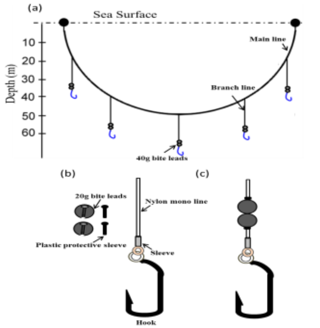


Fig. 6 (a) weighted branch lines (b, c) improved regime bite leads and slidable

(2) 魚類游泳行為與礁體放置前後關係

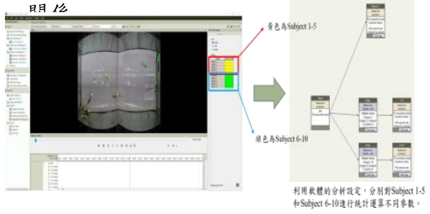


Fig. 7 動物軌跡追蹤系統實驗設計與軟體操作

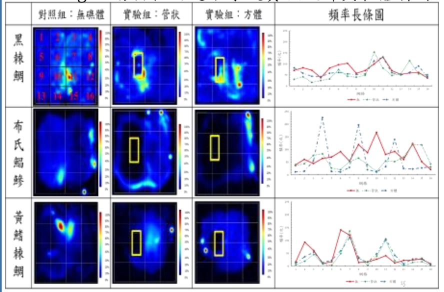
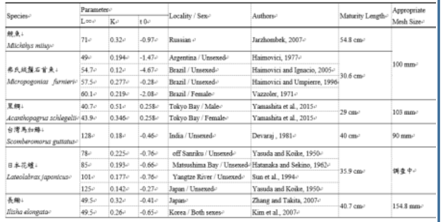


Fig. 8 魚類游泳熱點分布與魚礁放置變化關

(3)最適網目大小選擇性調查與

Fig. 9 連江縣漁船捕具之網目大小調查



Species	Parameter L∞	Parameter K	Parameter t 0	Locality / Sex	Authors	Maturity Length	Appropriate Mesh Size
鮸魚 *Miichthys miiuy*	71	0.32	-0.97	Russian	Jarzhombek, 2007	54.8 cm	100 mm
弗氏絨鬚石首魚 *Micropogonias furnieri*	49	0.194	-1.47	Argentina / Unsexed	Haimovici, 1977	30.6 cm	
	54.7	0.12	-4.67	Brazil / Unsexed	Haimovici and Ignacio, 2005		
	57.5	0.277	-0.28	Brazil / Unsexed	Haimovici and Umpierre, 1996		
	60.1	0.219	-2.08	Brazil / Female	Vazzoler, 1971		
黑鯛 *Acanthopagrus schlegelii*	40.7	0.51	0.258	Tokyo Bay / Male	Yamashita et al., 2015	29 cm	103 mm
	43.9	0.346	0.258	Tokyo Bay / Female	Yamashita et al., 2015		
台灣馬加鰆 *Scomberomorus guttatus*	128	0.18	-0.46	India / Unsexed	Devaraj , 1981	40 cm	90 mm
日本花鱸 *Lateolabrax japonicus*	78	0.225	-0.76	off Sanriku / Unsexed	Yasuda and Koike, 1950	35.9 cm	調查中
	85	0.193	-0.66	Matsushima Bay / Unsexed	Hatanaka and Sekino, 1962		
	101	0.177	-0.76	Yangtze River / Unsexed	Sun et al., 1994		
	125	0.142	-0.27	Japan / Unsexed	Yasuda and Koike, 1950		
長鰳 *Ilisha elongata*	49.5	0.32	-0.41	Japan	Zhang and Takita, 2007	40.7 cm	154.8 mm
	49.5	0.26	-0.65	Korea / Both sexes	Kim et al., 2007		

Fig. 10 連江縣主要漁獲物種生物參數與最適網目大小

Fishery Environmental Dynamics and Fishing Gear Research Laboratory

Kuo-Wei Lan
Associate Professor
Ext: 5027

- **Research focused on the relationship between marine environment changes and biophysics of pelagic fishes by collected environmental variables from multi-sensor satellite data to investigate effects of climate changes on the catch rates, distributions of pelagic fishes, e.g. tunas and grey mullet (*Mugil cephalus* L.) in the Taiwan.**
- **The research direction on fishing gear and fishing method are mainly related to fish behavioral dynamics and conservation, such as reduce the bycatch rates, fish swimming dynamics and fishing gear relationship, mesh selectivity and fishery waste recycling. To find a balance between fishing gear and sustainable use of fisheries.**

Research results(1): Marine environment changes and biophysics of pelagic fishes

(1) Effects of climate variability on the distribution and fishing conditions of tuna species in the Pacific Ocean and Indian Ocean

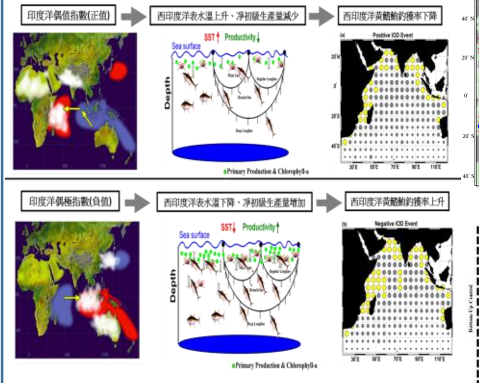


Fig. 1 Spatial distribution of CPUE of yellowfin tuna during positive and negative IOD events

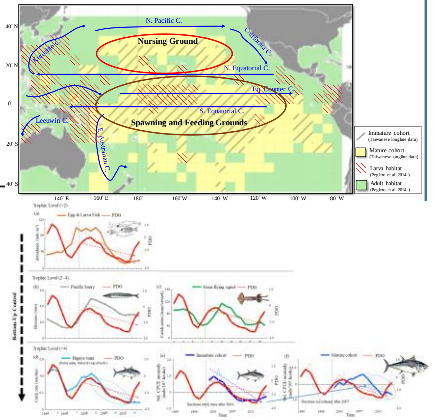


Fig. 2 Annual trends of the pelagic ecosystem for species with low trophic to high trophic levels in the Pacific Ocean

(2) Cyclic Fluctuations of Climate Change Effects on the Annual Fishing Conditions of Grey Mullet (*Mugil cephalus L.*) in the Taiwan Strait

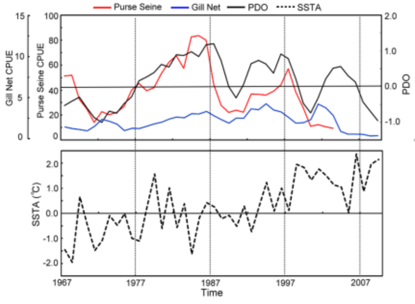


Fig. 3 Annual trends of (a) grey mullet CPUE of purse seiners and gill net with PDO and (b) winter SSTA

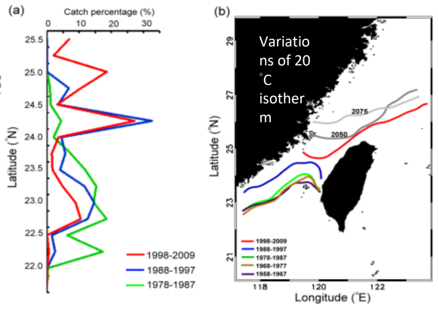


Fig. 4 (a) Latitudinal variations of the catch percentage of grey mullet (b) Latitudinal variations of the 20 ˚C isotherm in winter.

Research results(2): Fishing gear and sustainable use of fisheries

(1) Reduce the bycatch rates of seabirds in the longline fishing industry :

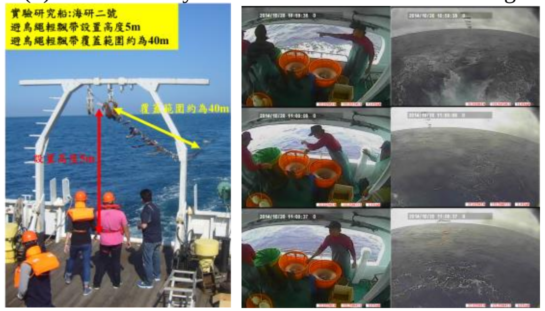


Fig. 5 Research on bird-scaring lines tangle with surface floats and lead to lost fishing gear

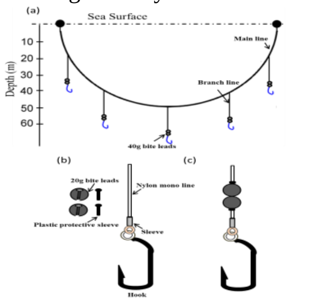


Fig. 6 (a) weighted branch lines (b, c) improved regime bite leads and slidable

(2) Swimming behavior of fishes with reefs

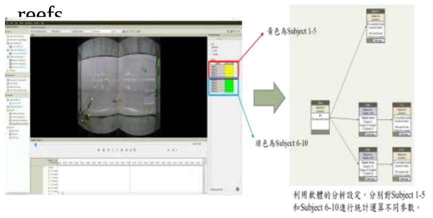


Fig. 7 Using animal trajectory tracking software

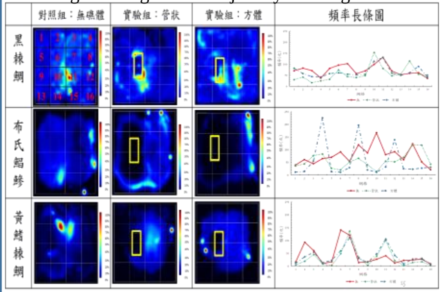


Fig. 8 Swimming behavior of fishes with reefs

(3) Investigation on mesh size

Fig.9 Photos on fishing gear and mesh size

Species	Parameter L∞	K	t 0	Locality / Sex	Authors	Maturity Length	Appropriate Mesh Size
鮸魚 *Miichthys miiuy*	71	0.32	-0.97	Russian	Jarzhombek, 2007	54.8 cm	100 mm
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	101	0.177	-0.76	Yangtze River / Unsexed	Sun et al., 1994		
	125	0.142	-0.27	Japan / Unsexed	Yasuda and Koike, 1950		
長鰳 *Ilisha elongata*	49.5	0.32	-0.41	Japan	Zhang and Takita, 2007	40.7 cm	154.8 mm
	49.5	0.26	-0.65	Korea / Both sexes	Kim et al., 2007		

Fig. 10 Biological parameters and optimal mesh size

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Article

Association of Environmental Factors in the Taiwan Strait with Distributions and Habitat Characteristics of Three Swimming Crabs

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台灣海峽三種梭子蟹科的分佈及棲地與環境因子間之關係

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重要研究成果

- 紅星梭子蟹(*Portunus sanguinolentus*)、鏽斑蟳(*Charybdis feriatus*)和遠海梭子蟹(*Portunus pelagicus*) 是台灣海峽重要的蟹類資源，本研究透過大數據漁船動態與漁業活動獲資料之收集與分析顯示，鏽斑蟳與紅星梭子蟹之分佈與捕獲率，主要受葉綠素a濃度所影響，而遠海梭子蟹則與底層海水溫度有顯著關係。
- 本研究結果除可做為臺灣梭子蟹科漁海況預報之資訊外，亦可做為梭子蟹科資源管理政策擬訂時之重要參考資料。

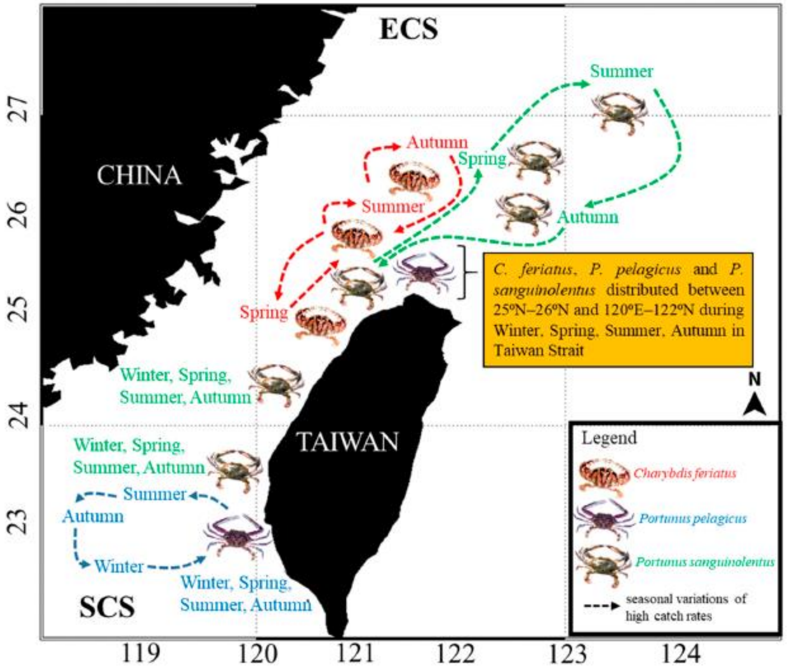

Figure 7. Illustration of the seasonal spatial distribution variations in high catch rates of *C. feriatus*, *P. pelagicus*, and *P. sanguinolentus* in the TS.

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doi:10.1016/j.dsr2.2020.104808

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Determining the effect of multiscale climate indices on the global yellowfin tuna (*Thunnus albacares*) population using a time series analysis

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[b] *Center of Excellence for Oceans, National Taiwan Ocean University, Keelung, Taiwan, ROC*
[c] *College of Fisheries, Ocean University of China, Qingdao, China*

利用時間序列分析法探討三大洋黃鰭鮪受到多尺度氣候變異指數影響下之族群變動影響

吳研綸[1]、藍國瑋[1,2*]、田永軍[3]

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3. 中國海洋大學海洋漁業系

重要研究成果

- 研究成果表明三大洋黃鰭鮪之漁獲努力量會受到長時間尺度氣候變異指數(如：太平洋十年震盪PDO、北太平洋環流震盪NPGO等)之影響，此外，其影響範圍並非侷限為單一區域。而短時間尺度之氣候變異指數(如：海洋聖嬰指數ONI以及印度洋偶極震盪DMI等)則對黃鰭鮪之分佈有顯著影響，然而其影響範圍則較局限於相鄰之洋區。
- 本研究結果除透過分析氣候變遷下各洋區黃鰭鮪之族群變動關係並提供漁政單位供其參考，亦可做為遠洋漁業管理政策擬訂時之重要參考資料。

Table 4
Summary of the findings of cross-wavelet analysis between the standardized yellowfin tuna CPUE and climate indices.

	Atlantic Ocean	Eastern Pacific Ocean	Western Pacific Ocean	Eastern Indian Ocean	Western Indian Ocean
AMO	1976-1991/16yr(x)	Unclear	1976-2010/8yr(x)	1971-1991/16yr(+)	Unclear
PDO	1971-2010/16yr(-)	Unclear	1981-2010/8yr(+)	Unclear	1996-2010/8yr(X)
NPGO	1971-2010/16yr(+)	Unclear	1976-1991/16yr(x)	Unclear	1996-2010/8yr(x)

Table 5
Summary of the findings of cross-wavelet analysis between the YFT longitudinal center of gravity and climate indices.

	Atlantic Ocean	Eastern Pacific Ocean	Western Pacific Ocean	Eastern Indian Ocean	Western Indian Ocean
AMO					1988-2010/4yr(+)
PDO		2002-2008/4yr(x)		2002-2010/8yr(+)	
NPGO	2000-2010/4yr(+)	1981-1998/8yr(-)	2004-2010/4yr(+)		
DMI	1981-2010/4yr(-)				1981-2010/4yr(-)
ONI			1981-2001/4yr(+)	1997-2010/4yr(+)	1997-2010/4yr(-)

AMO, Atlantic Multidecadal Oscillation; NPGO, North Pacific Gyre Oscillation; PDO, Pacific Decadal Oscillation; DMI, Dipole Mode Index; ONI, Ocean Nino Index.

Remote Sens. **2020**, *12*, *2689*.; doi:10.3390/rs12172689

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Article

Evaluating a Suitable Aquaculture Site Selection Model for Cobia (*Rachycentron canadum*) during Extreme Events in the Inner Bay of the Penghu Islands, Taiwan

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2 Center of Excellence for Oceans, National Taiwan Ocean University, Keelung 20224, Taiwan
3 Penghu Marine Biology Research Center, Fisheries Research Institute, Council of Agriculture, Executive Yuan, Penghu 88049, Taiwan; 20809001@mail.ntou.edu.tw
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check for updates

極端事件下臺灣澎湖內海海鱺之箱網養殖最適位置之評估

吳研綸[1]、李明安[1]、陳律祺[3]、詹瑞文[4]、藍國瑋[1,2*]

1. 國立臺灣海洋大學環境生物與漁業科學學系
2. 國立臺灣海洋大學海洋中心
3. 行政院農業委員會水產試驗所澎湖海洋生物研究中心
4. 臺灣海洋科技研究中心

重要研究成果

- 澎湖內海低溫寒害主要是由於強勁之東北季風連續吹拂所導致，本研究以強風吹拂天數為初步篩選條件匡列澎湖近年寒害所發生之年份，並搭配四個環境條件模擬寒害發生時澎湖內海之箱網放置適宜指數，研究表明澎湖東南部以及南部海域為澎湖寒害發生時，箱網最適宜之放置地點。
- 本研究結果除可提供澎湖漁政單位寒害之機制之資訊外，亦可做為寒害選址管理政策擬訂時之重要參考資料。

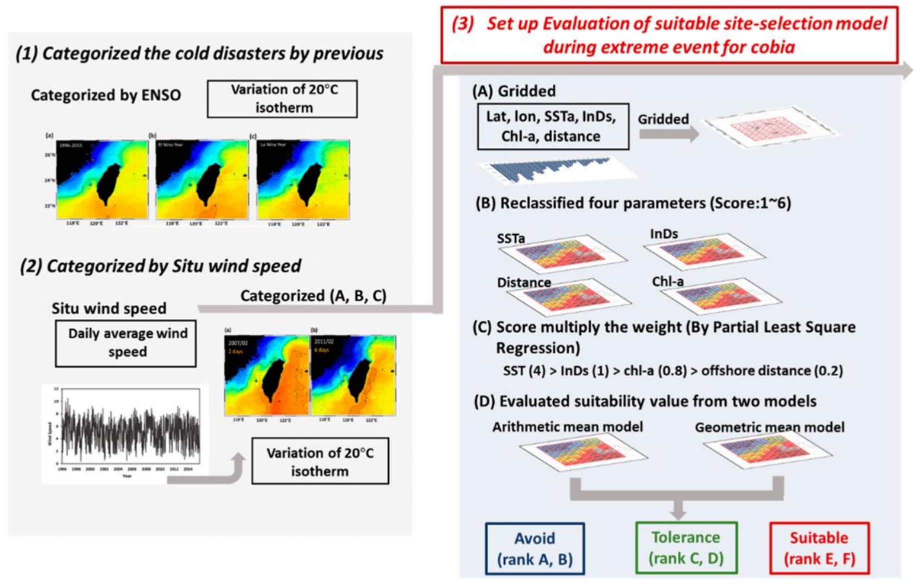
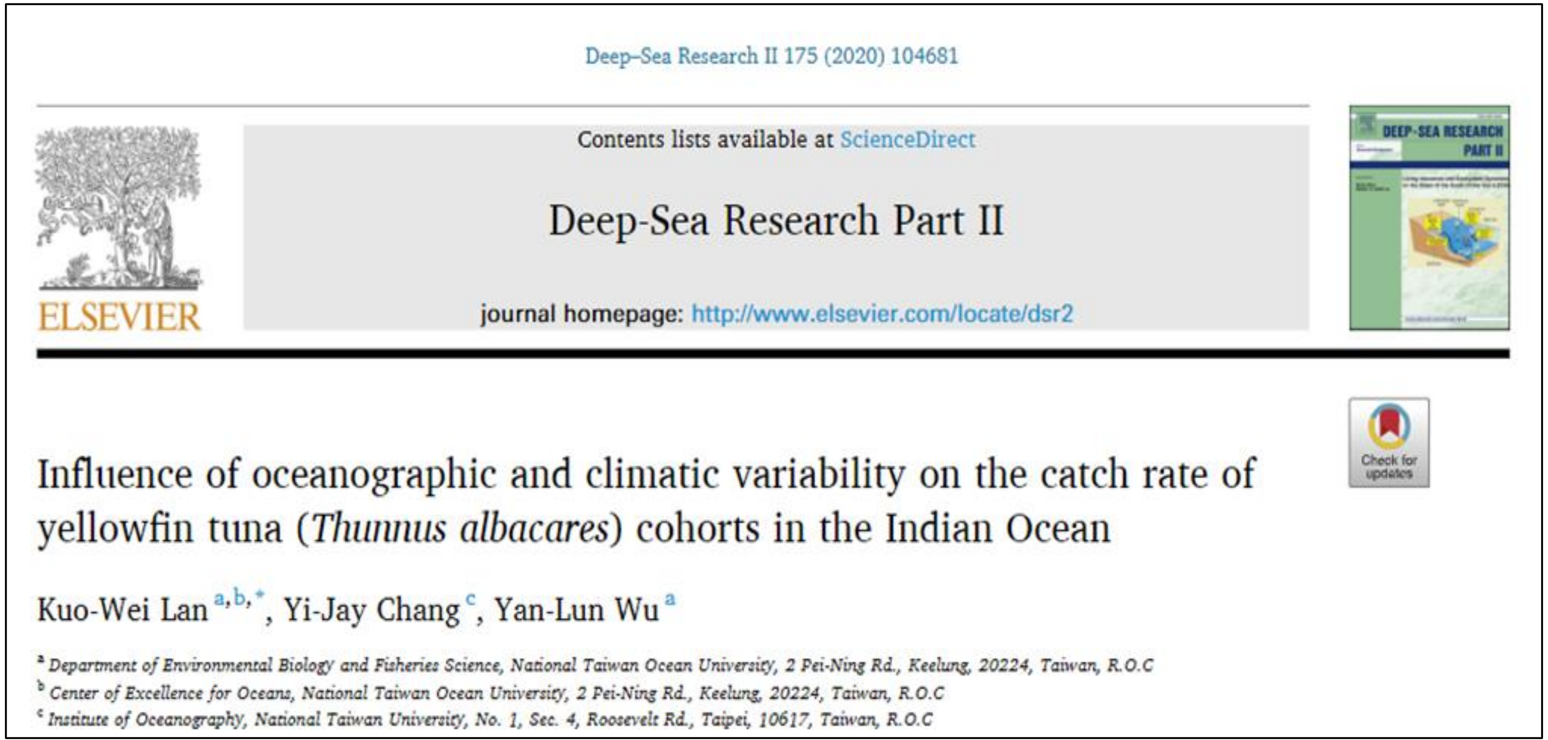


Figure 2. Schematic of the evaluation of site selection maps for cobia cage culture in the inner bay of the Penghu Islands.

Deep Sea Research Part II: Topical Studies in Oceanography **2020**, 175, 104681;
doi:10.1016/j.dsr2.2019.104681



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Influence of oceanographic and climatic variability on the catch rate of yellowfin tuna (*Thunnus albacares*) cohorts in the Indian Ocean

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探討印度洋黃鰭鮪年齡群釣獲率受到海洋環境與氣候變異之變動特性分析

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重要研究成果

- 研究結果顯示海洋表水溫同時為影響印度洋黃鰭鮪成熟與未成熟群族群變動之重要環境因子，另外也發現成熟與未成熟群約有3-4年正相關週期，兩者也分別與印度洋偶極事件(IDO)有3年之相關週期，成熟與未成熟群亦分別跟海洋聖嬰現象(ENSO)有1~3年之相關性。值得關注的是在2008-2009年間，由於IOD與ENSO之雙重影響下，西北印度洋之成熟黃鰭鮪較往年低
- 本研究結果除透過分析印度洋黃鰭鮪各年齡群族群變動特性並提供漁政單位供其參考，亦可做為遠洋漁業管理政策擬訂時之重要參考資料。

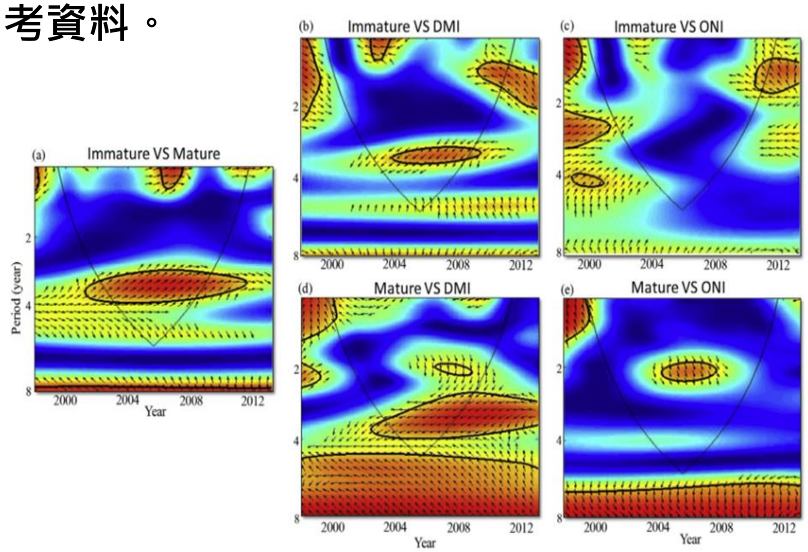

Fig. 6. Cross-wavelet coherence between catch rates of (a) immature and mature cohorts (b–c) immature and (d–e) mature cohorts with DMI and ONI from 1998 to 2012. The solid-black contour encloses regions of >95% confidence, and the black line indicates where edge effects become important. High variability is represented by red, and weak variability by blue. Arrows indicate the phase relationship, with in-phase arrows pointing to the right and out-of-phase arrows pointing to the left. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

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Validation of a Primary Production Algorithm of Vertically Generalized Production Model Derived from Multi-Satellite Data around the Waters of Taiwan

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利用衛星遙測資料透過VGMP演算法反演台灣周邊海域基礎生產力之驗證

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重要研究成果

- 利用衛星遙測海表溫(AVHRR SST)和三種類型的葉綠素資料(MODIS Chl-a)進行VGPM演算法所推導之初級生產力與由明暗瓶法之實地初級生產力呈線性相關，相關係數在春季最高。而台灣周遭四個子海域，分別與來自Aqua和Terr葉綠素資料具顯著相關。
- 整體來說，演算模型低估了實地PP，可能是由於水體中浮游植物的深度、短期氣候變化和光學複雜的陸架水域，然兩者具高度線性相關，此研究證明了衛星遙測推導之初級生產力可適用於台灣周遭海域，為後續研究提供貢獻。

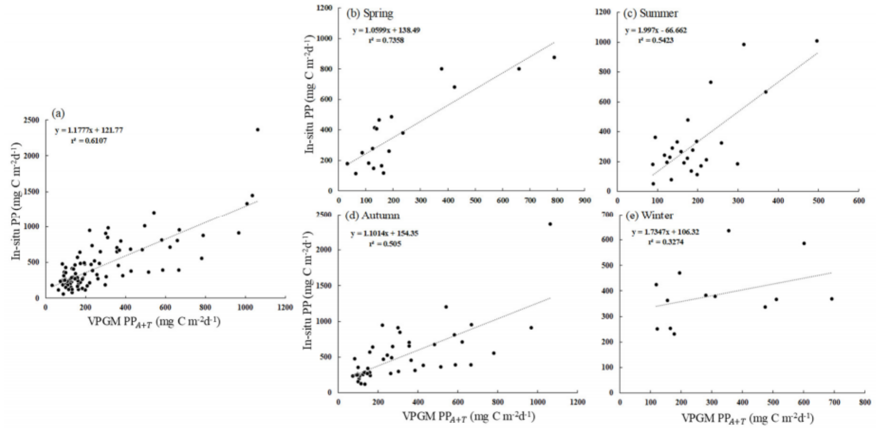

Figure 5. Relationship between the VPGM $PP_{A\&T}$ and in situ PP for (**a**) the whole year, (**b**) spring, (**c**) summer, (**d**) autumn, and (**e**) winter during the study period.

Table 3. Extracted number (n) of satellite-derived PPs with in situ PPs, correlation coefficients (r^2), and *p* values for $PP_{A\&T}$, PP_A, and PP_T for whole years in four subareas.

	China Coast			Taiwan Strait			Northeast Upwelling			Kuroshio		
	n	r^2	*p*	*n*	r^2	*p*	*n*	r^2	*p*	*n*	r^2	*p*
$PP_{A\&T}$	3	0.16	0.51	39	0.08	<0.05	12	0.01	0.79	48	0.02	0.07
PP_A	4	0.33	0.31	52	0.26	<0.05	12	0.37	<0.05	83	0.14	<0.05
PP_T	3	0.44	0.54	50	0.04	0.09	14	0.01	0.7	83	0.02	0.13

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Assessing Summertime Primary Production Required in Changed Marine Environments in Upwelling Ecosystems Around the Taiwan Bank

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臺灣淺灘夏季海洋環境變動對湧升生態系統基礎生產力需求量的影響

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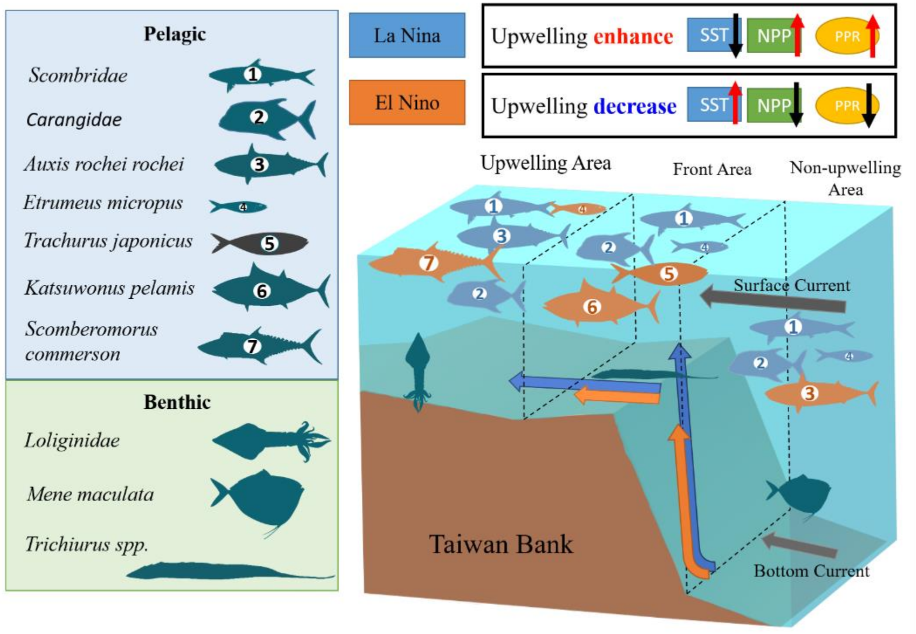
重要研究成果

- 臺灣淺灘夏季底層水流沿陸棚向上流動形成湧升區為一重要漁場，透過營養動力學理論將漁業捕撈量轉化為基礎生產力需求量，作為生態系統受環境變動影響之指標。
- 本研究結果顯示底層性物種PPR受基礎生產力影響且可能存在延遲之效應，另影響表層性種則主要與氣候變異指數有關，如反聖嬰年事件會導致湧升面積增加、表水溫降低進而增加基礎生產力，使得表層性物種PPR受環境因子變動影響而增加。



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Effects of Climate Change in Marine Ecosystems Based on the Spatiotemporal Age Structure of Top Predators: A Case Study of Bigeye Tuna in the Pacific Ocean

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基於頂端掠食者之年齡結構時空間變動探討氣候變遷對海洋生態系之影響：以太平洋大目鮪為例

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重要研究成果

- 海洋生態系統經常由下至上控制頂端掠食者之分佈與行為模式，本研究以太平洋大目鮪為例，得知在太平洋十年震盪指數(PDO)的影響下，2004-2005年大目鮪加入量有明顯下降之趨勢且低營養位階之生物豐度亦有與加入量同步之趨勢，又加入量與成熟群間存在3年之時間延遲效應。透過一連串分析可得知在氣候變遷的影響下，海洋生態系統對太平洋大目鮪進下行控制有顯著之影響。
- 本研究結果除透過分析氣候變遷下行控制影響太平洋大目鮪不同年齡結構變動並提供漁政單位供其參考，亦可做為遠洋漁業管理政策擬訂時之重要參考資料。

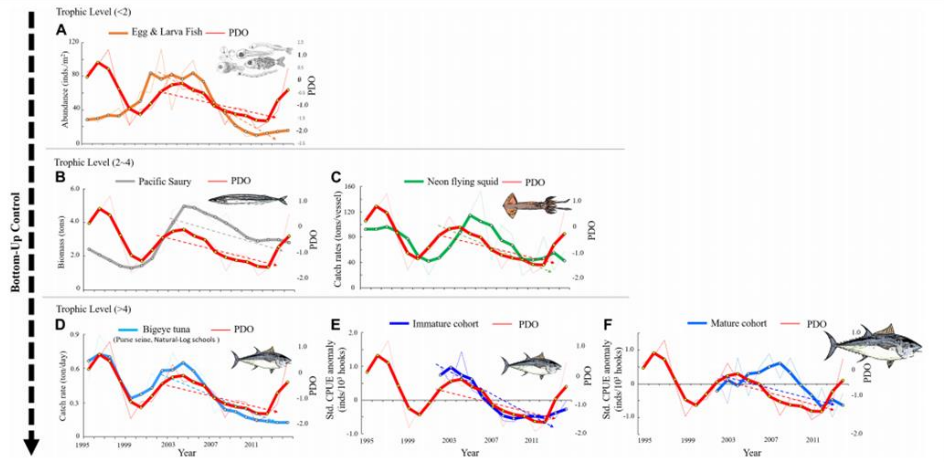

FIGURE 3 | Annual (thin dotted line) and 3-year mean (thick solid line) trends of the pelagic ecosystem for species with low trophic (<2) to high trophic (>4) levels as influenced by PDO in the WCPO. **(A)** Abundance of eggs and larvae, **(B)** biomass of Pacific saury, **(C)** catch rates of neon flying squid, **(D)** catch rates of nature-log schools of BET caught in purse seine nets, and **(E,F)** standardized CPUE anomaly of immature and mature cohorts of BET. The dashed lines in **(A–E)** indicate that the phases have significant correlations with the interannual pelagic ecosystem and PDO in a Pearson's test.