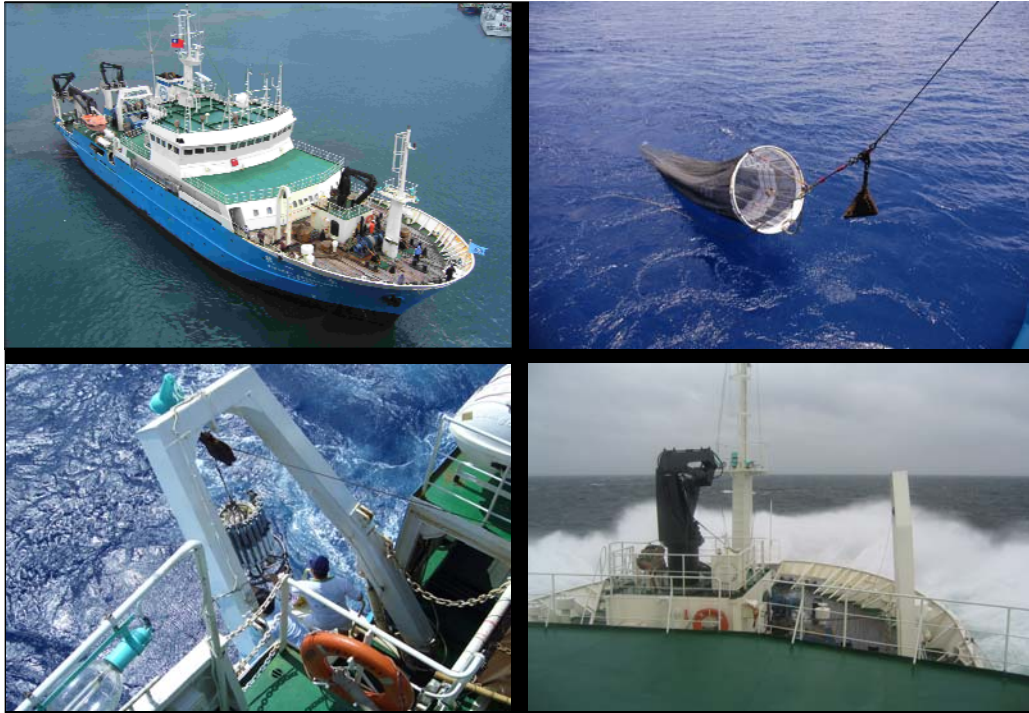




Cruise Report of TaiCOFI Surveys in 2015

2015 年台灣周邊海域漁場環境監測航次報告



2015

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序

台灣以海洋興國，周邊二百哩經濟海域內 43 萬平方公里的藍色國土，孕育著無限寬廣的機會，向海洋發展更見證了台灣人民不畏艱苦的勤奮特性，而得天獨厚的海洋環境賜給我們豐富的漁業資源，各式新鮮美味的魚蝦蟹貝更是國人最優質的蛋白質來源。然而，台灣沿近海漁業資源之利用已趨飽和，如何在人口增加的同時兼顧糧食需求的增加，謀求資源開發與生態保育間之平衡，將是我們未來最大的課題與挑戰。

漁業是一個古老的行業，但管理漁業資源卻需要最先進的科學。氣候變遷造成海水溫度升高，除了造成魚類棲地的改變，亦直接影響了魚群洄游的路徑與時間，改變了暖水性與冷水性魚種的分布界線，造成漁場的改變甚至消失，對漁業資源造成深遠的影響，而水溫、鹽度、基礎生產力等水團特性則是影響漁場、漁期變動的關鍵因子。為此，許多國家已致力於長期海洋環境及生物資源觀測資料庫之建置，以求有效監測海洋物理與化學環境，方能及時發現問題並提供解決對策，期能降低氣候變遷之衝擊。

長期海洋環境觀測是一個持續進行的過程，也是一連串的挑戰。本所自 2003 年起執行「台灣周邊海域漁場環境監測計畫」，運用「水試一號」與「水試二號」試驗船及其配備的各項科儀設備，克服一切險阻按季於周邊海域各測站蒐集海域溫鹽、營養鹽、葉綠素甲、基礎生產力及浮游動物等漁場環境資訊，迄今連續 13 年未曾間斷。本專刊記載彙錄同仁們辛苦工作的結晶，衷心希冀藉由本專刊之發行，將調查成果作為學術應用、漁業管理與接軌國際之橋梁，為我國漁業資源永續利用奠定良好之基礎。

所長

陳君如

謹誌

中華民國一零六年十二月

Preface

Taiwan is an island and the ocean is our priceless property. The EEZ of Taiwan covers 430 thousand square kilometers of ocean and unlimited opportunities. Consequently, the government promotes "Ocean rejuvenating" policy ideas and it fits well with the diligent nature of people in Taiwan. Our ocean is favorably endowed with all kind of fishery resources, which provide our compatriots the best high quality animal protein. However, the coastal resources are declining in recent years. Therefore, the balance between fishery development and conservation will be the biggest challenge in the future.

Fishery is an old business, but to manage it properly requires state of the art science. Climate change lead to rising water temperature, with the consequences of changing habitats, alteration of distribution boundary, and the oscillation of fishing grounds of aquatic resources. The effect of climate change is profound for fishery resources and water temperature, salinity and primary production of the water masses are the key factors that affect the variation of fishing grounds and fishing season. As a result, in order to monitor our ocean and to detect anomalies effectively and to find a way to mitigate the impact of climate change, many countries have devoted to establishing their long-term database for marine environment and aquatic living resources.

Long-term observation of the ocean is a continuous process with a series of challenges. Fisheries Research Institute implemented the Taiwan Cooperative Oceanic Fisheries Investigations (TaiCOFI) program to investigate in the hydrography and fisheries resources in the surrounding waters of Taiwan since 2003 and now a consecutive 13 years database of marine environment was established. With the publication of "Cruise report of TaiCOFI surveys in 2015", we hope this project to be helpful for fishery researchers and policy makers and to promote international academic exchange. Finally, we hope this project will contribute more to the society and lead fisheries in Taiwan toward sustainability.

Director

A handwritten signature in black ink, reading "June-ru Chen". The script is cursive and fluid, with the first name "June" and last name "Chen" clearly distinguishable.

Fisheries Research Institute

前言

近年來由於全球氣候變遷及海洋環境污染問題日益嚴重，許多國家已致力於海洋環境及生物資源之基礎探測與資料庫之建置。然以往我國有關海洋方面之研究計畫多侷限於局部海域之短期研究，觀測線或觀測點常隨計畫主題改變而改變，缺乏長期而有系統性的調查資料，再者，多數計畫係以海洋物理化學為研究重點，漁業研究學者欲將這些資料應用在水產資源研究上，著實不易。

有鑑於此，水產試驗所於 2003 年起著手實施「台灣周邊海域漁場環境監測」計畫，於周邊海域設置 62 個測站按季蒐集水溫、鹽度、營養鹽、葉綠素、浮游動物等漁場環境資訊，嘗試透過此全面性之調查來瞭解台灣周邊海域長期水文、海況及漁業生物時空分佈資訊，進而掌握影響台灣周邊海域漁業資源變動的機制。多年來，承蒙各方提供寶貴之經驗與建議，不斷改進海洋探測科儀操作及採樣相關流程，在本所同仁與國內相關學術單位的共同努力下，無論在各項科儀操作效率、漁場環境調查技術或漁業生物研究上均已小有成果。

本專刊彙集本所於 2015 年執行「台灣周邊海域漁場環境監測」計畫（農委會科技計畫編號：104 農科-11.2.1-水-A1(1)）之調查成果，計畫執行之海上採樣作業流程、各調查項目實驗室檢測流程、各航次出海採樣及樣本分析人員均有詳述於後。此外，本年度 1 月航次因海象惡劣取消；8、11 月航次則因試驗船任務需求，臨時縮減航程僅完成部分測站。本計畫內容涉及廣泛專業領域，雖戮力以赴亦難免有疏漏不周之處，希冀各界先進不吝賜教斧正。

Introduction

With the changing of climate and the growing of marine environmental pollutions in recent years, many countries have devoted to establishing their database for marine environment and aquatic living resources. However, in the past, marine research programs in Taiwan were mostly confined to a short time scale and of a limited region. Besides, transects or stations of surveys were usually changing with the changing of projects, resulted in a scarcity of long term and systematic observations of waters around Taiwan. Furthermore, most programs were aimed at marine chemistry and physics studies. It is hard for fishery scientists to incorporate that information into fishery stock assessment.

As a result, Fisheries Research Institute implemented 「Taiwan Cooperative Oceanic Fisheries Investigations, TaiCOFI」 program in 2003 to conduct quarterly cruises to collect water temperature, salinity, nutrients, chlorophyll-*a* and zooplankton measurements at 62 stations in the surrounding waters of Taiwan. Through this thorough investigation, we try to understand the coupling of physical, chemical and biological dynamics in the surrounding waters of Taiwan to figure out the factors associated with the fluctuation of fishery resources. For the past years, we really appreciated for the valuable advices from academic communities to improve our field sampling techniques and operation procedures of marine observation instrument. With the hardworking of our staff members and associated academic organizations, now we have preliminary achievements in the operating efficiency of marine observation instruments, fishing ground investigation techniques and fisheries biology research.

The data presented in this report were collected by TaiCOFI cruises in 2015. Standard procedures of field program and sample analysis are described in detail and the distribution of water temperature, salinity, nutrients, chlorophyll-*a*, zooplankton and primary production are illustrated in figures for each cruise. January cruise was cancelled due to heavy weather. For August and November cruises, only part of the stations were completed because of the mission adjustment of the research vessel. Finally, we will extend our special thanks for your advices to improve this cruise report.

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海上採樣作業流程

在台灣周邊海域選定 62 個測站，利用水試一號試驗船及其裝備，按季節別於 2015 年 3 月、8 月及 11 月，進行下列之工作項目：

1.CTD 溫鹽調查：

採用 Seabird SBE-911PLUS 溫鹽深儀 (CTD)，每測站均投放至 1000 m (水深不足之測站則以實際水深少 10 m 為原則)，取得溫深鹽之連續資料。

2.分層採水：

利用 General Oceanics 之自動採水瓶，採取 5、25、50、75、100、150 m 等水層之海水各 2000 ml。

3.葉綠素甲測定：

取各層海水 1000 ml，利用 Millipore 濾紙過濾後，以 -20℃ 急速冷凍保存，再攜回實驗室檢測。

4.營養鹽類測定：

分別收集各層海水 100 ml，以液態氮(-196℃)急速冷凍保存後，再攜回實驗室檢測。

5.浮游動物採集：

以 ORI 網下放至 200 m 深(水深不足之測站則以實際水深少 5 m 為原則)，以 1 m/s 速度上揚，取得之樣本以 5% 福馬林海水溶液保存，再攜回實驗室測定生物量及分類。

Field Observations

The survey was carried out in the waters surrounding Taiwan by *Fishery Researcher I* during quarterly cruise in March, August and November in 2015. The following procedures were conducted at each station.

1. Temperature and salinity:

CTD, Seabird SBE-911PLUS, was lowered from the surface to 1000 m (or 10 m above the bottom for shallow areas).

2. Water sampling for chlorophyll-*a* and nutrients:

The Rosette (GO-1015), mounted on the frame of CTD, were sequentially closed and collected 2 liter water sample at specific target depths (5, 25, 50, 75, 100, 150 m) as the CTD was raised.

3. Chlorophyll-*a* concentration measurement:

One liter of sea water samples were immediately filtered through Whatman GF/F filter papers and then put in -20°C refrigerator for chlorophyll-*a* concentration measurement in the laboratory.

4. Nutrients concentration measurement:

100 ml of sea water samples for each depth were collected and then put in liquid nitrogen (-196°C) for nutrients concentration measurement in the laboratory.

5. Sampling gear and methods for zooplankton:

The ORI net, with a 1.6 m diameter mouth opening, 6 m in length and 0.333 mm meshes, was towed obliquely to 200 m (for shallow areas, 10 m above the bottom) at each station. The net opening is fastened with a short 3-lead bridle connected to several meters of line which attached to the towing cable by a clamp. A General Oceanic flowmeter is suspended across the center of the net mouth to measure the amount of water filtered during each tow. The net was towed at a ship speed of 1.0 knots for about 10 minutes. After the net was on board, samples were pouring into the PVC bottle and preserved immediately in 5 % formalin buffered with sodium borate.

樣本實驗檢測流程

壹、營養鹽、葉綠素及基礎生產力之測定流程

取各水層水樣急速凍結保存後，分析各水層之硝酸（nitrate）、磷酸（phosphate）、矽酸（silicate）等營養鹽，另外將濾畢各層海水之濾紙以丙酮溶解萃取出葉綠素分析其葉綠素甲濃度；利用光暗瓶溶解氧法，分析台灣周邊海域之基礎生產力（primary productivity）。

1. 硝酸測定：

硝酸以 Wood-Armstrong-Ricgard 法測定，將過濾之試水通過銅-鎘還原管，使硝酸還原成亞硝酸，然後加入 Sulfanilamide 及 NED 溶液，於分光光度計上以 542 nm 測定吸光值並計算其濃度，另取同樣試水不經銅-鎘還原管，直接測定水中之亞硝酸濃度，將經過銅-鎘還原管之數值扣除水中亞硝酸之濃度後，依銅-鎘還原管之還原率計算水中硝酸之濃度。

2. 磷酸測定：

磷酸以 Molybdenum blue-Ascorbic acid 法測定，將過濾後之試水加入以 Ammonium molybdate、Sulfuric acid、Ascorbic acid 及 Potassium antimonyl-tartrate 所配製的還原溶液，待其成色後在分光光度計以波長 885 nm 測定吸光值並計算待測物之濃度。

3. 矽酸測定：

矽酸以 Molybdosilicate 法測定，將過濾之試水先後添加 50 % HCl、10 % Ammonium molybdate 及 10 % Oxalic acid 後，加入以 1-amino-2-naphthol-4-sulfonic acid、 Na_2SO_3 及 NaHSO_3 所配製的還原試劑，混合完成後於分光光度計上以波長 815 nm 測定其吸光值，由各波長之吸光值並計算待測物之濃度。

4. 葉綠素甲測定：

葉綠素甲以 Trichromatic 法測定，將各水層過濾後的濾紙，分別加入丙酮研磨後，放入恆溫培養箱（4℃）24 小時之後，將樣品置於冷凍離心機 4℃、轉速 3000 rpm 離心 15 秒後，分別取出上清液，使用分光光度計測其各波長之吸光值後由公式(Jeffrey and Humphrey, 1975)計算葉綠素甲濃度。

5. 基礎生產力測定：

將試水分別裝入錫箔紙包覆之暗色溶氧及透明瓶中，分別進行光度恆溫培養，經 24 小時後，測定溶氧瓶中水樣始末之溶氧差，換算成碳生產力即得。

貳、浮游動物鑑種及計數流程

返航後先將樣品靜置，以便後續分量。

分樣：

取一瓶樣品，將其上部的澄清液先用小塊 100 目網布過濾直至網布上有浮游動物出現為止，然後先將樣品瓶中的動浮液倒入小燒杯中，再利用洗滌瓶將樣品瓶中及網布上的浮游動物完全沖洗至小燒杯內，再將採樣回來的樣品瓶上標籤撕下，貼在一個 150 ml 的標本瓶上。接著，將小燒杯中的動浮液倒入分樣器中，將分樣器左右擺動約十次，然後站在分樣器前方目測左右數量是否一致，若一致再將其倒出，倒出後會分為兩部分，將其中一部分裝入剛才貼有標籤的 150 ml 的標本瓶（該瓶分量為 1/2），將剩下的那一部分再倒入分樣器內進行分樣，重複上述步驟。直到目測該分量的樣品中約有 1000 隻左右浮游動物為止。

鑑種及計數：

將該測站的最小分量樣本瓶中的動浮液倒入培養皿，將裝有動浮液的培養皿擺上顯微鏡的載物台計數及鑑種，計數時以 Z 字的方法依序計數，一個方格內的動浮算完再算下一個方格，鑑一隻就按一下該種的計數器，緩慢移動培養皿，該培養皿算完後，將其倒入 250 ml 的燒杯中，再算第二盤直到將該最小分量樣本瓶中的動浮液全數算完，此時確認計數器的值全部加起來是否有超過 2000 隻，若超過 2000 隻，該測站即計算完畢；若尚未超過 2000 隻，則將另一瓶還未計算的最小分量樣本瓶的動浮液全數算完，若仍然小於 2000 隻，就再將上一分量的樣本瓶的動浮液全數算完，直到計數器全部加起來有超過 2000 隻，該測站樣本才算計數完畢。

生物沉澱量、排水容積、濕重：

- 1.生物沉澱量：取 100 ml 沉澱管，將管中的水位都標定到 100，靜置一個晚上後，目視生物沉澱量刻度，在記錄沉澱管上的數值時需要往下數一格，以減少誤差。
- 2.濕重：將一測站之樣本倒入沉澱管中，並注意沉澱管中樣本之容積之刻度，在將沉澱管中之樣品倒入吸引器中，將其樣本浮游動物與樣本液分開，吸至浮游動物沒有多餘之樣本液後，將其浮游動物放入秤中量其重量，即為其濕重。
- 3.排水容積：濕重測量完畢時，剩下的澄清液倒入沉澱管中觀察其刻度。

Laboratory procedures

Seawater samples were collected at discrete depths (from 5 to 150 m) for inorganic nutrients (NO_3^- 、 PO_4^{3-} 、 SiO_2^{2-})、chlorophyll-*a* (chl-*a*) and primary productivity (PP) and then were analyzed with standard methods depending on variable chemical properties in the laboratory.

1. Nitrate

Nitrate (NO_3^-) was measured by reducing nitrate to nitrite (NO_2^-) and then determining the nitrite by employing the pink azo dye method. Sulfanilamide and NED solutions were added to seawater samples and then measured by using a spectrophotometer analyzer at 542 nm for final determination of concentrations.

2. Phosphate

Phosphate (PO_4^{3-}) was determined by the molybdenum blue method. Ammonium molybdate、Sulfuric acid、Ascorbic acid and Potassium antimonyl-tartrate mixed solutions at room temperature were added to seawater samples and then measured by using a spectrophotometer analyzer at 885 nm for final determination of concentrations.

3. Silicate

Silicate (SiO_2^{2-}) was measured by the Molybdenum blue method. Seawater samples were immediately acidified with 50 % Hydrochloric acid、10 % Ammonium molybdate and 10 % Oxalic acid and then 1-amino-2-naphthol-4-sulfonic acid、 Na_2SO_3 and NaHSO_3 mixed solutions were added to the samples. For final determination of concentrations, samples were measured by using a spectrophotometer analyzer at 815 nm.

4. Chlorophyll-*a*

Chlorophyll-*a* (chl-*a*) was measured by the Trichromatic method. Pigments were extracted in cold acetone (90%) for 24 hours. The samples were centrifuged at 3000 rpm under 4°C for 5 minutes and then transfer the samples extracts from the centrifuge tube to the cuvette by careful pipeting. The final determination of chlorophyll-*a* samples were measured by using a spectrophotometer.

5. Primary productivity

Primary productivity (PP) were measured by the Dissolved Oxygen method. Seawater samples were cultured in the light and dark tanks for 24 h and then measured by using a DO meter analyzer on board.

6. Zooplankton

Each plankton sample was repeatedly divided with a Folsom splitter until its subsample contained 2000 specimens of zooplankton. Zooplanktons were then sorted and classified into 30 categories. The number of each category was recorded and the abundance of each category was expressed as the number of individuals per cubic meter (inds/m³).

計畫主持人 Program leader

農業委員會水產試驗所研究員兼主任秘書 劉燈城 Liu Don-Chung

計畫執行人員 Participating researchers

單位名稱	研究人員	職稱
農業委員會水產試驗所海洋漁業組	吳繼倫 Wu Chi-Lun	研究員兼組長
農業委員會水產試驗所海洋漁業組	陳郁凱 Chen Yu-Kai	副研究員
農業委員會水產試驗所海洋漁業組	藍揚麒 Lan Yang-Chi	副研究員
農業委員會水產試驗所海洋漁業組	王友慈 Wang Yu-Tzu	聘用助理研究員
農業委員會水產試驗所海洋漁業組	潘佳怡 Pan Chia-I	聘用助理研究員
農業委員會水產試驗所海洋漁業組	蘇博堃 Su Bo-Kuan	漁航員
農業委員會水產試驗所海洋漁業組	張伯瑋 Chang Po-Wei	輪機員
國立台灣海洋大學環境生物與漁業科學系	鄭學淵 Cheng Sha-Yen	教授

各航次出海採樣人員 Cruise personnel

2015- 03- 18 航次	所內人員		所外人員	
	陳郁凱	副研究員	關智揚	海大環漁系研究生
	陳瑞谷	技佐	簡孜翰	海大環漁系研究生
2015- 08- 07 航次	所內人員		所外人員	
	陳郁凱	副研究員	關智揚	海大環漁系研究生
	陳均龍	助理研究員	簡孜翰	海大環漁系研究生
2015- 11-13 航次	所內人員		所外人員	
	陳郁凱	副研究員	關智揚	海大環漁系研究生
	潘佳怡	聘用助理研究員	李惠淇	海大環漁系研究生
水試一號試驗船人員	陳林耀	船長	王瑞霖	大副
	林正雄	二副	朱振銘	三副
	鄭潤修	漁撈長	翁建順	大管
	謝耀瑩	二管	陳柏青	三管
	李堂炯	電信員	陳家偉	輪機員
	何文聰	輪機員	林梓雲	輪機員
	張伯璋	輪機員	曾顯榮	輪機員
	陳建良	大廚	蔡嘉進	二廚
	施畢成	漁航員	羅勝義	漁航員
	陳家齊	漁航員	丁元宏	漁航員
	何國銘	漁航員	許俊為	漁航員
	蘇博堃	漁航員	陳賢榮	漁航員
	曹金生	漁航員	黃閔裕	漁航員
	林文賢	漁航員	楊幼祥	漁航員
	王凱毅	探測技正		
水試二號試驗船人員	高懷恩	船長	林冠宏	大副
	蔡宏義	二副	張文發	輪機長
	高振傑	二管	陳明展	電信員
	蔡安傑	大廚	李淵林	輪機員
	蔡明益	漁航員	蔡忠和	漁航員
	黃世龍	漁航員		

各航次參數分析人員

Personnel participating in the data analysis

分析項目	分析人員
海洋氣象觀測	陳郁凱、藍揚麒
CTD 溫鹽探測	陳郁凱、藍揚麒
營養鹽濃度分析	蘇博堃、張伯瑋
葉綠素甲濃度分析	蘇博堃、張伯瑋
基礎生產力	海洋大學鄭學淵研究室
浮游動物分類	潘佳怡、林芝仔

略語表

Abbreviations

Date	作業日期
SMT	作業開始時間
Lati.	緯度(°N)
Long.	經度(°E)
Depth	深度(m)
SST	表層水溫(°C)
Air T.	氣溫(°C)
Air P.	氣壓(mb)
Wind D.	風向
Wind F.	風速(節)
O.N.D.	作業水深(m)
Fl. Ct.	濾水器讀數
V.W.S.	濾水體積(m ³)
N.A.	Not Available

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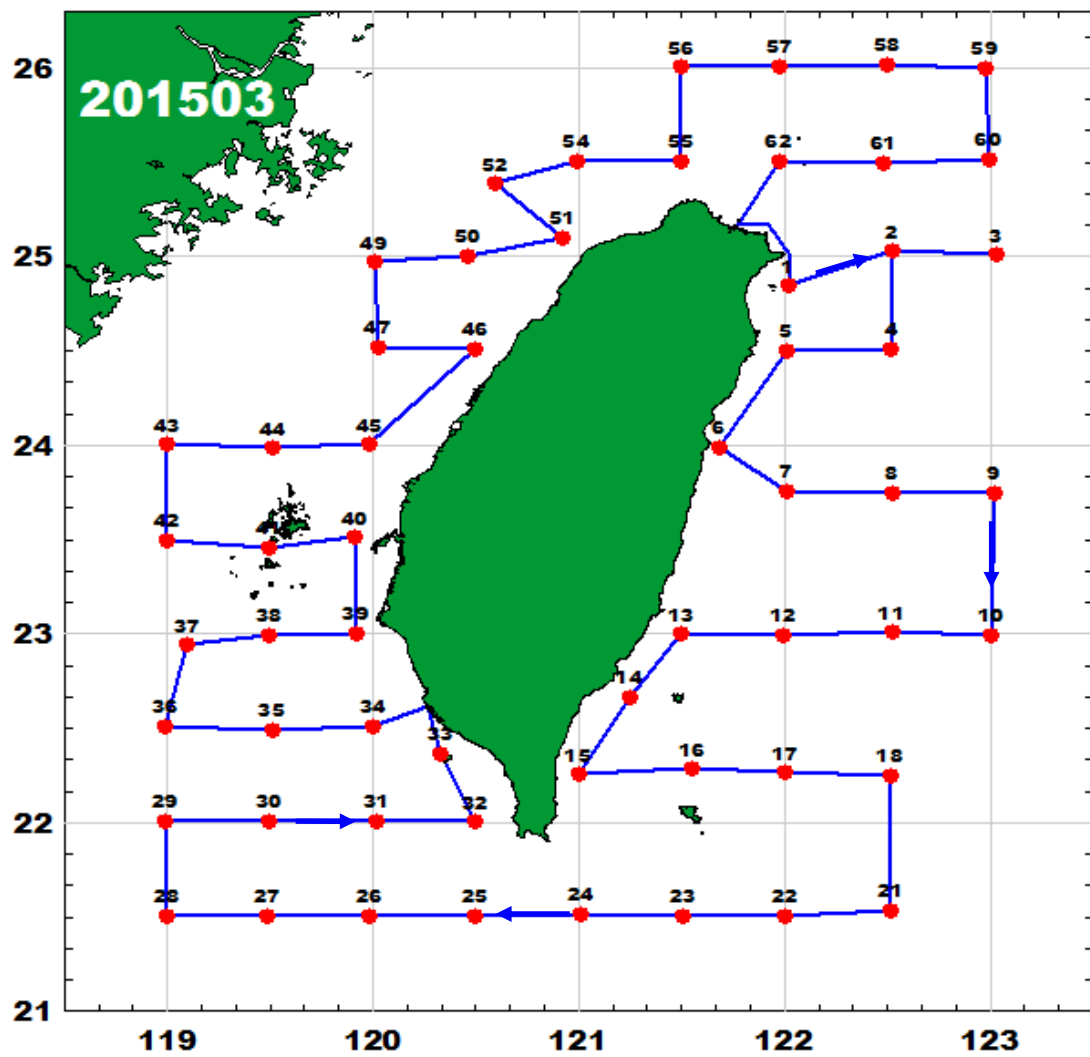


圖 01. 2015-03 航次航跡圖

Fig. 01. Stations and Cruise tracks for TaiCOFI Survey in Mar. 2015.

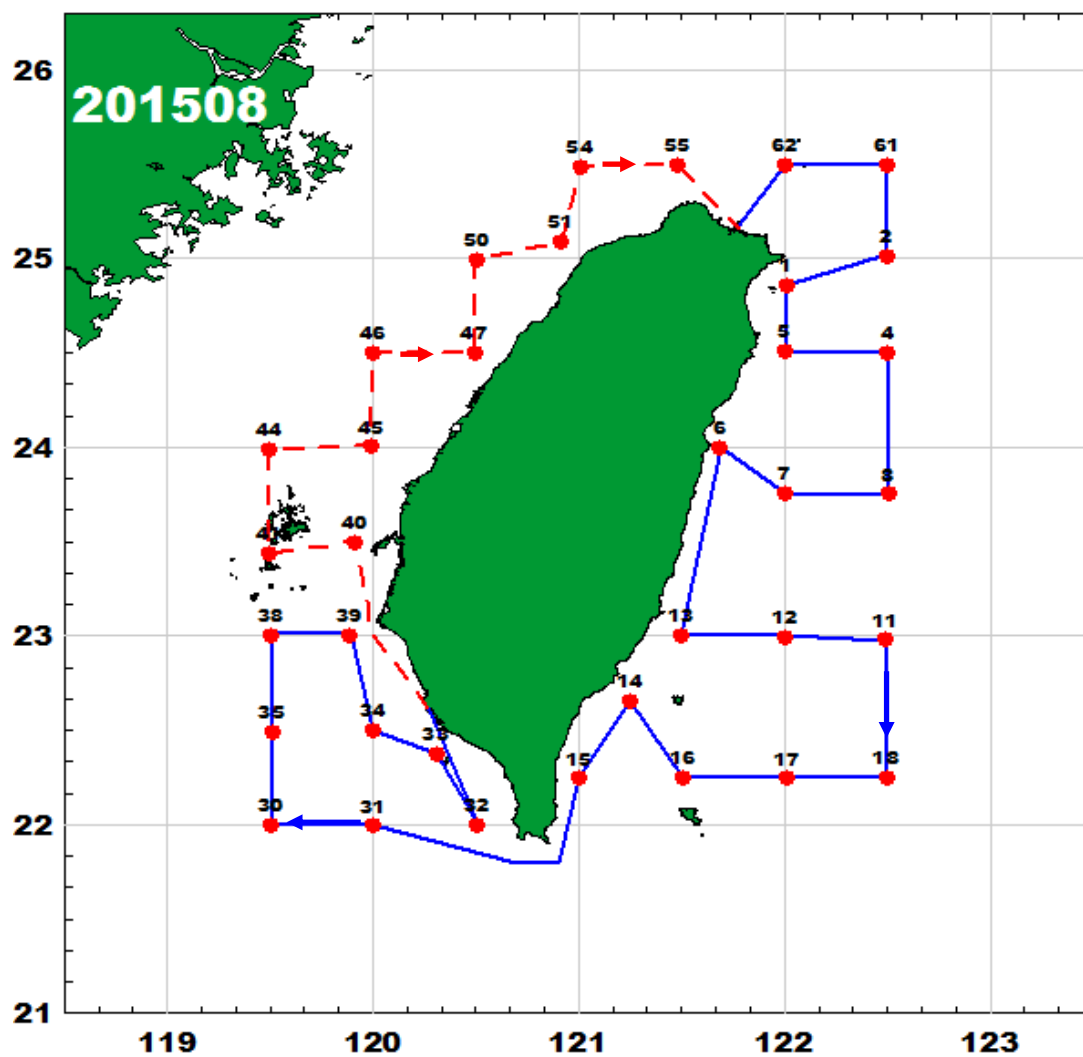


圖 02. 2015-08 航次航跡圖

Fig. 02. Stations and Cruise tracks for TaiCOFI Survey in Aug. 2015.

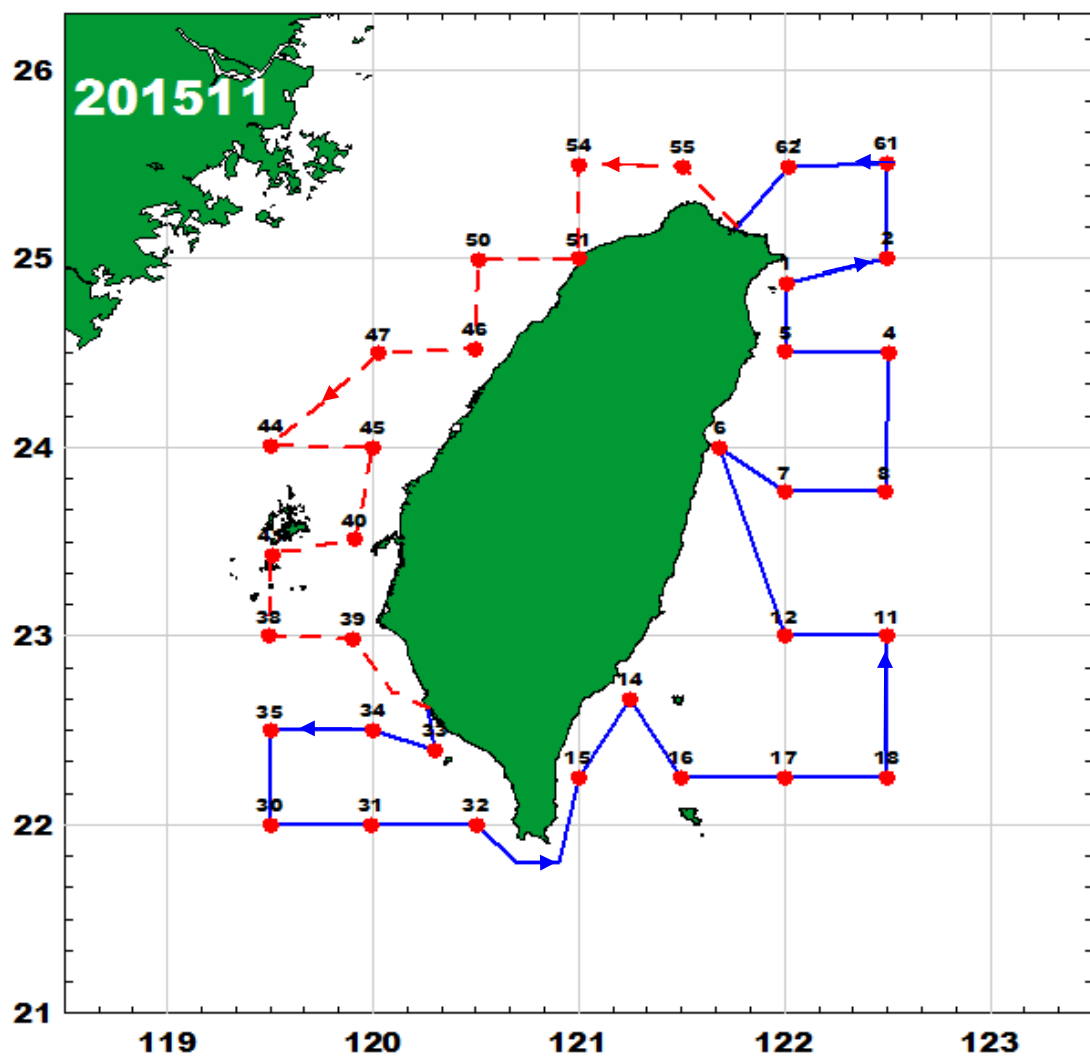


圖 03. 2015-11 航次航跡圖

Fig. 03. Stations and Cruise tracks for TaiCOFI Survey in Nov. 2015.

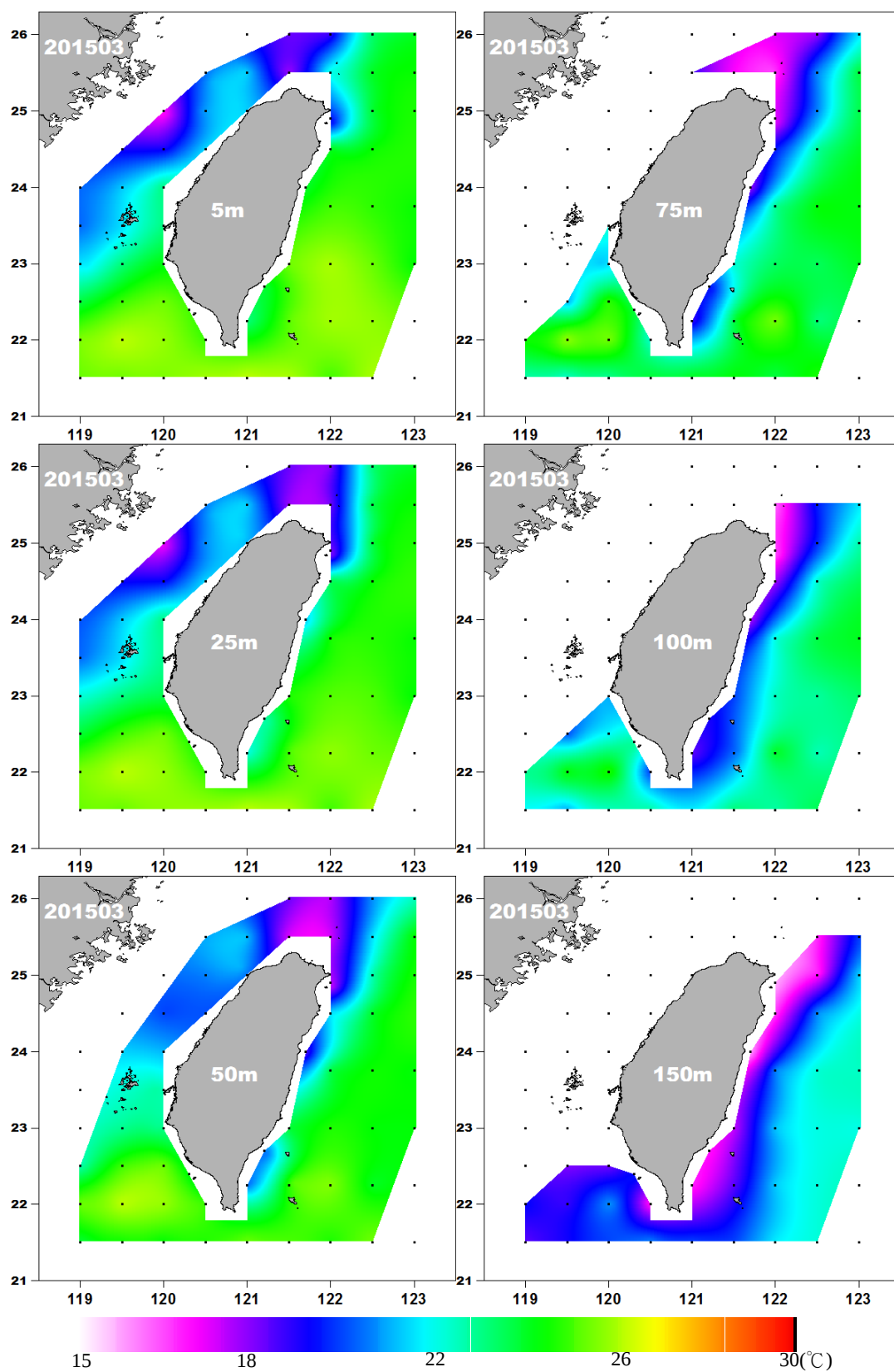


圖 04. 2015-03 航次水溫分布

Fig. 04. Temperature distribution in Mar. 2015.

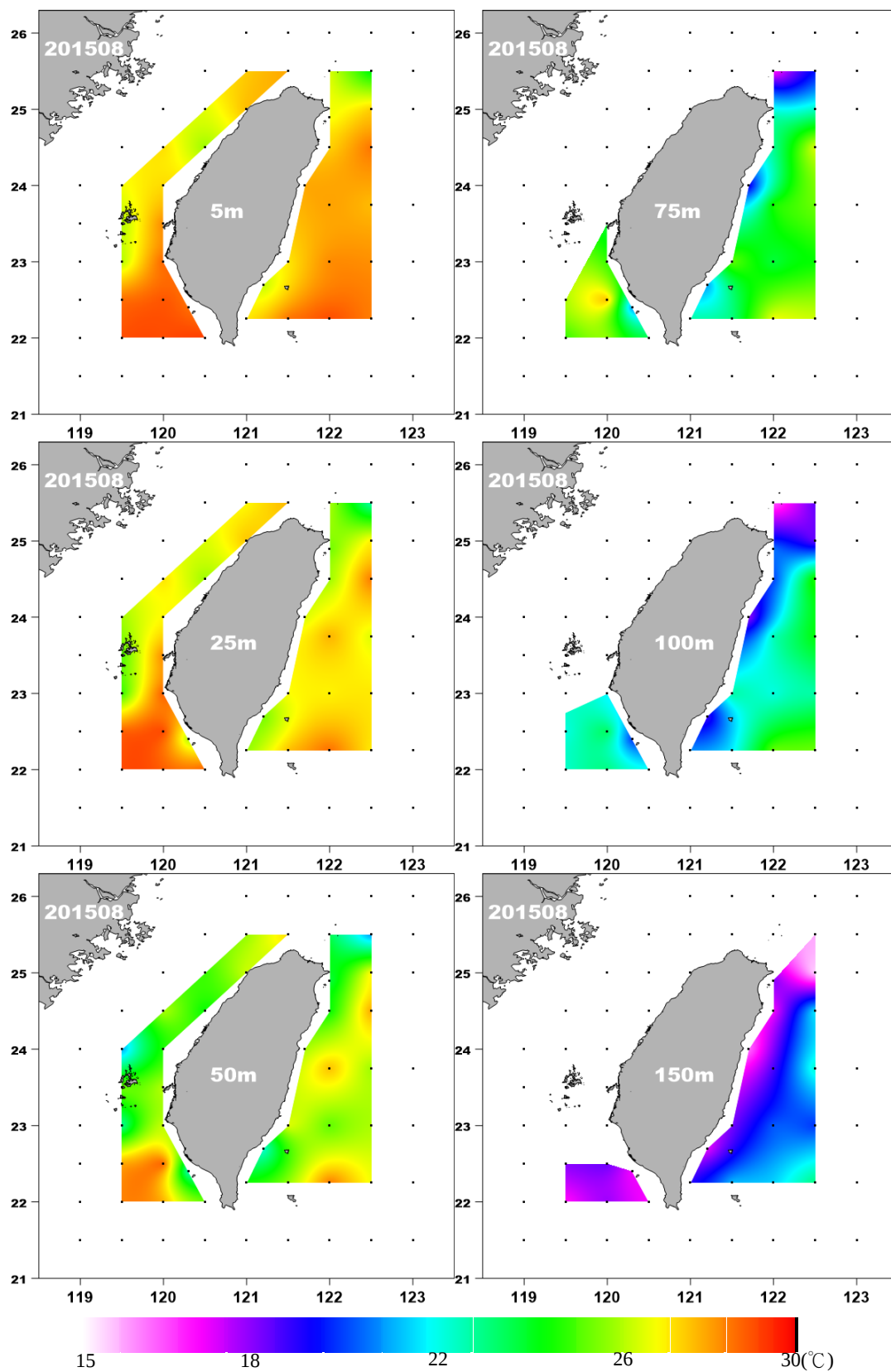


圖 05. 2015-08 航次水溫分布
Fig.05. Temperature distribution in Aug. 2015.

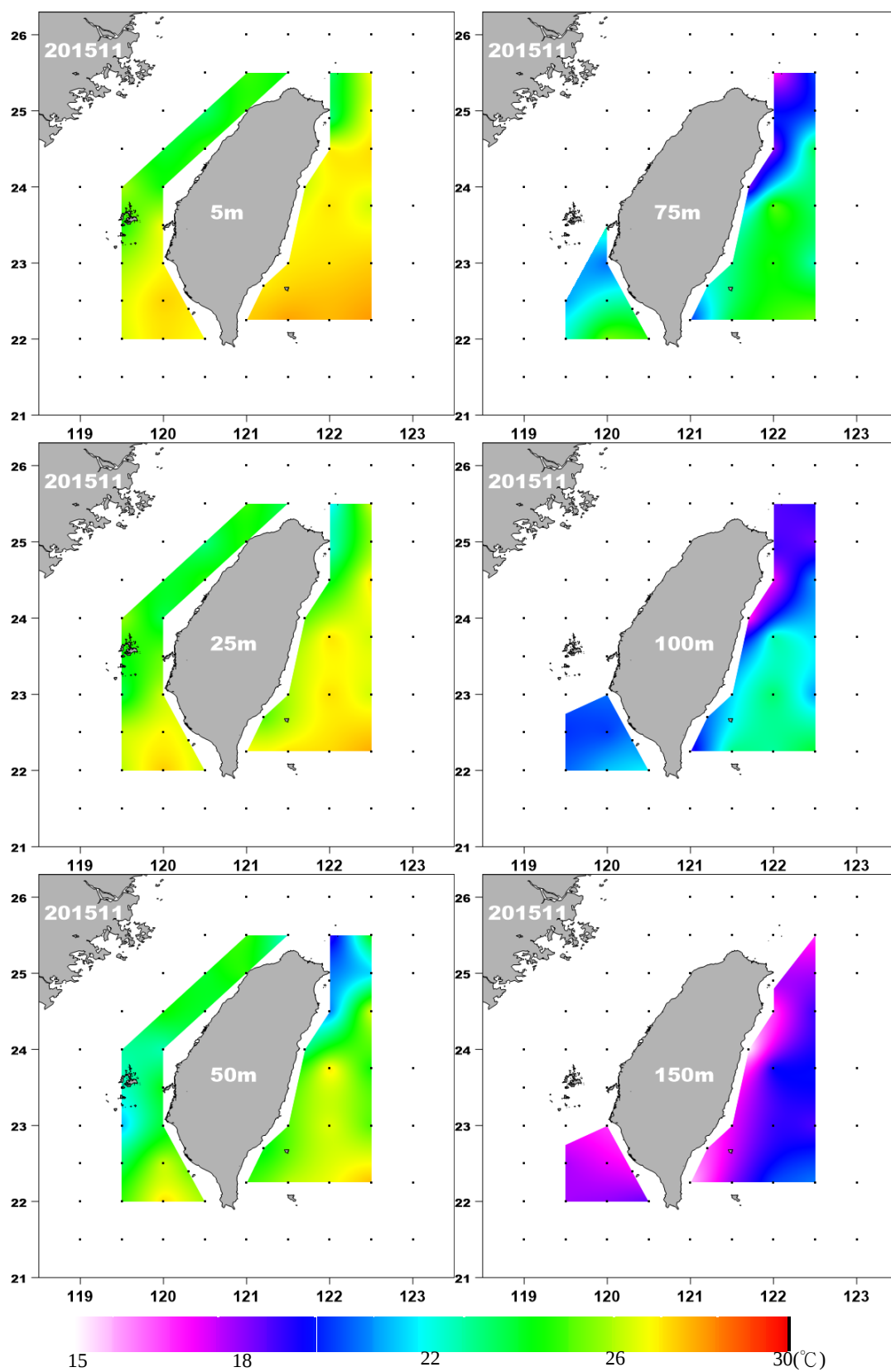


圖 06. 2015-11 航次水溫分布
Fig. 06. Temperature distribution in Nov. 2015.

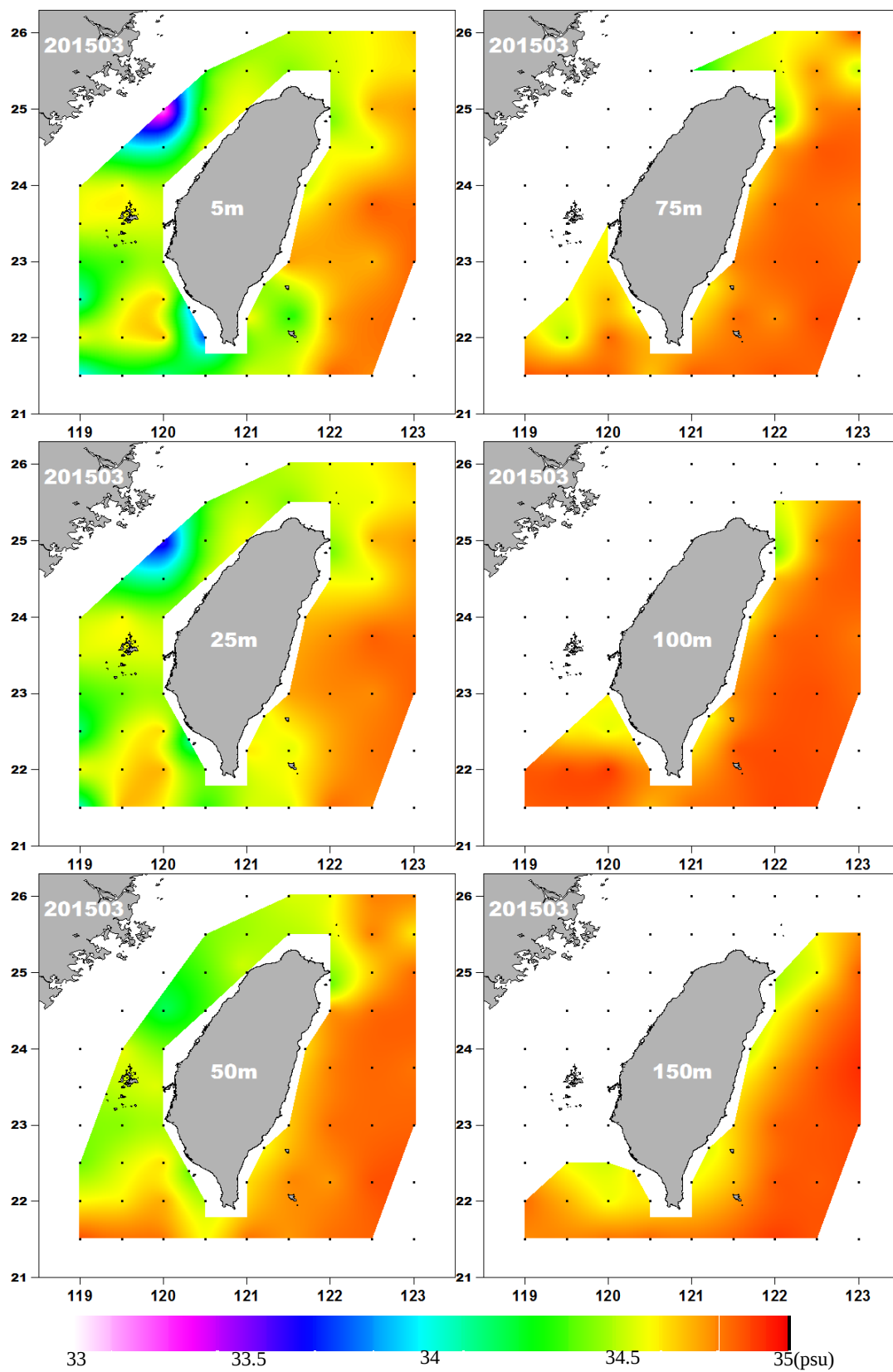


圖 07. 2015-03 航次鹽度分布
Fig. 07. Salinity distribution in Mar. 2015.

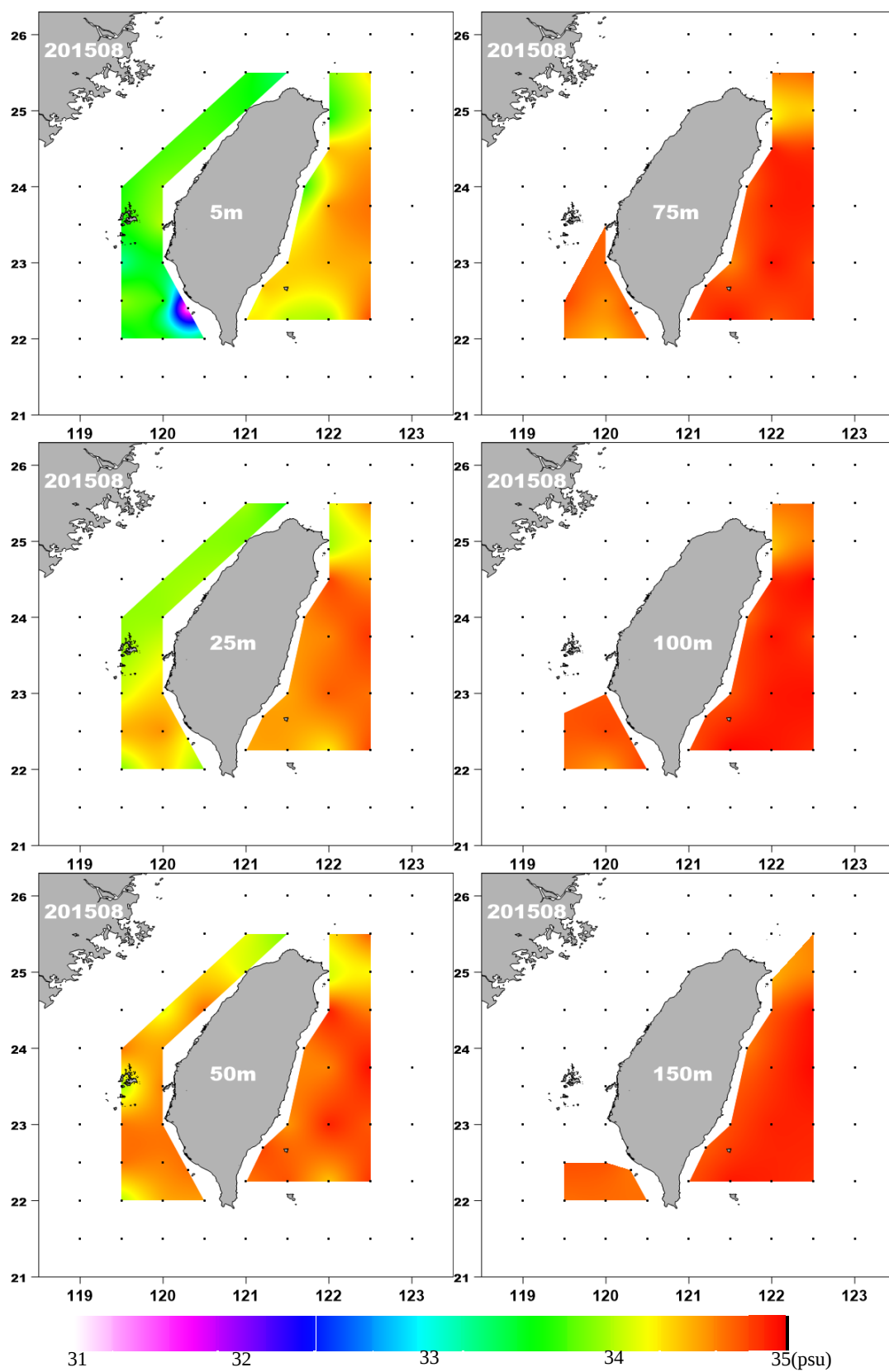


圖 08. 2015-08 航次鹽度分布
Fig. 08. Salinity distribution in Aug. 2015.

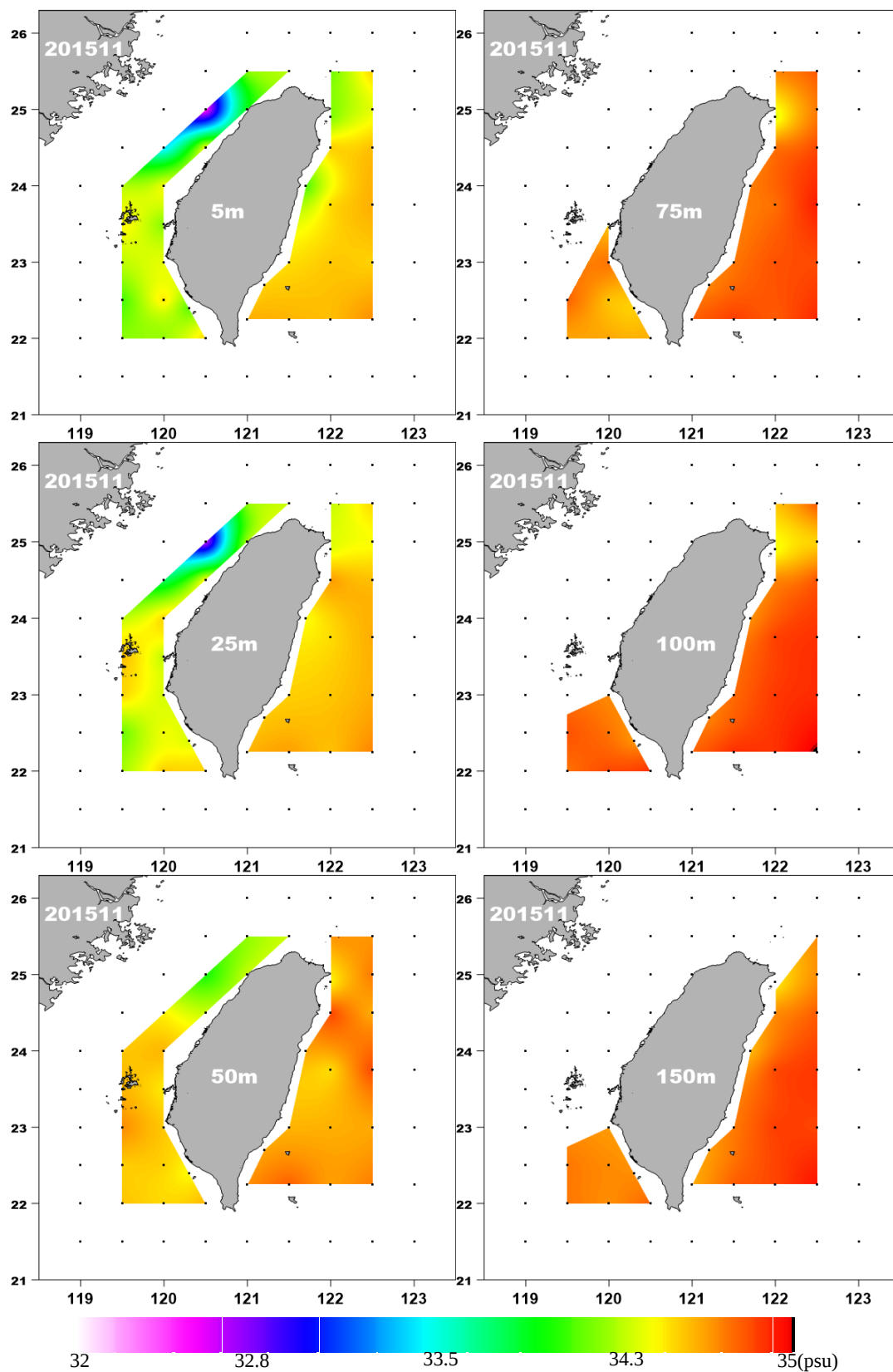


圖 09. 2015-11 航次鹽度分布
Fig. 09. Salinity distribution in Nov. 2015.

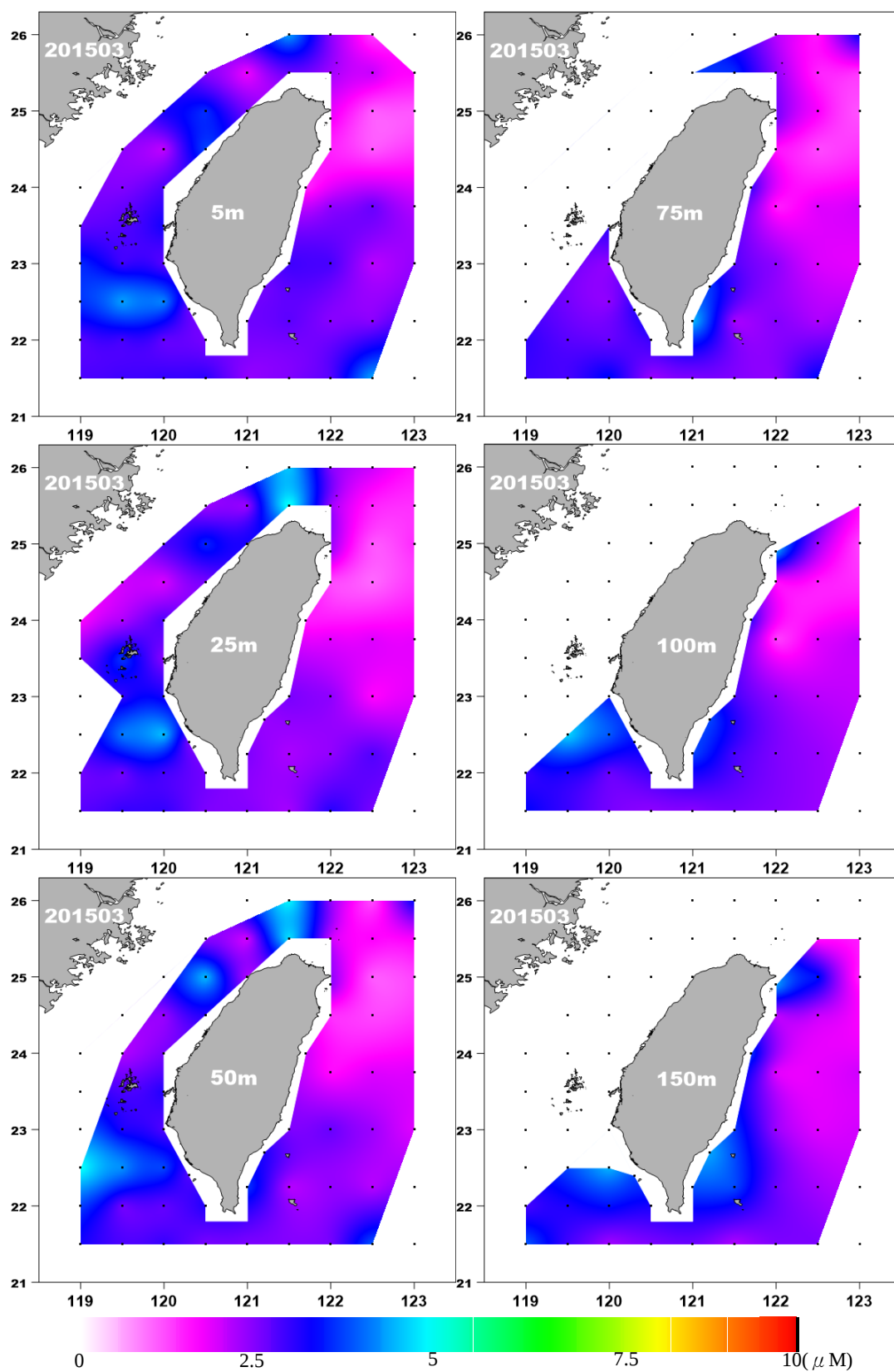


圖 10. 2015-03 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 10. Nitrate (NO_3^-) distribution in Mar. 2015.

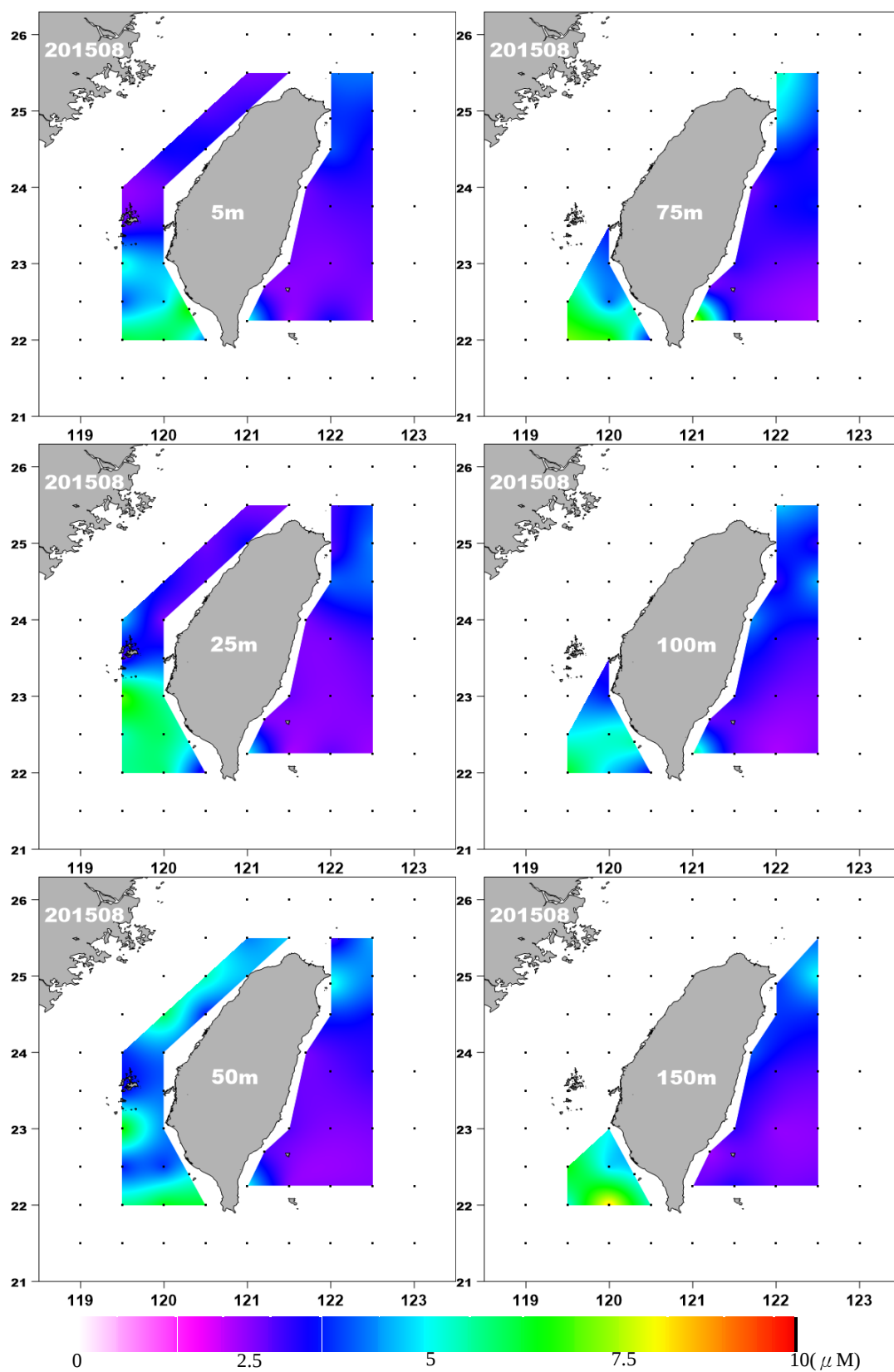


圖 11. 2015-08 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 11. Nitrate (NO_3^-) distribution in Aug. 2015.

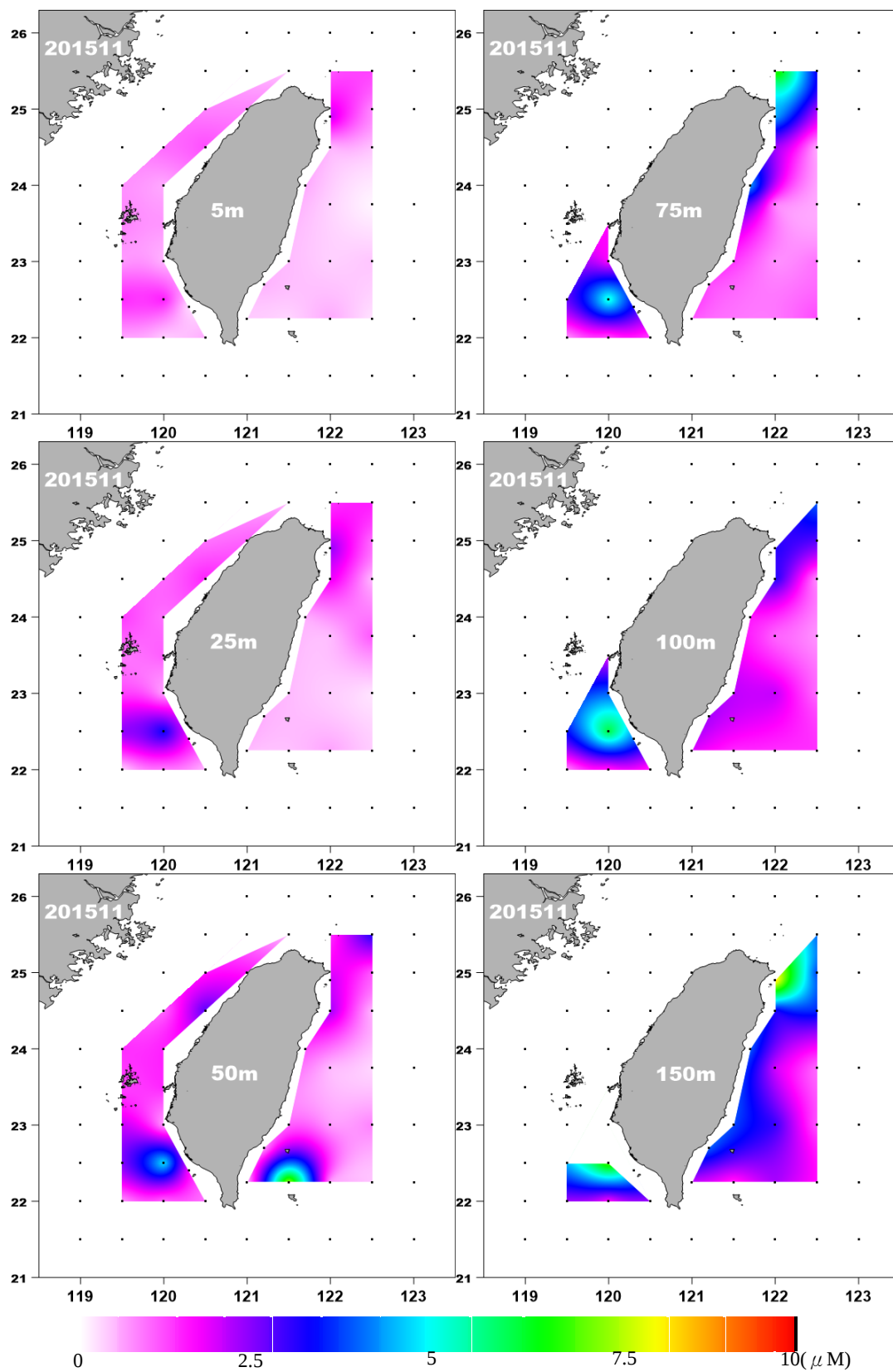


圖 12. 2015-11 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 12. Nitrate (NO_3^-) distribution in Nov. 2015.

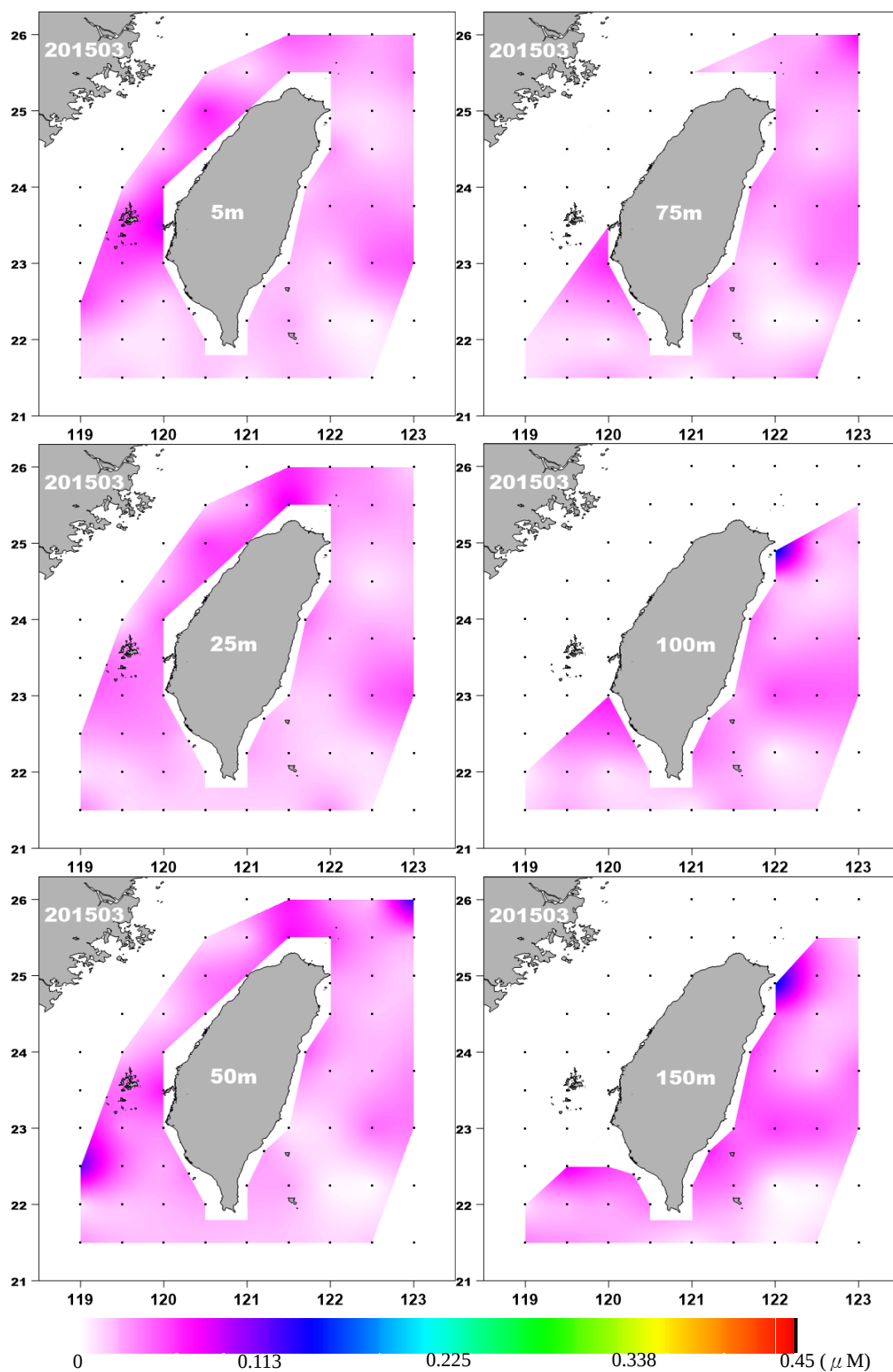


圖 13. 2015-03 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 13. Phosphate (PO_4^{3-}) distribution in Mar. 2015.

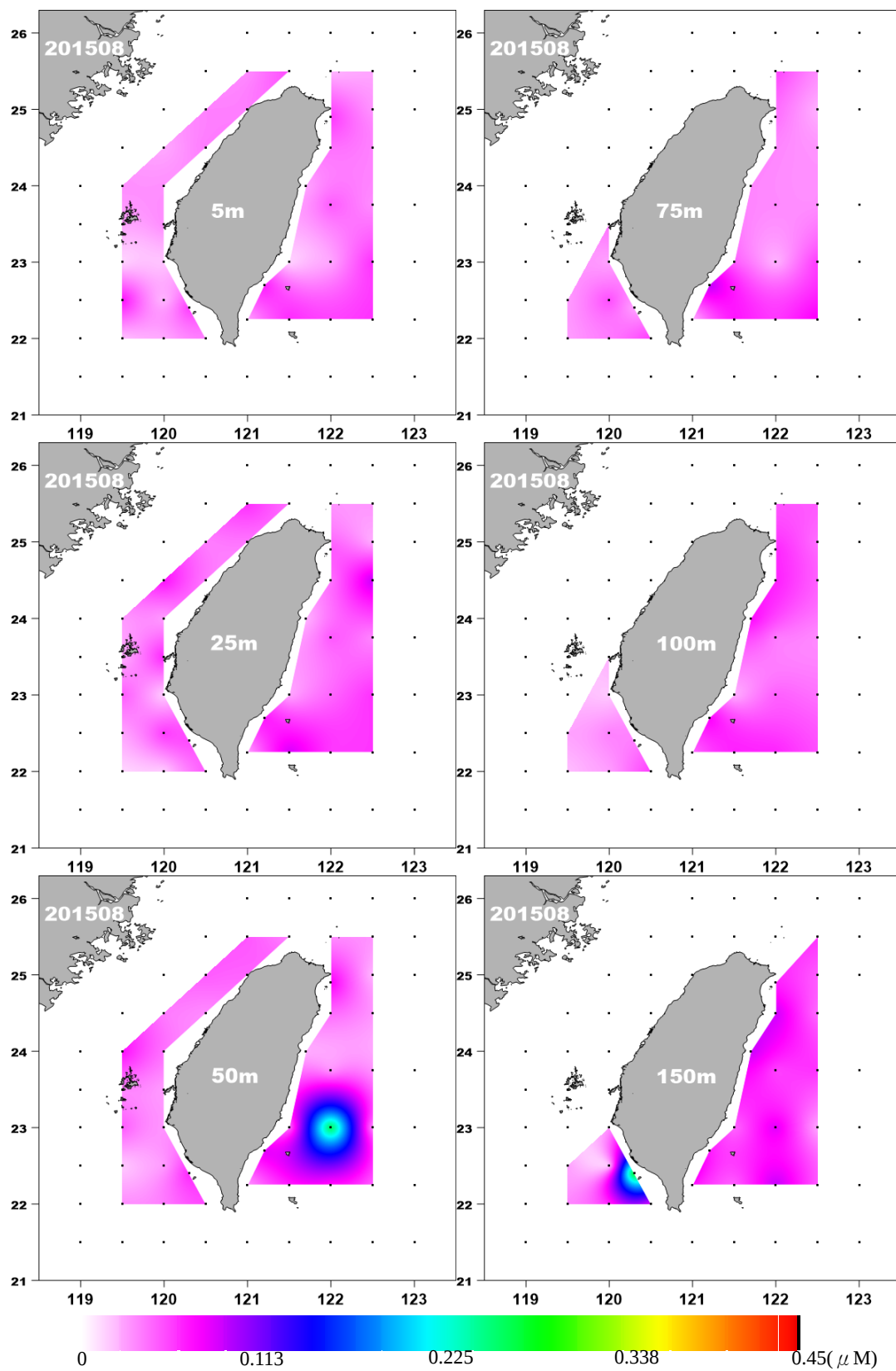


圖 14. 2015-08 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 14. Phosphate (PO_4^{3-}) distribution in Aug. 2015.

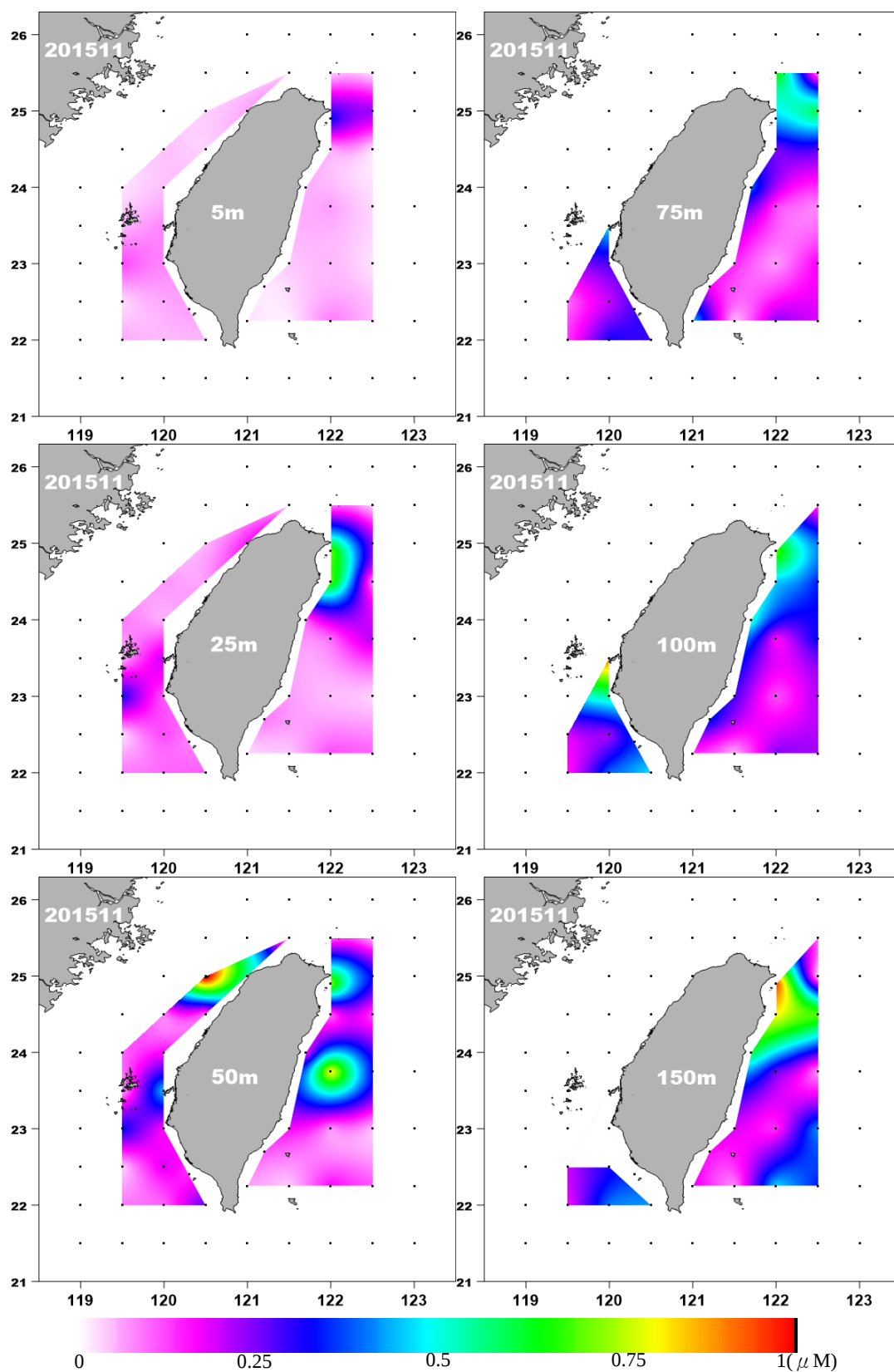


圖 15. 2015-11 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 15. Phosphate (PO_4^{3-}) distribution in Nov. 2015.

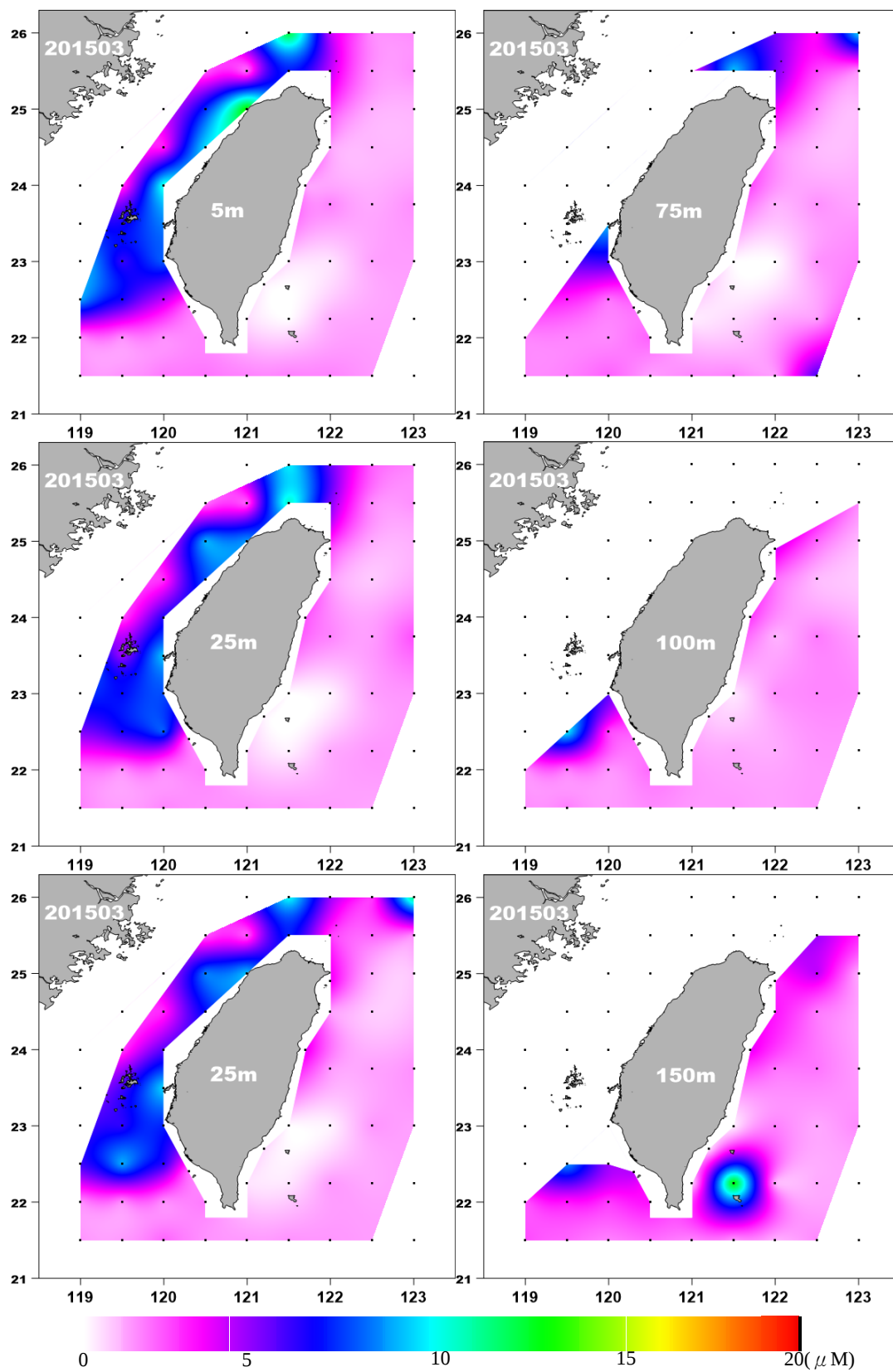


圖 16. 2015-03 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 16. Silicate (SiO_2^{2-}) distribution in Mar. 2015.

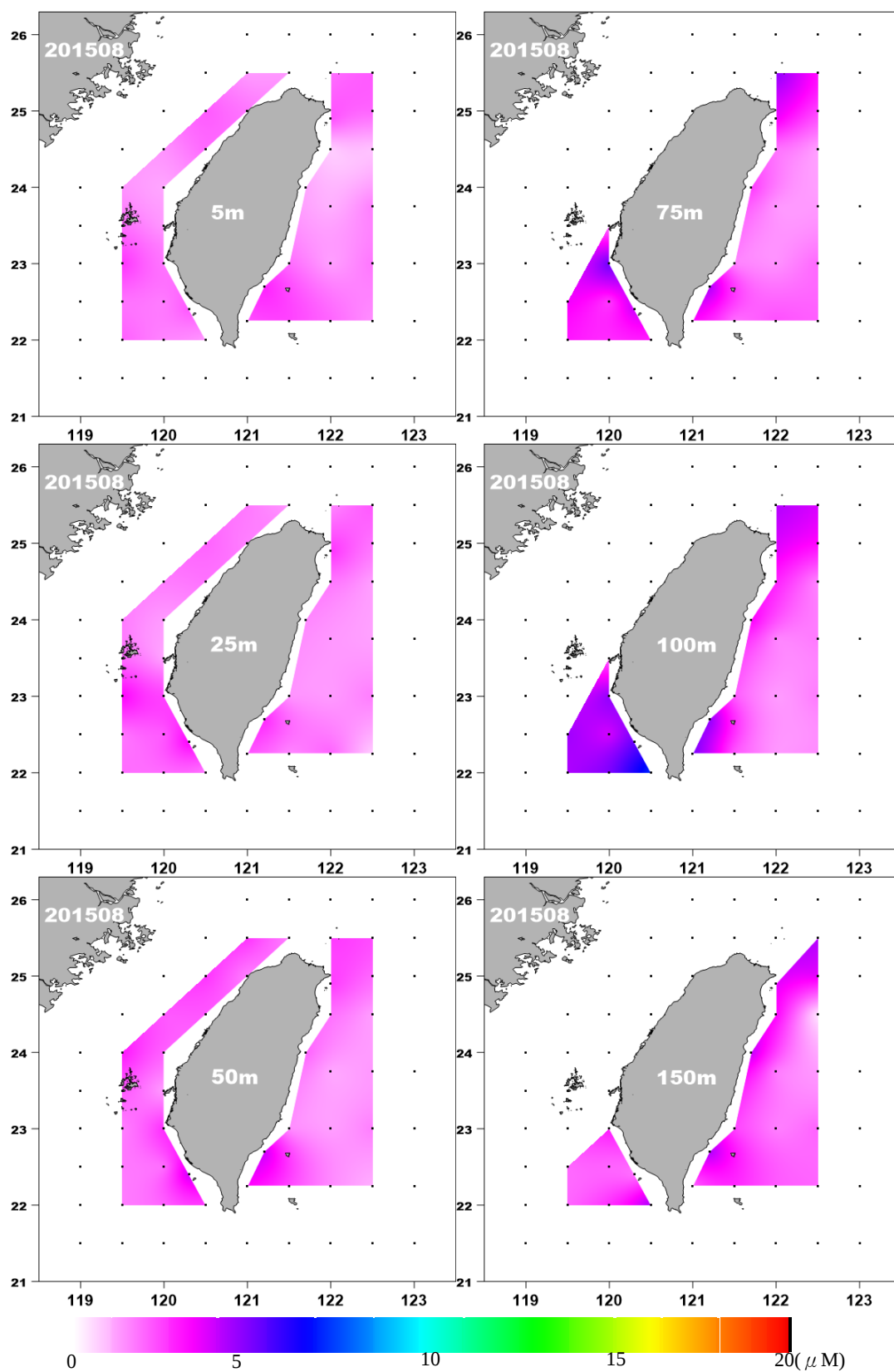


圖 17. 2015-08 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 17. Silicate (SiO_2^{2-}) distribution in Aug. 2015.

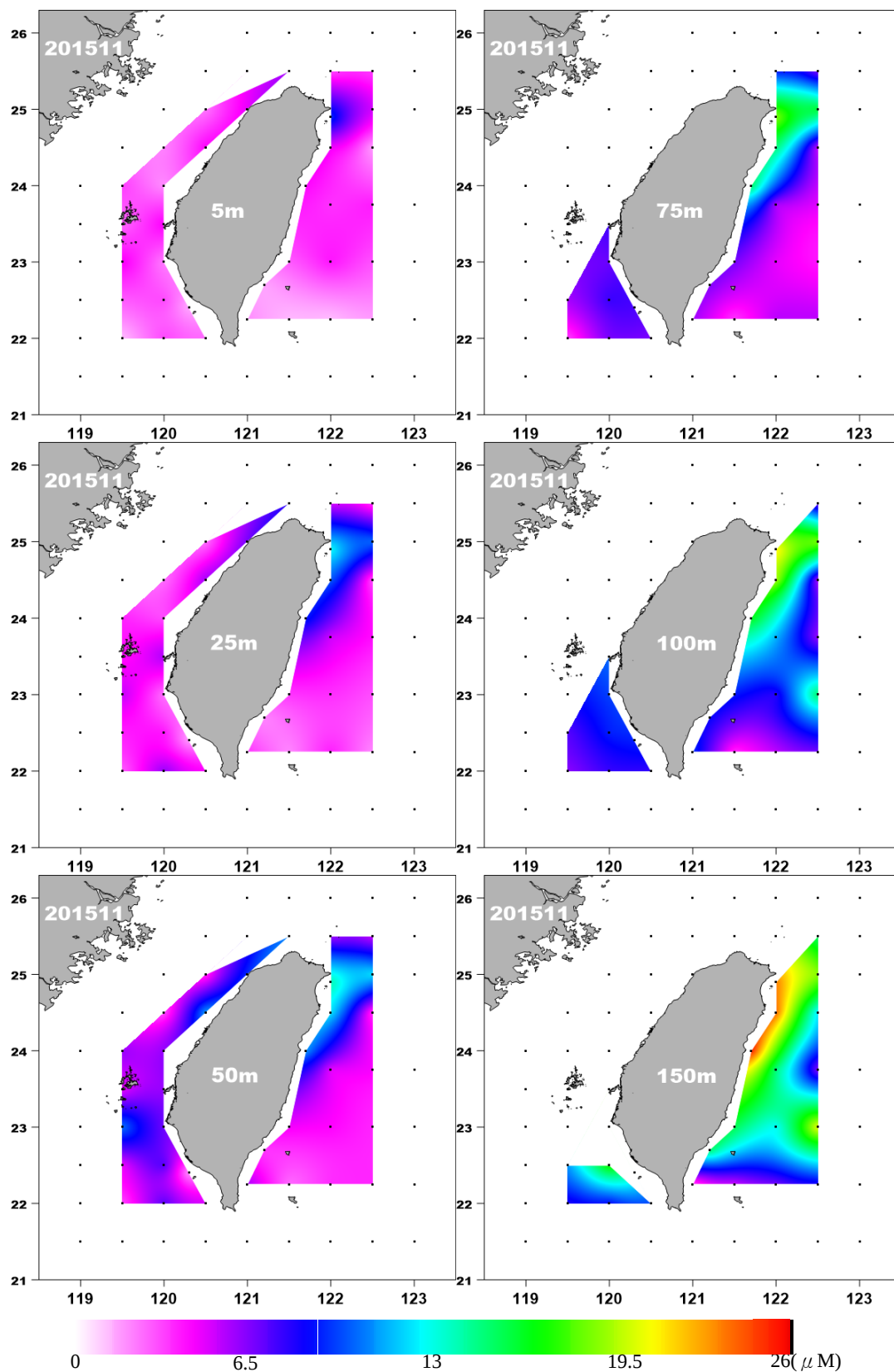


圖 18. 2015-11 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 18. Silicate (SiO_2^{2-}) distribution in Nov. 2015.

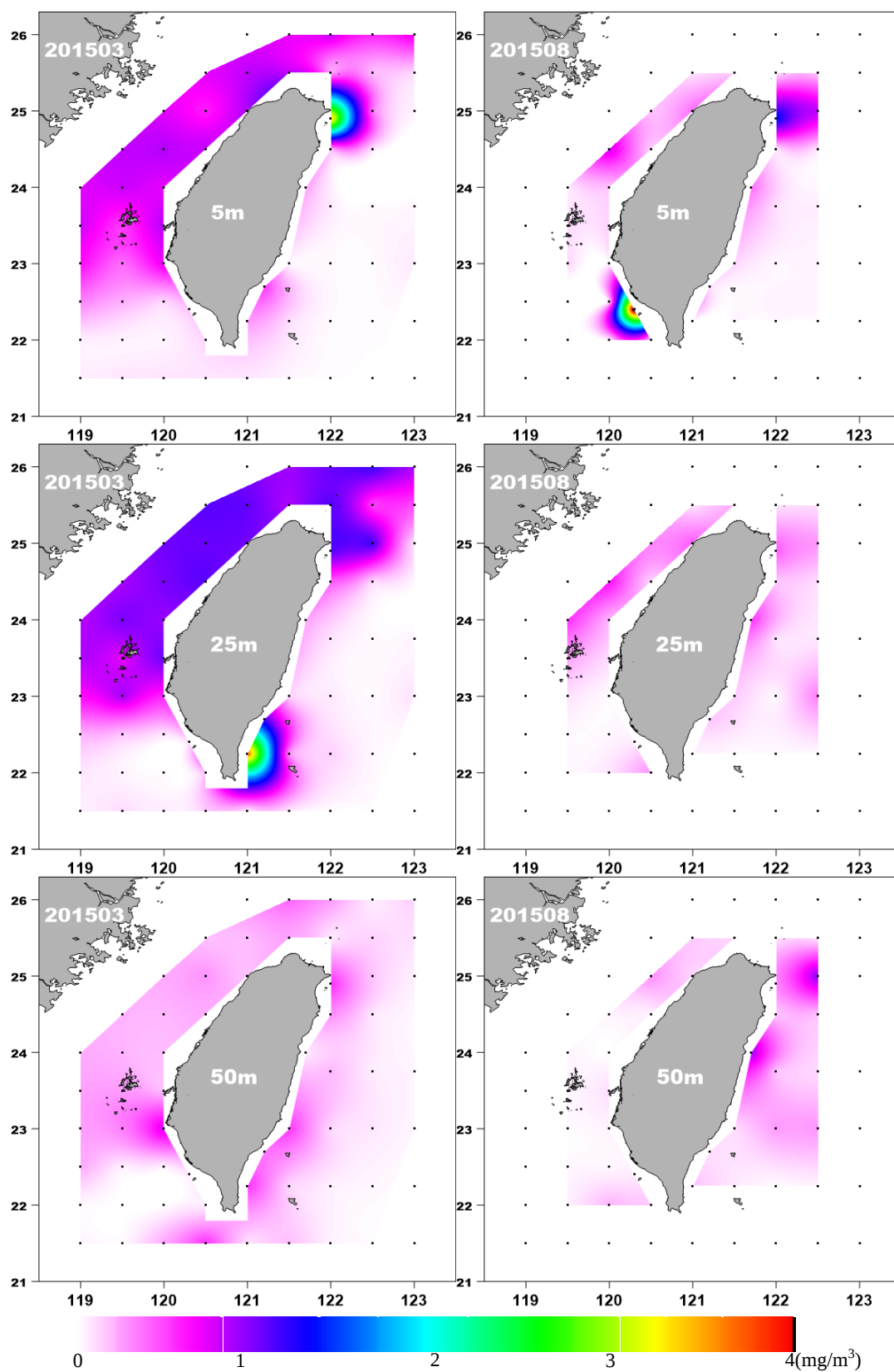


圖 19. 2015 年 3 月及 8 月葉綠素甲(chl-*a*)分布
 Fig. 19. Chlorophyll-*a* (chl-*a*) distribution in Mar. and Aug. 2015.

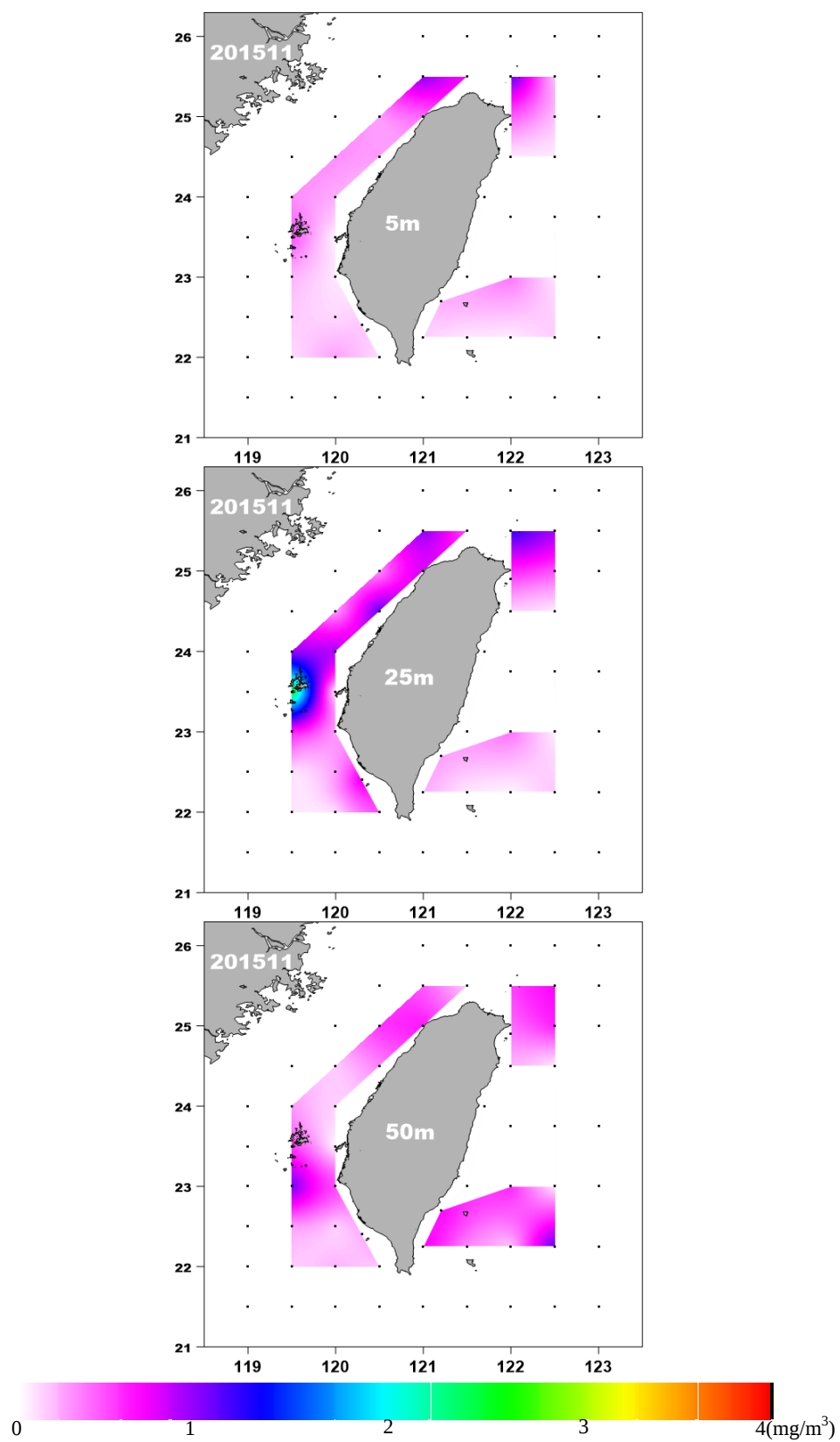


圖 20. 2015 年 11 月葉綠素甲(chl-a)分布
 Fig. 20. Chlorophyll-a (chl-a) distribution in Nov. 2015.

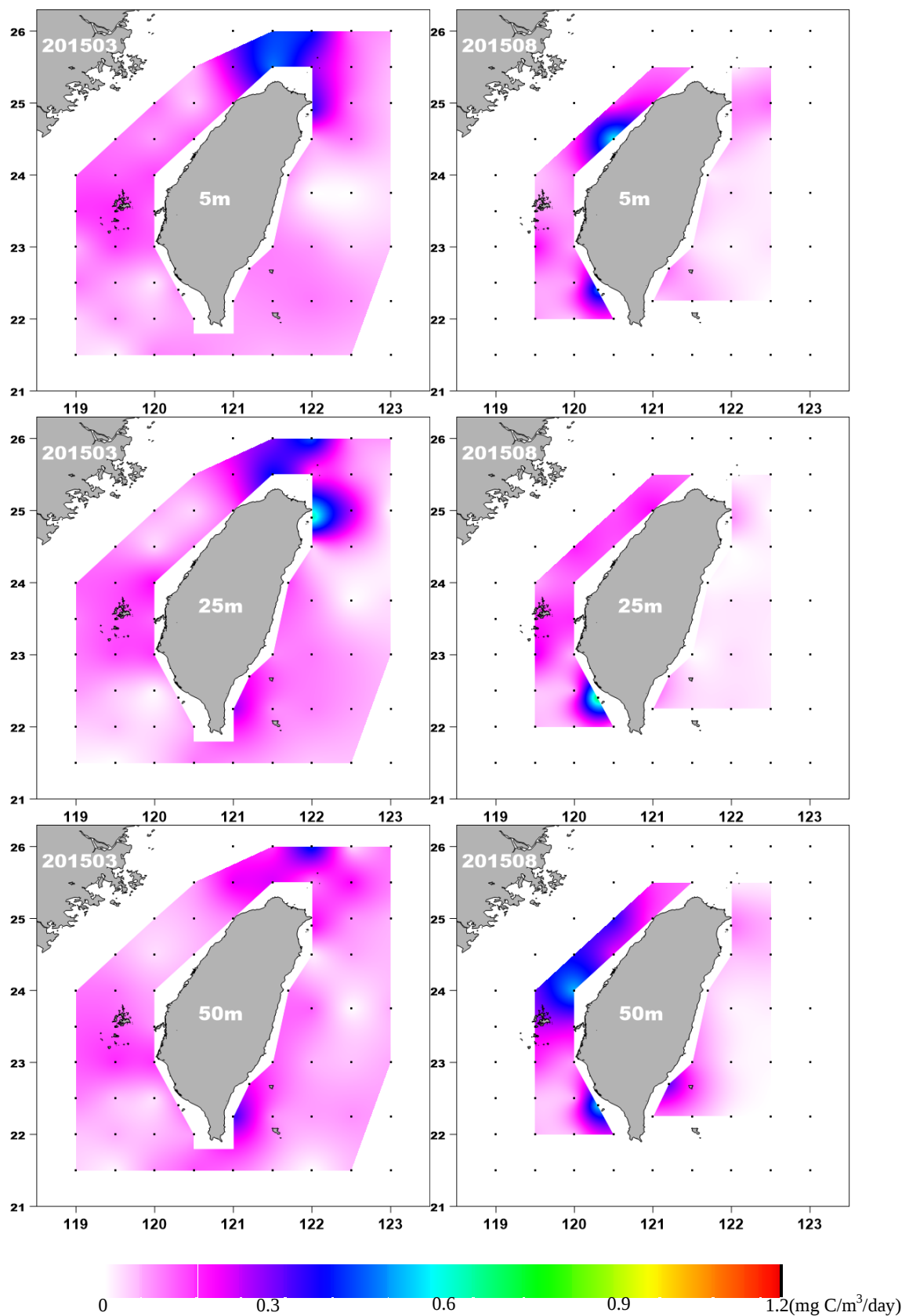


圖 21. 2015 年 3 月及 8 月基礎生產力分布
 Fig. 21. Primary production distribution in Mar. and Aug. 2015.

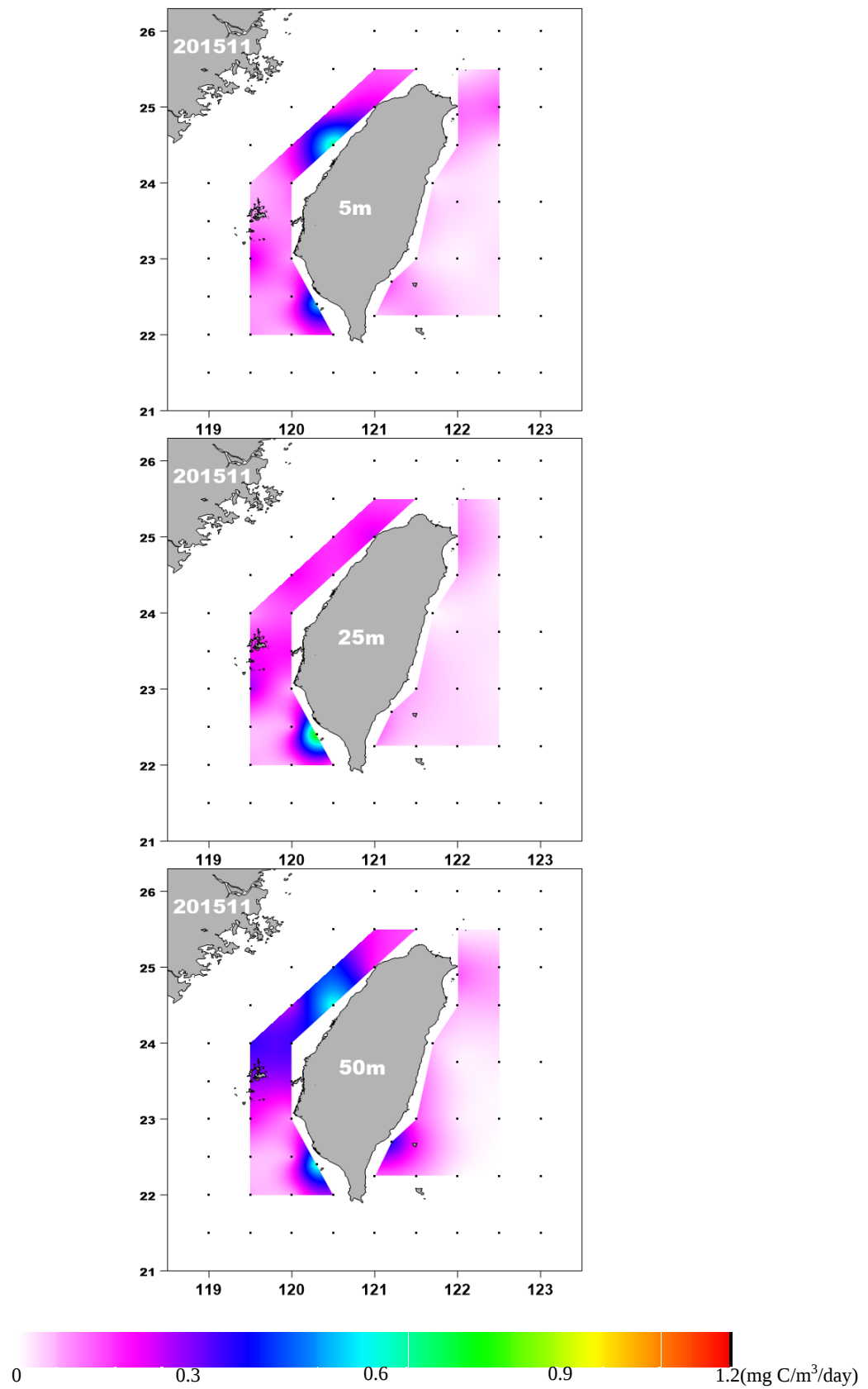


圖 22. 2015 年 11 月基礎生產力分布
 Fig. 22. Primary production distribution in Nov. 2015.

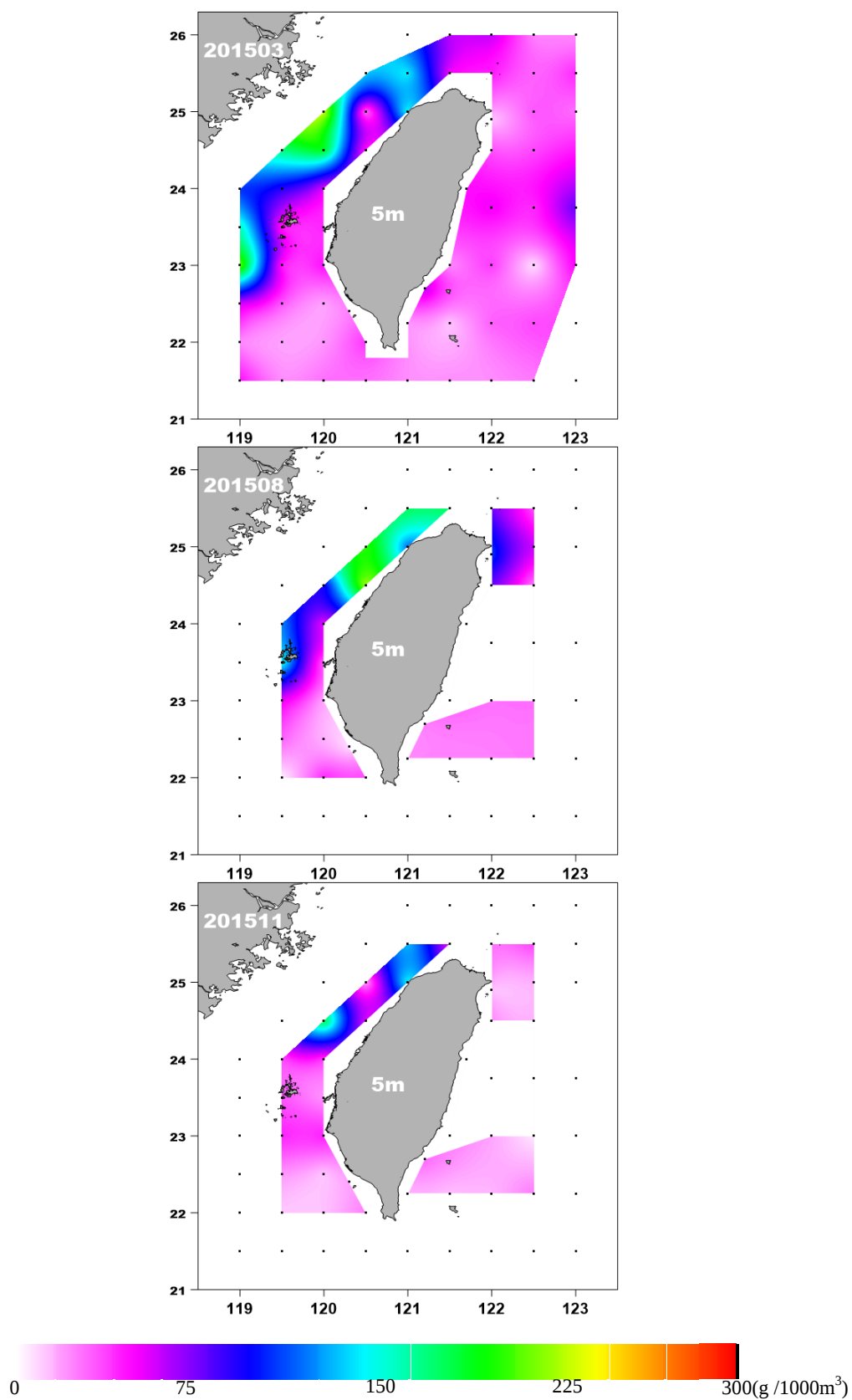


圖 23. 2015 年 3 月、8 月及 11 月浮游動物生物量分布
 Fig. 23. Biomass of zooplankton sample in 2015.

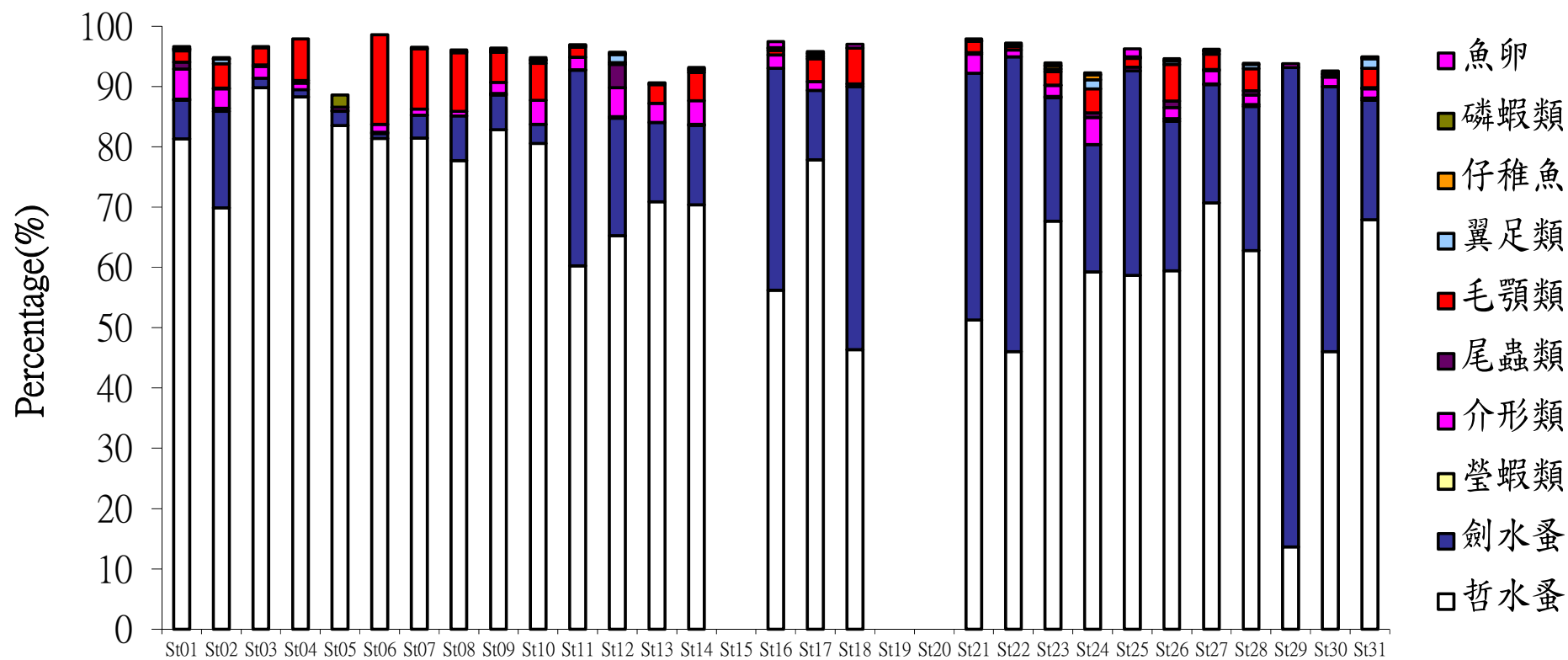


圖 24. 2015-03 航次浮游動物優勢大類出現百分率

Fig. 24. Percentage of the composition of zooplankton in Mar. 2015.

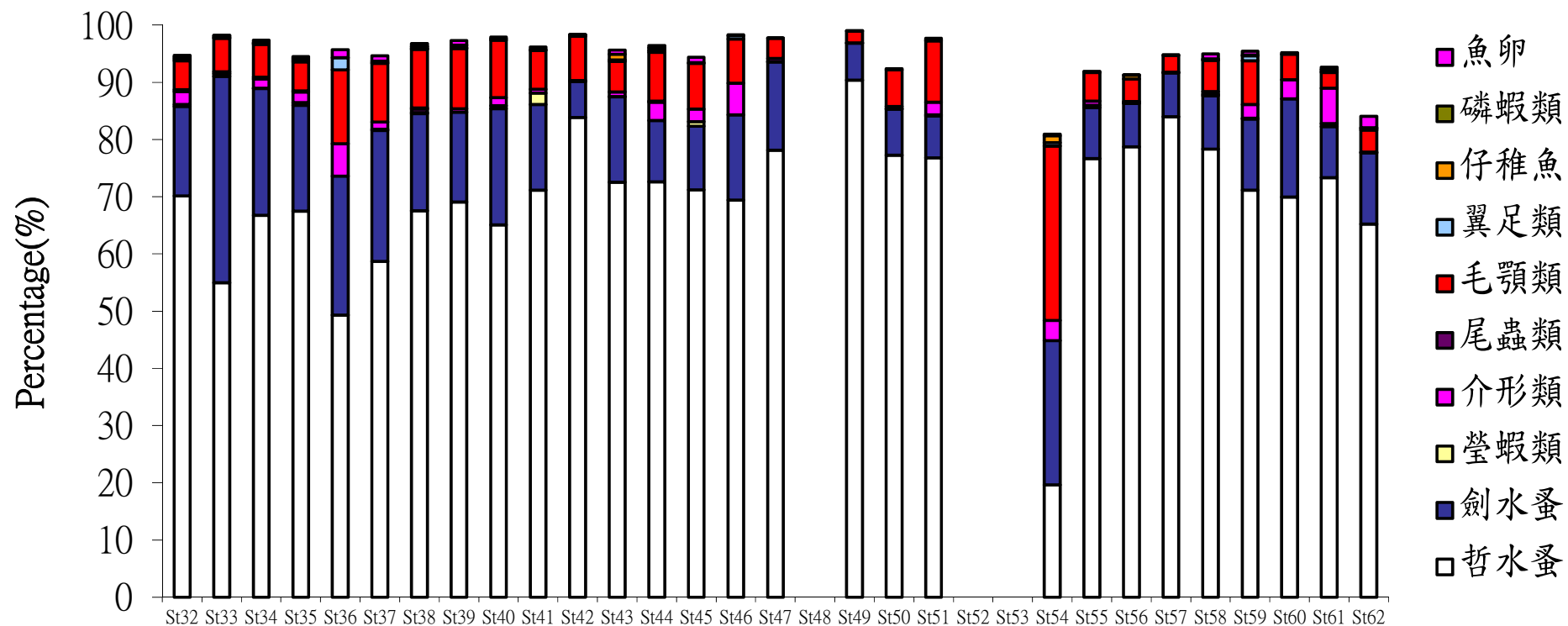


圖 25. 2015-03 航次浮游動物優勢大類出現百分率(續)

Fig. 25. Percentage of the composition of zooplankton in Mar. 2015.

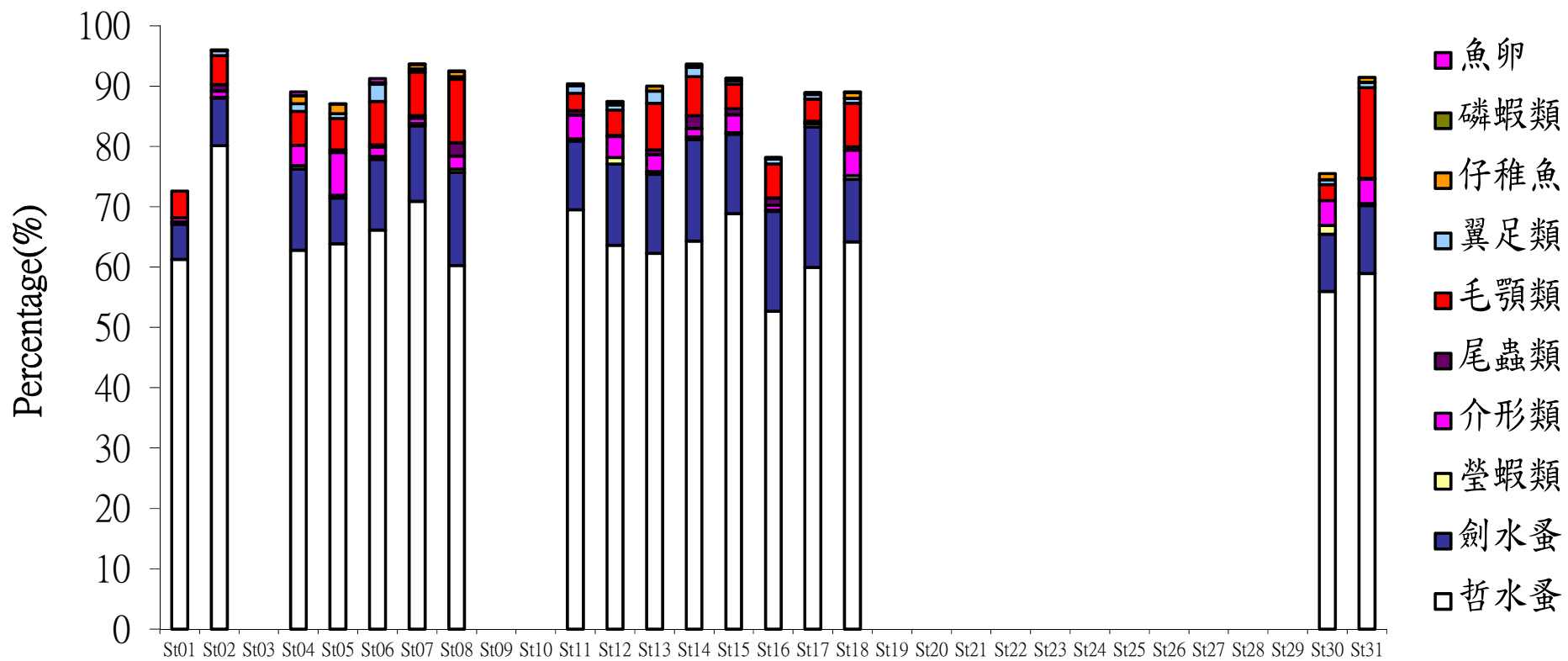


圖 26. 2015-08 航次浮游動物優勢大類出現百分率

Fig. 26. Percentage of the composition of zooplankton in Aug. 2015.

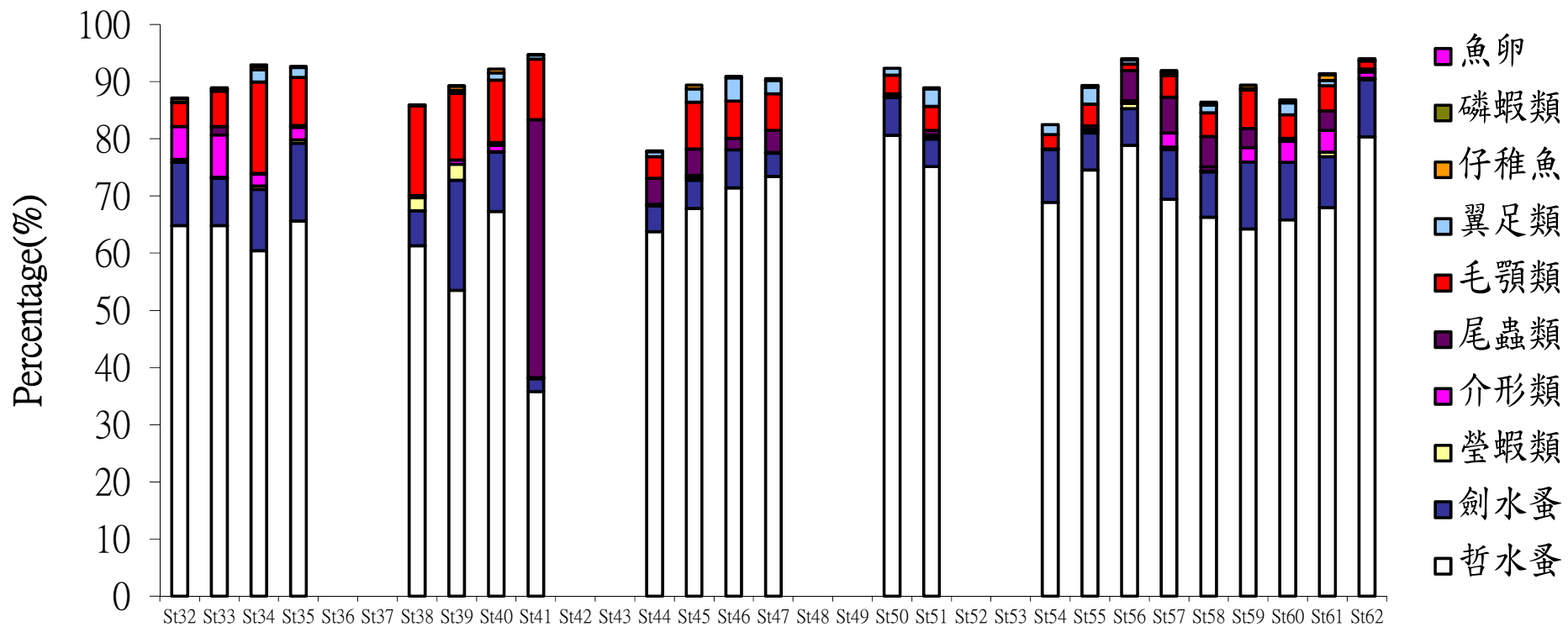


圖 27. 2015-08 航次浮游動物優勢大類出現百分率(續)

Fig. 27. Percentage of the composition of zooplankton in Aug. 2015.

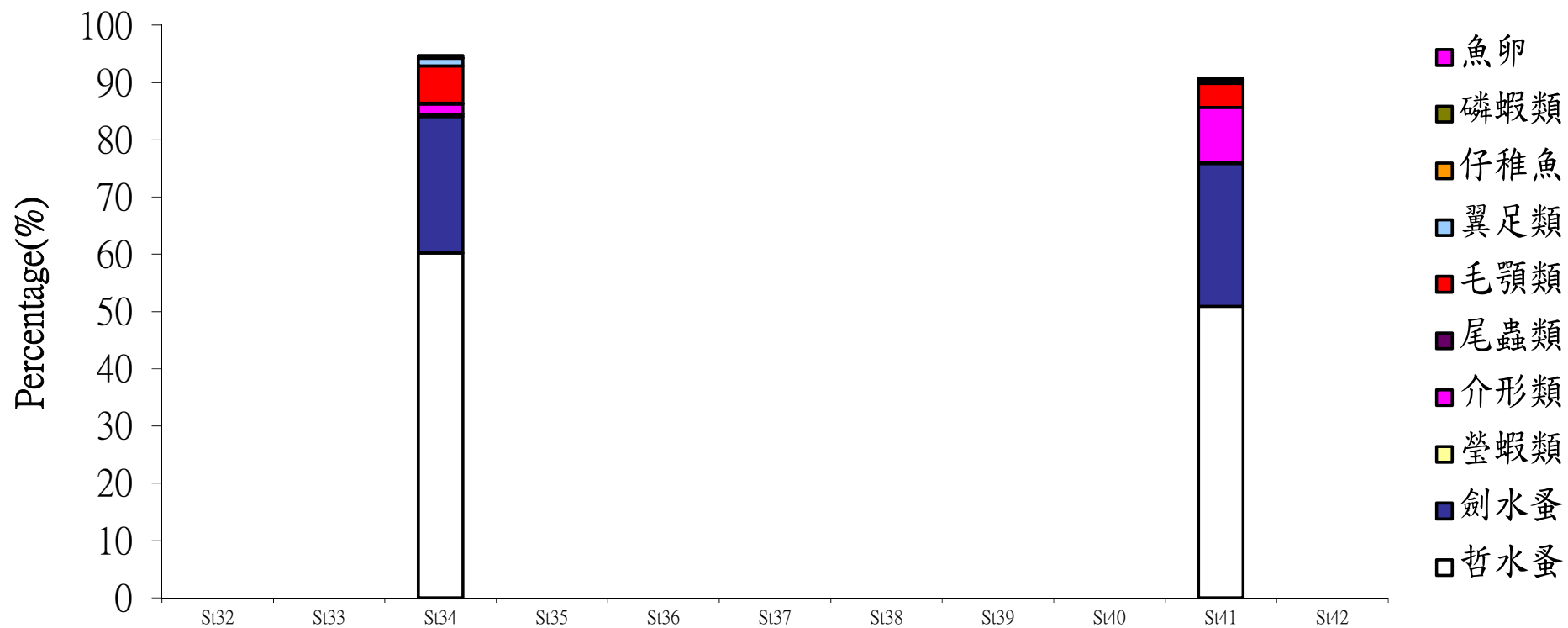


圖 28. 2015-11 航次浮游動物優勢大類出現百分率

Fig. 28. Percentage of the composition of zooplankton in Nov. 2015.

表 01. 2015 年 3 月航次基礎觀測資料
Chart 01. Basic observation data in Mar. 2015

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20150318	1327	24.85	122.02	362	22.7	22.8	1007.93	005	10.0	200	1616	969.6
St.02	20150318	1736	25.03	122.53	1410	24.7	23.7	1007.93	-	-	200	727	436.2
St.03	20150318	2125	25.01	123.03	1595	25.4	24.1	1010.60	055	8.1	200	934	560.4
St.04	20150319	0615	24.51	122.52	567	25.8	24.4	1011.85	055	4.5	200	555	333.0
St.05	20150319	1037	24.50	122.01	947	26.2	24.4	1012.20	005	7.6	200	614	368.4
St.06	20150319	1521	23.99	121.68	172	26.4	24.5	1014.2	005	5.2	200	487	292.2
St.07	20150319	1827	23.76	122.01	3158	26.3	24.3	1011.85	005	4.0	200	840	504.0
St.08	20150319	2204	23.75	122.52	2979	26.0	23.6	1013.27	172	2.4	200	948	568.8
St.09	20150320	0125	23.75	123.02	3158	26.0	23.1	1012.92	087	0.0	200	793	475.8
St.10	20150320	0801	22.99	123.00	4107	25.7	23.3	1015.40	108	3.7	200	903	541.8
St.11	20150320	1135	23.01	122.52	5546	26.8	23.9	1015.05	089	4.3	200	923	553.8
St.12	20150320	1531	23.00	121.99	4117	27.3	24.7	1012.20	132	3.7	200	589	353.4
St.13	20150320	1856	23.00	121.50	1868	26.9	24.0	1013.63	206	3.3	200	812	487.2
St.14	20150320	2201	22.67	121.25	1035	26.2	23.7	1014.87	347	0.0	200	486	291.6
St.15	20150321	0141	22.26	121.00	1204	25.4	22.8	1013.27	330	3.4	200	645	387.0
St.16	20150321	0522	22.29	121.55	1118	26.1	23.5	1014.52	052	5.5	200	1154	692.4
St.17	20150321	0836	22.27	122.01	4557	26.7	24.2	1016.65	069	4.1	200	598	358.8
St.18	20150321	1220	22.25	122.51	4836	27.2	24.3	1014.70	097	3.1	200	632	379.2
St.19	-	-	-	-	-	-	-	-	-	-	-	-	-
St.20	-	-	-	-	-	-	-	-	-	-	-	-	-
St.21	20150321	1756	21.54	122.51	4791	27.1	24.6	1013.27	083	3.7	200	638	382.8
St.22	20150321	2129	21.51	122.00	3223	26.6	24.2	1015.05	048	4.3	200	898	538.8
St.23	20150322	0108	21.51	121.51	2081	26.9	24.1	1013.98	064	7.4	200	784	470.4
St.24	20150322	0505	21.51	121.01	1120	27.1	24.3	1013.45	067	7.3	200	920	552.0
St.25	20150322	0838	21.51	120.50	1638	26.9	23.2	1014.87	046	12.0	200	506	303.6
St.26	20150322	1142	21.51	119.98	2957	27.0	24.8	1014.87	062	6.8	200	797	478.2
St.27	20150322	1438	21.51	119.49	2949	6.9	24.1	1012.92	027	5.7	200	987	592.2
St.28	20150322	1748	21.51	119.00	2764	26.7	23.8	1013.45	028	10.0	200	988	592.8
St.29	20150322	2155	22.01	118.99	1321	26.4	22.9	1015.59	019	11.5	200	977	586.2
St.30	20150323	0202	22.01	119.49	2355	26.9	23.9	1014.34	013	4.8	200	643	385.8
St.31	20150323	0551	22.01	120.02	1201	26.8	24.3	1013.63	101	13.4	200	793	475.8
St.32	20150323	0940	22.01	120.50	371	26.8	23.8	1014.70	314	9.2	200	876	525.6
St.33	20150323	1246	22.37	120.33	371	26.8	23.8	1014.70	314	9.2	130	568	340.8
St.34	20150325	1336	22.51	120.00	688	25.3	21.2	1019.68	355	12.1	200	756	453.6
St.35	20150325	1821	22.49	119.51	239	24.7	20.2	1020.39	022	15.0	200	928	556.8
St.36	20150325	2147	22.51	118.99	82	24.1	19.8	1021.99	030	14.7	75	523	313.8
St.37	20150326	0123	22.94	119.10	25	-	-	-	023	14.3	15	91	54.6
St.38	20150326	0421	23.00	119.50	70	-	-	-	019	16.4	70	342	205.2
St.39	20150326	0723	23.01	119.92	124	24.3	19.7	1021.46	031	11.7	120	593	355.8
St.40	20150326	1100	23.51	119.92	114	24.3	20.7	1022.53	010	11.9	109	434	260.4
St.41	20150326	1349	23.46	119.50	60	23.1	17.9	1020.21	018	11.7	50	307	184.2
St.42	20150326	1653	23.50	119.00	53	21.6	17.5	1020.93	023	10.6	45	230	138.0
St.43	20150326	2100	24.01	119.00	56	21.0	15.9	1023.24	021	10.2	53	263	157.8
St.44	20150327	0022	23.99	119.52	63	21.6	16.7	1021.46	016	8.3	55	214	128.4
St.45	20150327	0322	24.01	119.98	46	22.5	17.5	1019.32	010	7.5	40	196	117.6
St.46	20150327	0801	24.51	120.50	52	22.4	18.8	1021.64	006	6.4	47	310	186.0
St.47	20150327	1106	24.52	120.02	60	21.7	18.6	1021.46	027	7.4	54	377	226.2
St.48	-	-	-	-	-	-	-	-	-	-	-	-	-
St.49	20150327	1411	24.97	120.01	51	19.7	17.2	1019.15	034	6.5	45	225	135.0
St.50	20150327	1703	25.00	120.46	76	21.8	19.1	1017.90	058	9.0	65	409	245.4
St.51	20150327	1944	25.10	120.92	81	21.9	18.4	1019.68	060	9.8	73	313	187.8
St.52	20150327	2246	25.39	120.60	74	22.0	18.3	1020.39	054	8.7	68	397	238.2
St.53	-	-	-	-	-	-	-	-	-	-	-	-	-
St.54	20150328	0140	25.51	120.99	88	21.7	17.4	1018.43	039	10.0	81	369	221.4
St.55	20150328	0507	25.51	121.50	117	20.4	16.0	1018.26	031	7.0	110	548	328.8
St.56	20150328	0856	26.01	121.50	67	19.3	15.0	1019.15	024	9.5	60	250	150.0
St.57	20150328	1202	26.01	121.98	101	19.8	15.8	1017.19	012	7.0	90	665	399.0
St.58	20150328	1514	26.02	122.50	106	22.1	16.5	1015.41	009	6.0	100	508	304.8
St.59	20150328	1758	26.00	122.97	98	22.7	17.5	1015.59	040	6.6	90	419	251.4
St.60	20150328	2121	25.52	122.99	774	23.4	18.9	1016.83	185	1.0	200	857	514.2
St.61	20150329	0038	25.50	122.48	375	23.9	18.9	1015.41	167	0.0	200	1230	738.0
St.62	20150329	0330	25.51	121.97	120	23.6	19.2	1015.23	132	0.0	100	532	319.2

表 02. 2015 年 8 月航次基礎觀測資料
Chart 02. Basic observation data in Aug. 2015

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20150831	1958	24.86	122.01	382	26.3	25.3	1008.70	356.4	4.6	200	1296	777.6
St.02	20150831	1643	25.02	122.50	1436	26.8	25.8	1007.70	306.6	9.3	200	1219	731.4
St.03	-	-	-	-	-	-	-	-	-	-	-	-	-
St.04	20150901	0125	24.50	122.50	630	28.5	27.6	1008.00	26	4.1	200	1181	708.6
St.05	20150831	2235	24.51	122.00	952	27.3	23.5	1009.00	354.1	3.1	150	-	-
St.06	20150901	1142	24.00	121.69	447	28.7	26.8	1010.00	32.7	4.1	200	-	-
St.07	20150901	0909	23.76	122.00	3361	28.7	27.4	1008.90	349.2	5.1	200	-	-
St.08	20150901	0550	23.75	122.51	3248	27.8	27.1	1007.80	155.8	3.9	200	-	-
St.09	-	-	-	-	-	-	-	-	-	-	-	-	-
St.10	-	-	-	-	-	-	-	-	-	-	-	-	-
St.11	20150901	2334	22.98	122.49	5536	28.2	28.0	1011.90	177.2	4.0	200	1166	699.6
St.12	20150901	2035	23.00	122.00	4935	28.4	27.6	1010.80	143.9	1.3	200	1077	646.2
St.13	20150901	1737	23.00	121.50	1954	28.6	27.2	1010.00	264.9	1.6	200	788	472.8
St.14	20150902	1423	22.66	121.25	1103	28.7	28.2	1010.70	248.1	1.7	200	1245	747.0
St.15	20150902	1730	22.25	121.00	1207	28.1	27.4	1009.00	338.6	2.4	200	1165	699.0
St.16	20150902	1138	22.25	121.51	644	29.2	28.0	1010.60	162.5	1.2	200	1193	715.8
St.17	20150902	0815	22.25	122.01	4731	27.6	28.0	1013.00	112	1.7	200	1250	750.0
St.18	20150902	0500	22.25	122.50	4918	27.6	27.8	1013.00	199.2	1.2	200	1152	691.2
St.19	-	-	-	-	-	-	-	-	-	-	-	-	-
St.20	-	-	-	-	-	-	-	-	-	-	-	-	-
St.21	-	-	-	-	-	-	-	-	-	-	-	-	-
St.22	-	-	-	-	-	-	-	-	-	-	-	-	-
St.23	-	-	-	-	-	-	-	-	-	-	-	-	-
St.24	-	-	-	-	-	-	-	-	-	-	-	-	-
St.25	-	-	-	-	-	-	-	-	-	-	-	-	-
St.26	-	-	-	-	-	-	-	-	-	-	-	-	-
St.27	-	-	-	-	-	-	-	-	-	-	-	-	-
St.28	-	-	-	-	-	-	-	-	-	-	-	-	-
St.29	-	-	-	-	-	-	-	-	-	-	-	-	-
St.30	20150903	0325	22.00	119.50	2273	28.3	29.0	1012.00	103.4	5.1	200	752	451.2
St.31	20150903	0023	22.00	120.00	1117	28.7	29.1	1012.00	99.1	6.5	200	959	575.4
St.32	20150903	2010	22.00	120.51	337	29.4	27.8	1008.00	75.6	5.2	200	1108	664.8
St.33	20150903	1615	22.38	120.31	306	28.8	29.5	1011.60	313.3	4.5	200	996	597.6
St.34	20150903	1412	22.50	120.00	699	29.6	29.7	1012.30	343.8	4.4	200	1173	703.8
St.35	20150903	0640	22.50	119.51	243	28.6	28.3	1012.20	134.8	4.8	200	1034	620.4
St.36	-	-	-	-	-	-	-	-	-	-	-	-	-
St.37	-	-	-	-	-	-	-	-	-	-	-	-	-
St.38	20150903	0924	23.01	119.50	73.4	-	-	-	350.7	4.7	65	477	286.2
St.39	20150903	1119	23.01	119.89	202	28.5	28.3	1014.00	359.5	5.4	105	485	291.0
St.40	20150910	1549	23.50	119.91	122	28.3	28.1	1011.00	355	9.7	100	628	376.8
St.41	20150910	1757	23.44	119.50	58	26.7	27.2	1010.00	8.7	18.7	50	173	103.8
St.42	-	-	-	-	-	-	-	-	-	-	-	-	-
St.43	-	-	-	-	-	-	-	-	-	-	-	-	-
St.44	20150910	2100	23.99	119.49	64.5	26.0	27.0	1013.00	8.6	27.8	50	377	226.2
St.45	20150911	0015	24.01	119.99	43	28.1	25.9	1012.00	032	6.0	30	204	122.4
St.46	20150911	1548	24.50	120.00	64	28.0	22.9	1012.00	10	7.2	50	297	178.2
St.47	20150911	0639	24.50	120.49	59.1	25.2	21.6	1010.50	5.2	33.8	50	352	211.2
St.48	-	-	-	-	-	-	-	-	-	-	-	-	-
St.49	-	-	-	-	-	-	-	-	-	-	-	-	-
St.50	20150911	0940	25.00	120.50	7.8	26.3	25.1	1011.30	9.7	39.4	75	455	273.0
St.51	20150911	1150	25.09	120.92	75.8	27.3	27.5	1011.00	22.9	8.7	65	450	270.0
St.52	-	-	-	-	-	-	-	-	-	-	-	-	-
St.53	-	-	-	-	-	-	-	-	-	-	-	-	-
St.54	20150911	1354	25.49	121.01	99.3	28.1	28.6	1011.00	27.1	8.8	85	597	358.2
St.55	20150911	1605	25.50	121.48	116	26.3	27.8	1009.40	5.3	58.3	-	468	280.8
St.56	-	-	-	-	-	-	-	-	-	-	-	-	-
St.57	-	-	-	-	-	-	-	-	-	-	-	-	-
St.58	-	-	-	-	-	-	-	-	-	-	-	-	-
St.59	-	-	-	-	-	-	-	-	-	-	-	-	-
St.60	-	-	-	-	-	-	-	-	-	-	-	-	-
St.61	20150831	1351	25.50	122.50	429	24.8	24.8	1008.00	272	7.0	200	1148	688.8
St.62	20150831	1129	25.50	122.00	124	26.9	25.6	1008.40	280	7.7	100	563	337.8

表 03. 2015 年 11 月航次基礎觀測資料
Chart 03. Basic observation data in Nov. 2015

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20151116	0916	24.87	122.01	383	24.6	24.9	1017	244.7	1.5	200	1551	930.6
St.02	20151116	1155	25.01	122.50	1484	26.0	25.0	1016	215	5.5	200	1551	930.6
St.03	-	-	-	-	-	-	-	-	-	-	-	-	-
St.04	20151116	0404	24.51	122.51	610	26.3	25.8	1016	116.2	10.4	200	1268	760.8
St.05	20151116	0710	24.51	122.01	1080	25.2	25.3	1016	259	5.2	200	-	714.6
St.06	20151115	1520	24.00	121.69	294	26.8	24.1	1016	2.0	11.9	200	-	766.8
St.07	20151115	2001	23.77	122.00	2972	26.2	27.1	1017	318	6.0	200	-	847.8
St.08	20151115	2317	23.76	122.49	3248	26.0	26.8	1017	95	7.7	200	-	790.8
St.09	-	-	-	-	-	-	-	-	-	-	-	-	-
St.10	-	-	-	-	-	-	-	-	-	-	-	-	-
St.11	20151115	0143	23.00	122.62	5419	27.1	26.9	1015	061	10.0	200	1178	706.8
St.12	20151115	0535	23.01	122.02	4117	27.3	26.5	1015	38.1	12.3	200	1229	737.4
St.13	-	-	-	-	-	-	-	-	-	-	-	-	-
St.14	20151114	1133	22.67	121.25	1152	27.4	26.8	1015	76.2	2.9	200	1020	612.0
St.15	20151114	0823	22.25	121.00	1242	27.3	26.7	1018	12.9	4.0	200	853	511.8
St.16	20151114	1449	22.26	121.67	540	27.1	27.4	1013	60	3.1	200	1052	631.2
St.17	20151114	1757	22.25	123.00	4751	27.2	27.3	1014	22	4.0	200	1274	764.4
St.18	20151114	2114	22.26	123.00	4918	27.2	26.9	1015	359	6.5	200	863	517.8
St.19	-	-	-	-	-	-	-	-	-	-	-	-	-
St.20	-	-	-	-	-	-	-	-	-	-	-	-	-
St.21	-	-	-	-	-	-	-	-	-	-	-	-	-
St.22	-	-	-	-	-	-	-	-	-	-	-	-	-
St.23	-	-	-	-	-	-	-	-	-	-	-	-	-
St.24	-	-	-	-	-	-	-	-	-	-	-	-	-
St.25	-	-	-	-	-	-	-	-	-	-	-	-	-
St.26	-	-	-	-	-	-	-	-	-	-	-	-	-
St.27	-	-	-	-	-	-	-	-	-	-	-	-	-
St.28	-	-	-	-	-	-	-	-	-	-	-	-	-
St.29	-	-	-	-	-	-	-	-	-	-	-	-	-
St.30	20151113	2110	22.00	119.50	2439	26.5	26.5	1016	33	3.8	200	1070	642.0
St.31	20151114	0020	22.00	119.99	1199.4	26.9	27.1	1016	059	2.8	200	1340	804.0
St.32	20151114	0403	22.00	120.50	337.22	27.2	27.1	1016	086	4.8	200	1340	804.0
St.33	20151113	1221	22.40	120.30	131	27.0	26.7	1016	319.4	5.7	-	-	-
St.34	20151113	1445	22.50	120.00	662	26.7	26.7	1016	345	5.5	200	1200	720.0
St.35	20151113	1802	22.50	119.50	241	25.0	26.3	1017	18	6.0	200	1495	897.0
St.36	-	-	-	-	-	-	-	-	-	-	-	-	-
St.37	-	-	-	-	-	-	-	-	-	-	-	-	-
St.38	20151119	0339	23.00	119.50	84	-	-	-	016	6.3	75	355	213.0
St.39	20151119	0552	22.98	119.91	134	26.7	25.2	1017	020	5.3	119	643	385.8
St.40	20151118	0907	23.51	119.91	122	25.8	26.4	1016	53.8	2.2	110	862	517.2
St.41	20151118	1121	23.43	119.51	55	25.3	26.3	1017	88.6	0.6	50	404	242.4
St.42	-	-	-	-	-	-	-	-	-	-	-	-	-
St.43	-	-	-	-	-	-	-	-	-	-	-	-	-
St.44	20151118	0329	24.01	119.50	71.6	25.2	25.9	1016	336.7	1.1	63	561	336.6
St.45	20151118	0608	24.00	120.00	45.9	25.0	26.3	1016	68.7	1.3	39	281	168.6
St.46	20151117	2107	24.52	120.50	58	24.6	24.9	1016	001	1.1	51	258	154.8
St.47	20151117	2335	24.50	120.03	66	24.1	25.4	1016	234	2.0	60	390	234.0
St.48	-	-	-	-	-	-	-	-	-	-	-	-	-
St.49	-	-	-	-	-	-	-	-	-	-	-	-	-
St.50	20151117	1822	25.00	120.51	83	23.7	24.5	1016	83	2.9	70	573	343.8
St.51	20151117	1557	25.10	120.60	89	24.5	24.0	1016	24	3.6	70	314	188.4
St.52	-	-	-	-	-	-	-	-	-	-	-	-	-
St.53	-	-	-	-	-	-	-	-	-	-	-	-	-
St.54	20151117	1337	25.50	121.01	89	24.5	24.0	1016	24	3.6	90	397	238.2
St.55	20151117	1106	25.49	121.50	111	25.1	23.9	1016	159	0.6	-	560	336.0
St.56	-	-	-	-	-	-	-	-	-	-	-	-	-
St.57	-	-	-	-	-	-	-	-	-	-	-	-	-
St.58	-	-	-	-	-	-	-	-	-	-	-	-	-
St.59	-	-	-	-	-	-	-	-	-	-	-	-	-
St.60	-	-	-	-	-	-	-	-	-	-	-	-	-
St.61	20151116	1421	25.51	122.50	414	25.3	24.5	1015	243	1.6	200	1027	616.2
St.62	20151116	1702	25.49	122.02	107	24.3	23.4	1015	125	1.4	100	838	502.8

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發行所：行政院農業委員會水產試驗所

發行人：陳君如

編輯顧問：張錦宜

總編輯：曾振德

編輯委員：葉信明、林志遠、鄭學淵

編輯：陳郁凱、曾秀茹、潘佳怡

執行單位：海洋漁業組

地址：基隆市中正區 20246 和一路 199 號

電話：(02)24622101

傳真：(02)24629388

網址：<http://www.tfrin.gov.tw>

信箱：service@mail.tfrin.gov.tw

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