Cruise Report of TaiCOFI Surveys in 2019

2019年臺灣周邊海域漁場環境監測航次報告




農委會科技計畫編號：108農科-9.2.3-水-A1(4)

Fisheries Research Institute
Council of Agriculture, Executive Yuan
Keelung, Taiwan

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行政院農業委員會水產試驗所

中 華 民 國 109 年 7 月

序

臺灣以海洋興國，周邊二百浬經濟海域內 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臺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，臺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「臺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，克服一切險阻於周邊海域大範圍蒐集海域溫鹽、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

中華民國一零九年七月

Preface

Taiwan is an island and the ocean is our priceless property. The Exclusive Economic Zone (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 17 years database of marine environment was established. With the publication of "Cruise report of TaiCOFI surveys in 2019", 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 General

June-ru Chen

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，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「臺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臺灣周邊海域長期水文、海況及漁場環境時空分布資訊，進而掌握影響臺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有成果。

本專刊彙集本所於 2019 年執行「臺灣周邊海域漁場環境監測」計畫（農委會科技計畫編號：108 農科-9.2.3-水-A1(4)）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，以圖示方式刊出臺灣周邊海域之水溫、鹽度、營養鹽、葉綠素、浮游動物及基礎生產力等漁場環境因子之調查成果以供各界參考。此外，本年度因試驗船機件老舊維修期程無法配合，故取消原訂之夏季及秋季航次。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 2019. 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. Summer and autumn cruises were cancelled due to the maintenances of our research vessels. Finally, we will extend our special thanks for your advices to improve this cruise report.

目錄

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海上採樣作業流程

在臺灣周邊海域選定 62 個測站，利用水試二號試驗船及其裝備，按季節別於 2019 年 4 月及 7 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℃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以淺 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 II during quarterly cruise in April and July 2019. 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 collectded 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℃ 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℃) 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, 5 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，分析臺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。

6.浮游動物鑑種及計數流程：

單一測站浮游動物樣本數可能為 2000 個樣本之數倍之多。為促進實驗效率，每一測站之浮游生物樣品均透過 Folsom 分離器進行樣本分離至樣本數接近 2000 為止。 分離後之樣本從樣本瓶倒入培養皿，並將培養皿擺上顯微鏡的載物臺計數及鑑種。將 30 大類鑑種後之浮游生物分別記錄每個類別的數量，在依每立方公尺水體的同類物種個體數(inds./m^3)作為個別浮游生物種類豐度之指標。

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-tartrat 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 was 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℃ for 15 seconds 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 hours 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 than 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./m^3).

計畫執行人員 Participating researchers

單　位　名　稱	研　究　人　員	職　稱
行政院農業委員會水產試驗所海洋漁業組	嚴國維 Yen, Kuo-Wei	助理研究員
行政院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
行政院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
行政院農業委員會水產試驗所海洋漁業組	蘇博堃 Su, Bo-Kuan	漁航員
行政院農業委員會水產試驗所海洋漁業組	曾秀茹 Tseng, Hsiu-Ju	自僱臨時人員
國立臺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

航次名	姓名	職稱
2019-04-09 航次	嚴國維	助理研究員
	陳郁凱	副研究員
	張芷瑋	職務代理人
2019-04-17 航次	王友慈	聘用助理研究員
	陳瑞谷	助理研究員
	黃鼎傑	探測技正
2019-04-29 航次	陳瑞谷	助理研究員
	蘇博堃	漁航員
	戴靖萱	研究助理
2019-07-29 航次	嚴國維	助理研究員
	陳瑞谷	助理研究員
	潘佳怡	聘用助理研究員
	劉康熙	自僱臨時人員
2019-08-17 航次	王友慈	聘用助理研究員
	蘇博堃	漁航員
	張海龍	技工
	蔡孟昌	計畫助理

<table>
<tr><td rowspan="11">水試二號
試驗船</td><th>姓名</th><th>職稱</th><th>姓名</th><th>職稱</th></tr>
<tr><td>高懷恩</td><td>船長</td><td>林冠宏</td><td>大副</td></tr>
<tr><td>張文發</td><td>輪機長</td><td>蔡宏義</td><td>二副</td></tr>
<tr><td>李淵林</td><td>大管輪</td><td>蔡明益</td><td>漁撈長</td></tr>
<tr><td>許益銘</td><td>二管輪</td><td>陳明展</td><td>電信員</td></tr>
<tr><td>高振傑</td><td>輪機員</td><td>王銘言</td><td>漁航員</td></tr>
<tr><td>陳正達</td><td>輪機員</td><td>黃世龍</td><td>漁航員</td></tr>
<tr><td>楊紹弘</td><td>漁航員</td><td>趙仲昆</td><td>漁航員</td></tr>
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<tr><td>賴蓉葦</td><td>漁航員</td><td>蔡安傑</td><td>大廚</td></tr>
<tr><td>黃星翰</td><td>探測技正</td><td></td><td></td></tr>
</table>

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	嚴國維
CTD 溫鹽探測	嚴國維
營養鹽濃度分析	蘇博堃
葉綠素甲濃度分析	蘇博堃
浮游動物分類	潘佳怡、曾秀茹
基礎生產力	海洋大學鄭學淵研究室

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(℃)
Air T.	氣溫(℃)
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)

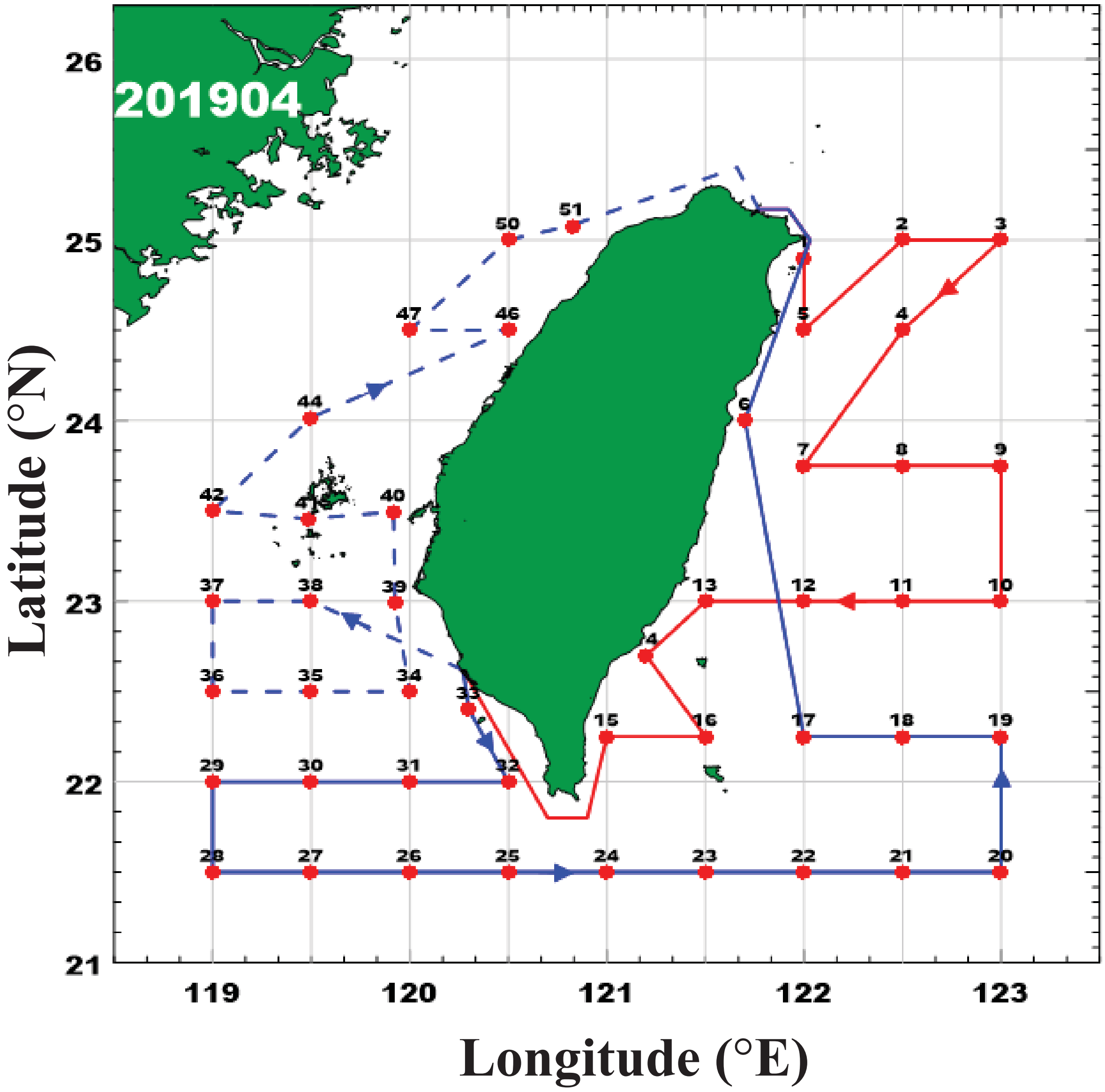

圖 1. 2019 年 4 月航次航跡圖 (1)藍實線為 4 月 9-12 日航跡 (2)紅實線為 4 月 17-22 日航跡 (3)藍虛線為 4 月 29 日至 5 月 9 日航跡

Fig. 1. Stations and cruise tracks for TaiCOFI project in April 2019.
(1) solid blue line surveyed from April 9th to 12th (2) solid red line surveyed from April 17th to 22nd (3) dotted blue line surveyed from April 29th to May 9th

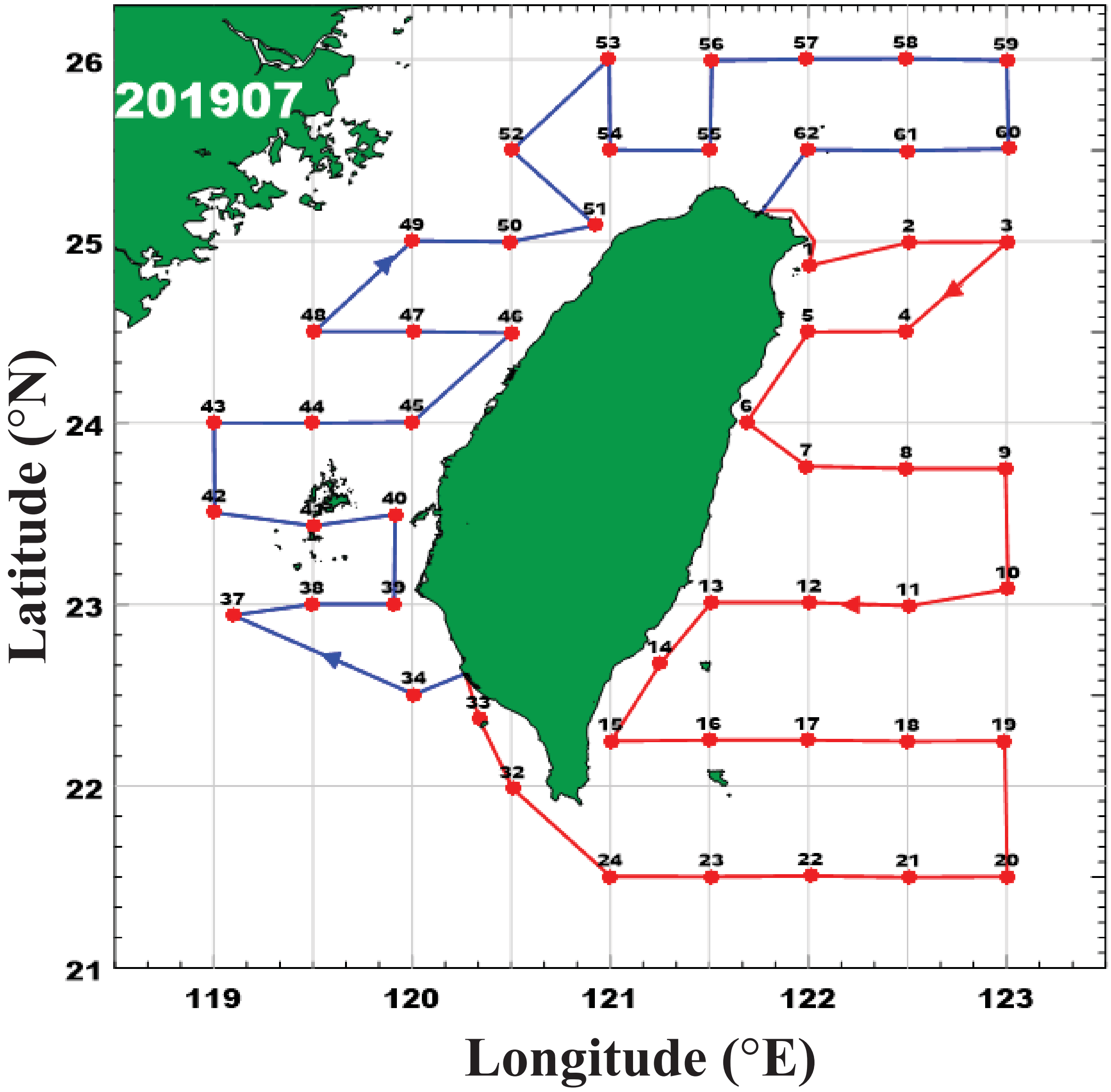

圖 2. 2019 年 7 月航次航跡圖 (1)藍實線為 7 月 29 日至 8 月 2 日航跡 (2)紅實線為 8 月 17-21 日航跡

Fig. 2. Stations and cruise tracks for TaiCOFI project in July 2019. (1) solid blue line surveyed from July 29th to August 2nd (2) solid red line surveyed from August 17th to 21st

圖 3. 2019 年 4 月航次海面水溫分布

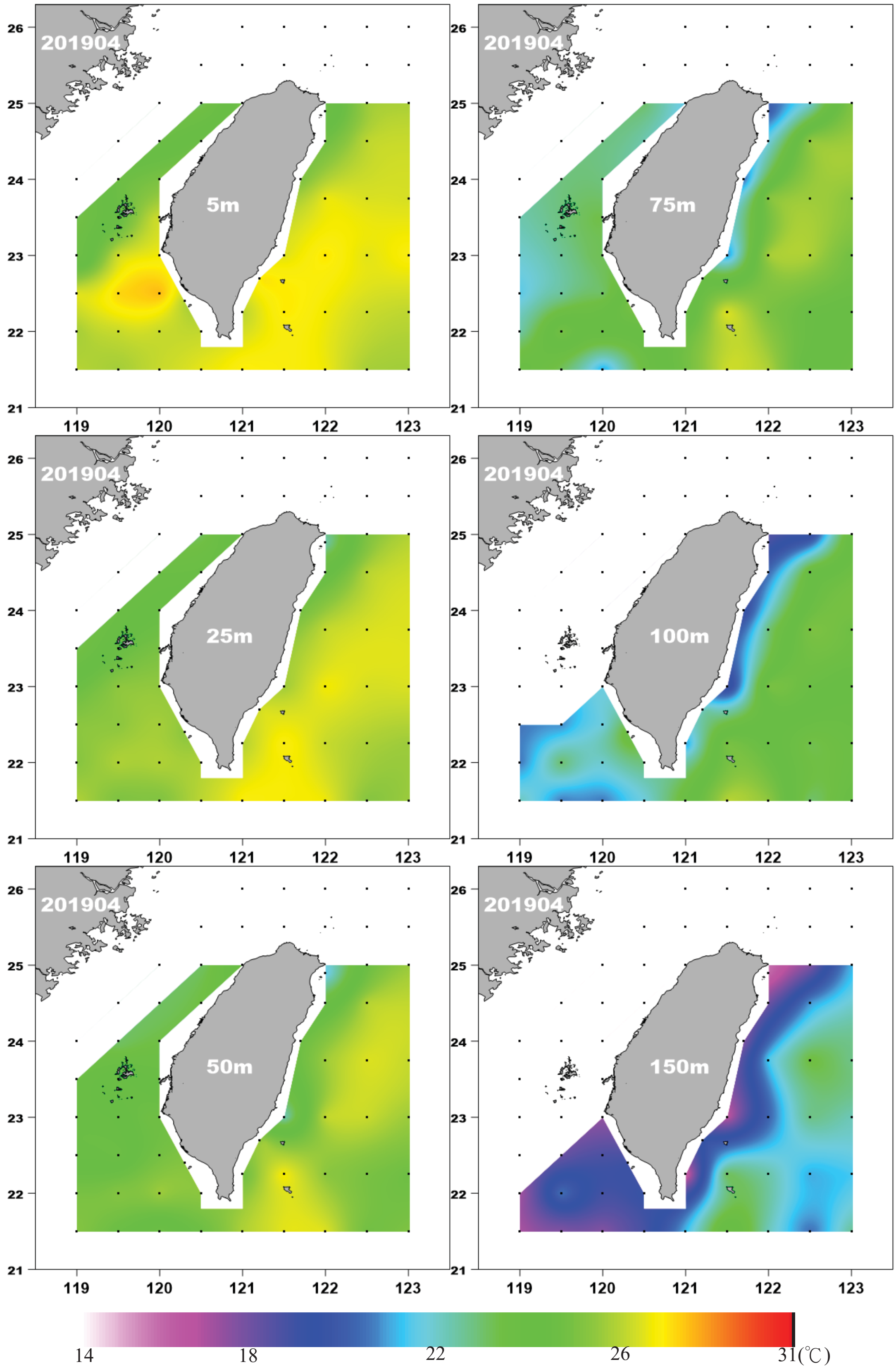

Fig. 3. Sea surface temperature in April 2019.

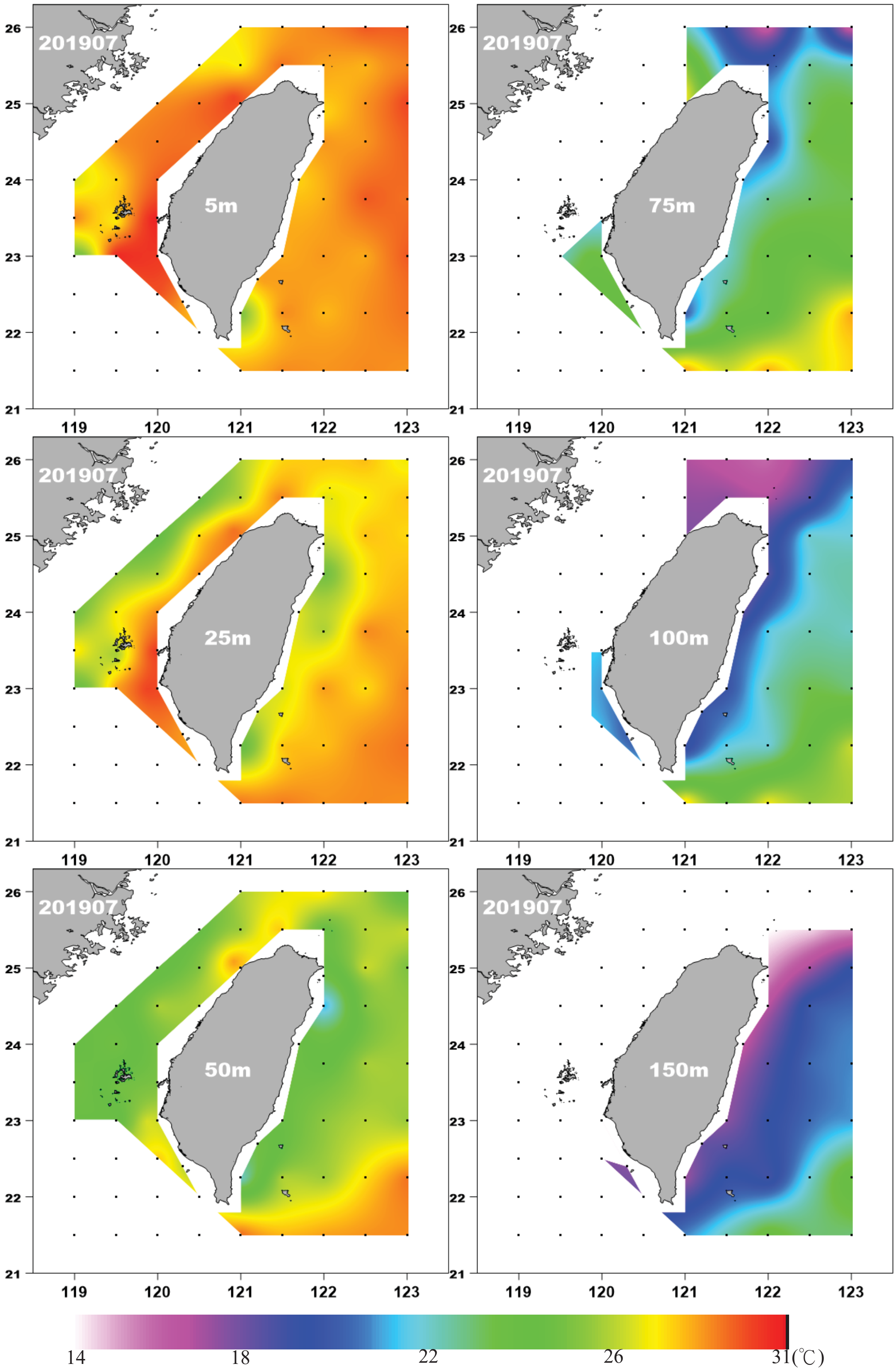

圖 4. 2019 年 7 月航次海面水溫分布
Fig. 4. Sea surface temperature in July 2019.

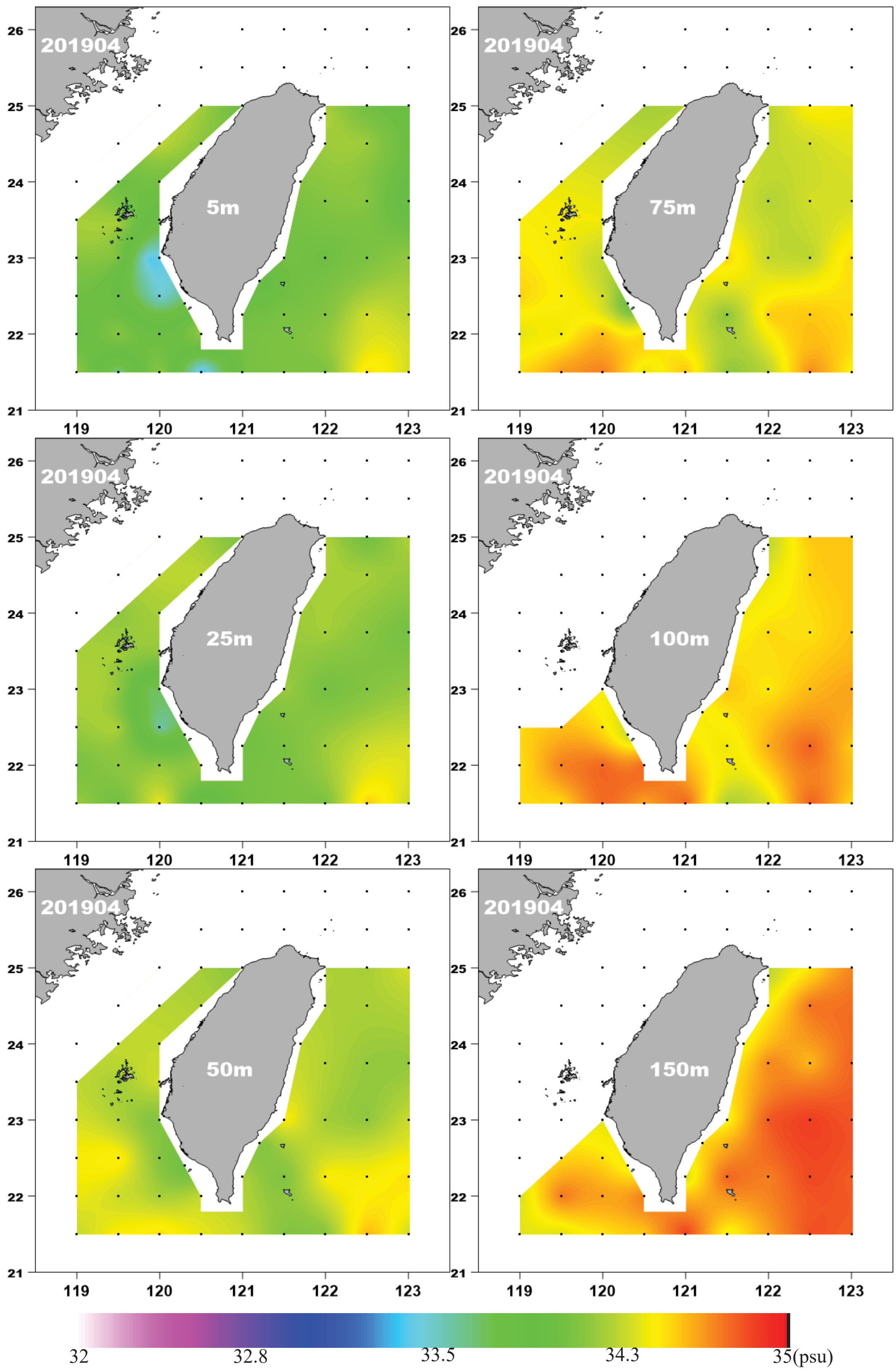

圖 5. 2019 年 4 月航次海面鹽度分布
Fig. 5. Sea surface salinity in April 2019.

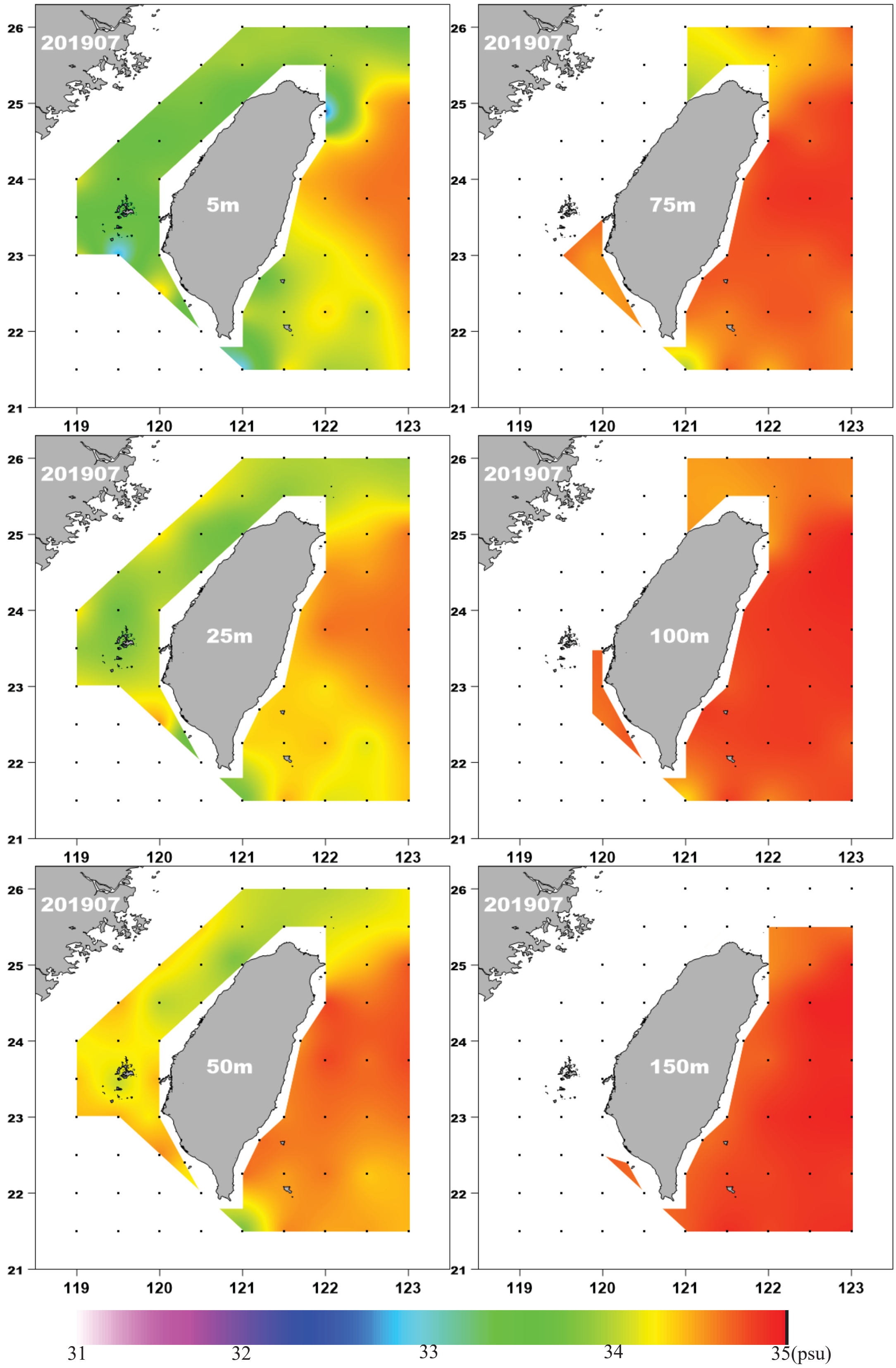

圖 6. 2019 年 7 月航次海面鹽度分布
Fig. 6. Sea surface salinity in July 2019.

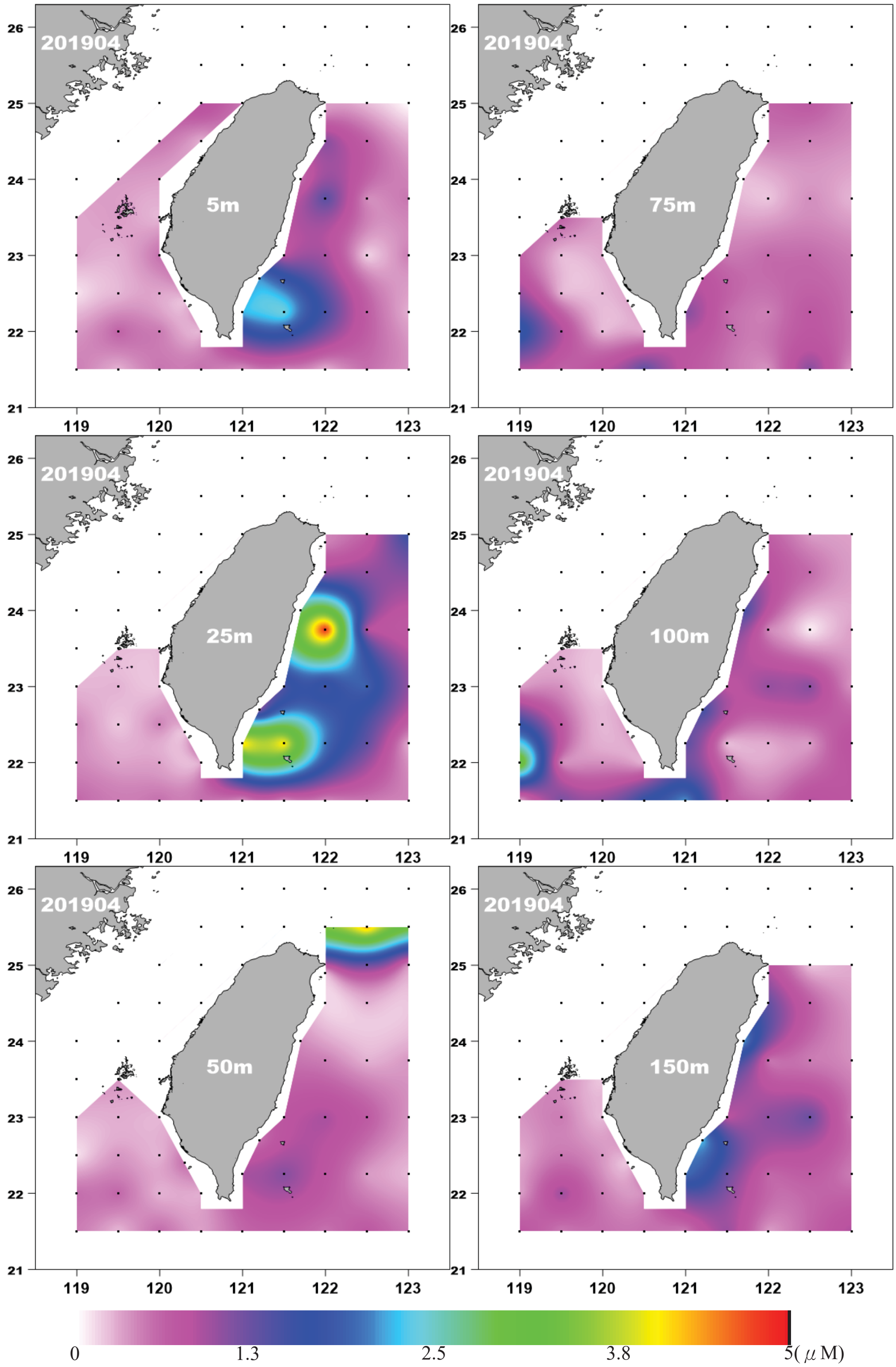

圖 7. 2019 年 4 月航次海面硝酸鹽(NO_3^-)濃度分布

Fig. 7. Sea surface nitrate (NO_3^-) concentration in April 2019.

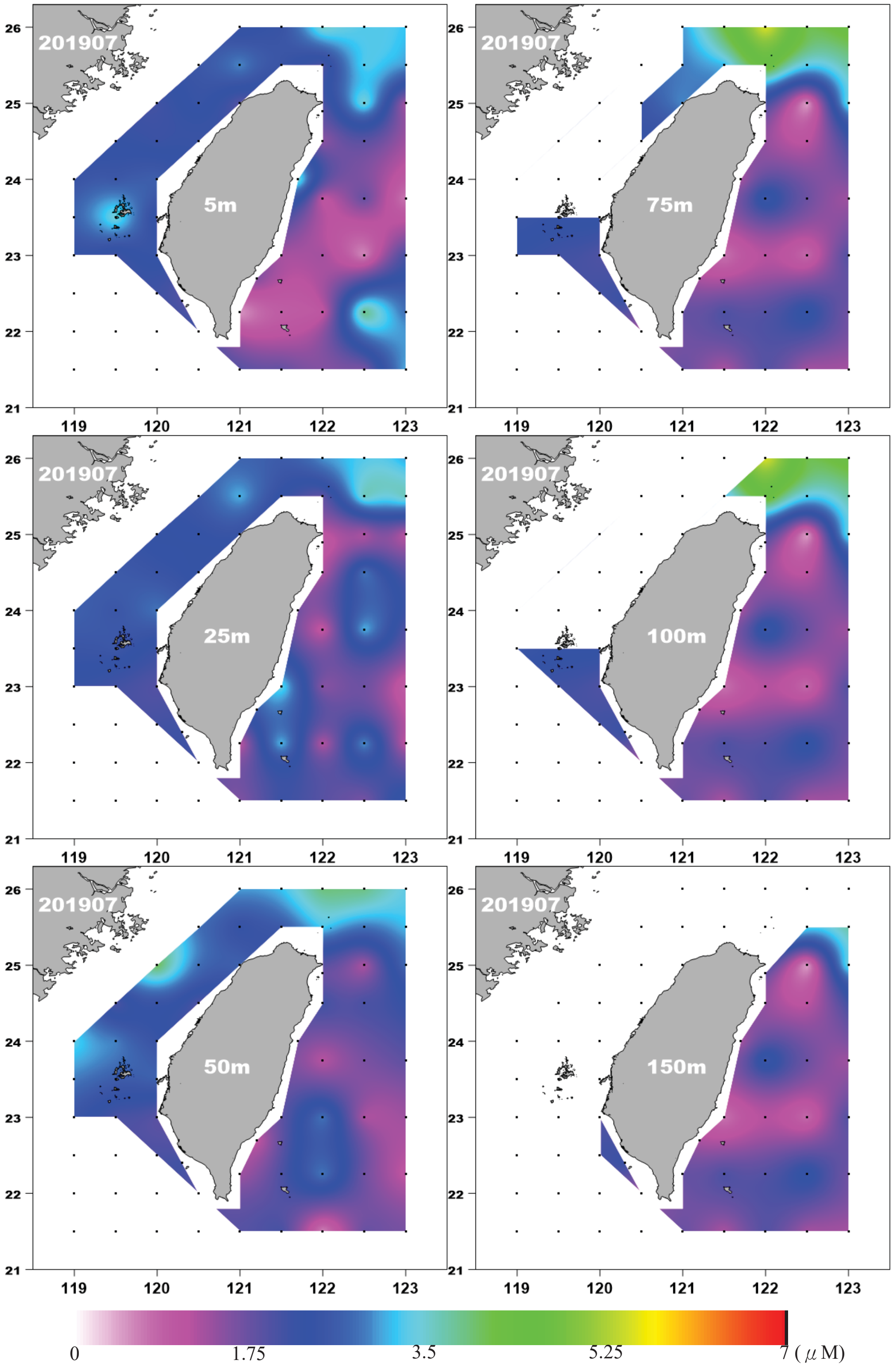

圖 8. 2019 年 7 月航次海面硝酸鹽(NO_3^-)濃度分布

Fig. 8. Sea surface nitrate (NO_3^-) concentration in July 2019.

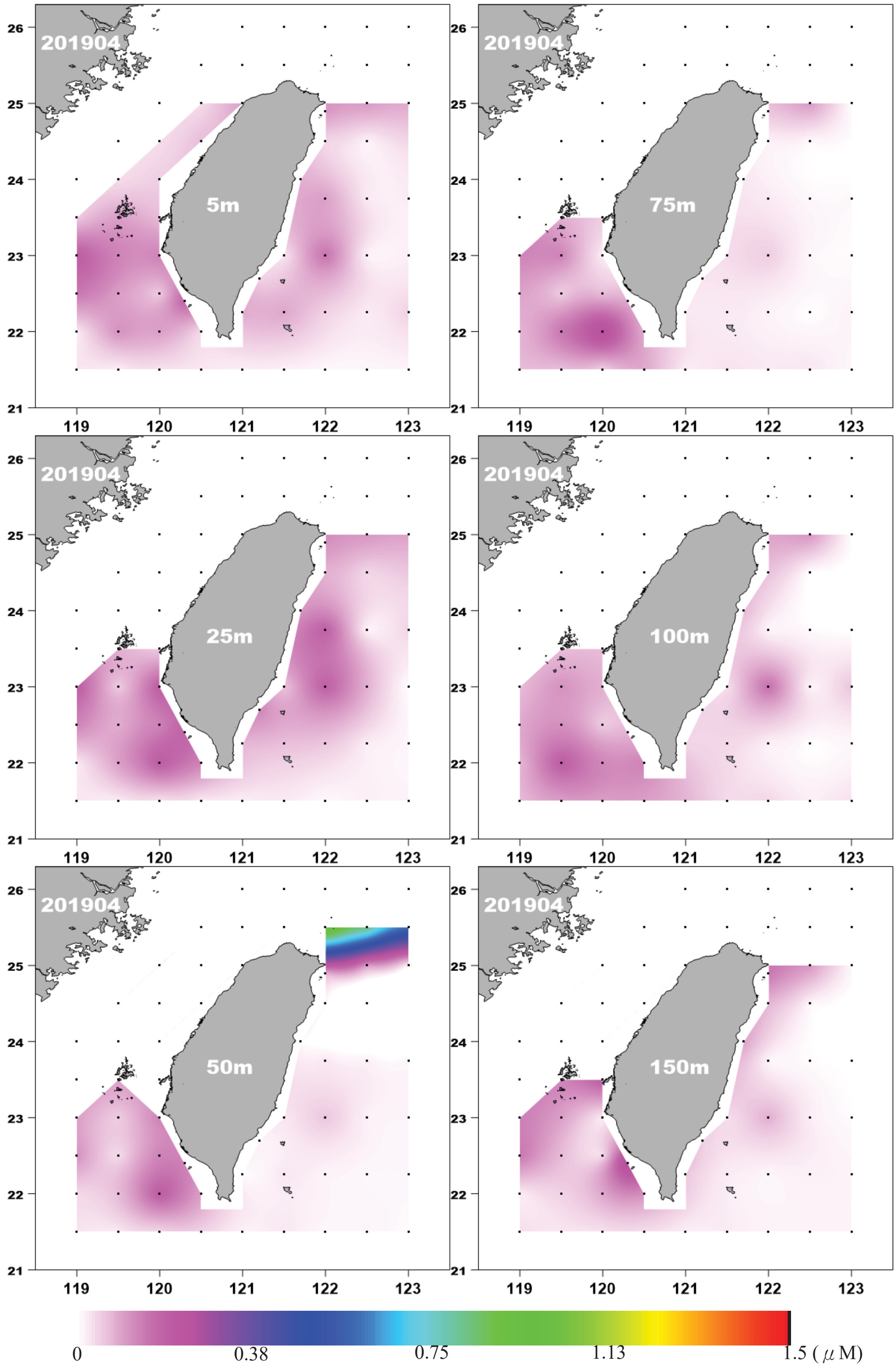

圖 9. 2019 年 4 月航次海面磷酸鹽(PO_4^{3-})濃度分布
Fig. 9. Sea surface phosphate (PO_4^{3-}) concentration in April 2019.

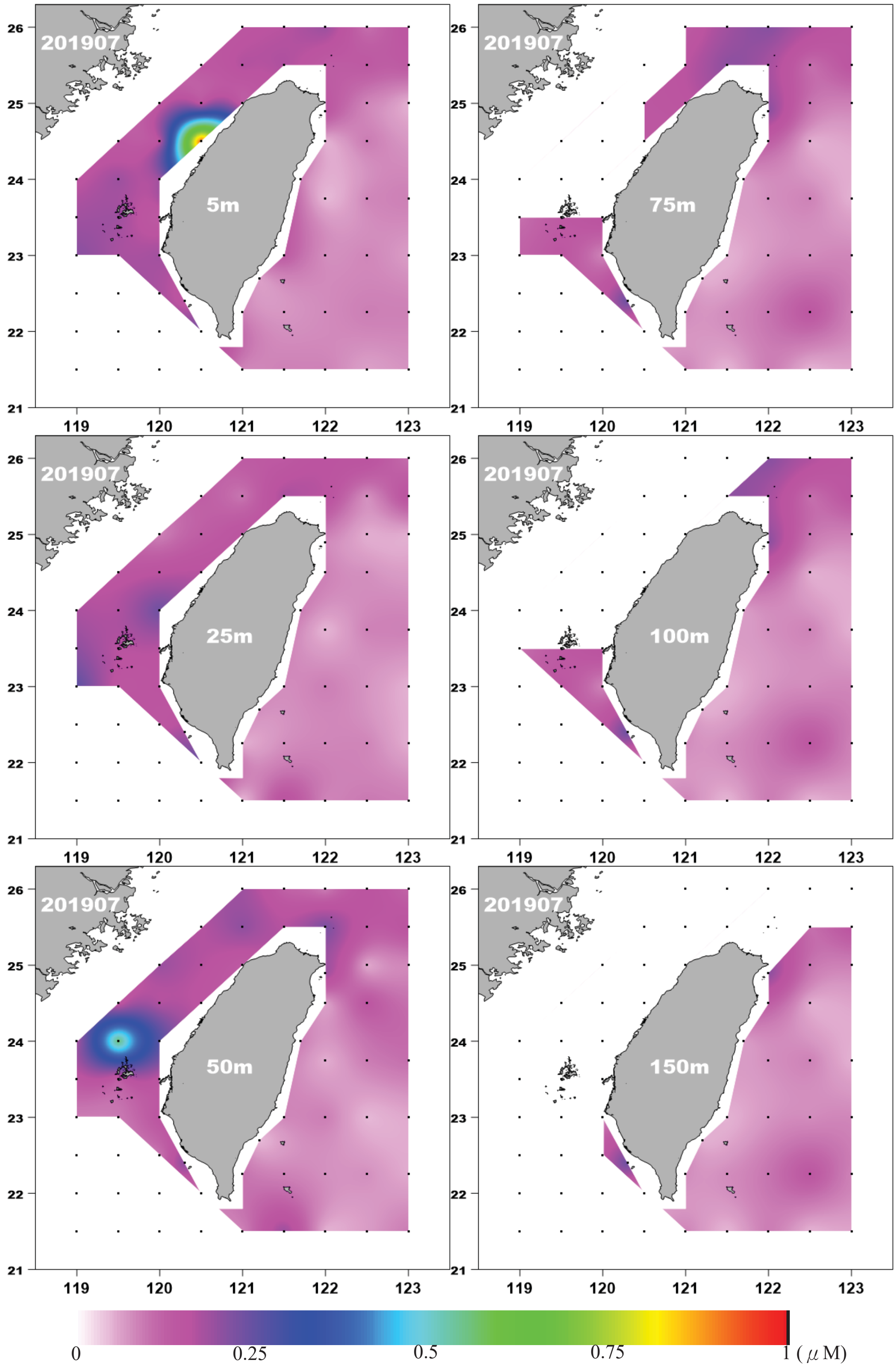

圖 10. 2019 年 7 月航次海面磷酸鹽(PO_4^{3-})濃度分布
Fig. 10. Sea surface phosphate (PO_4^{3-}) concentration in July 2019.

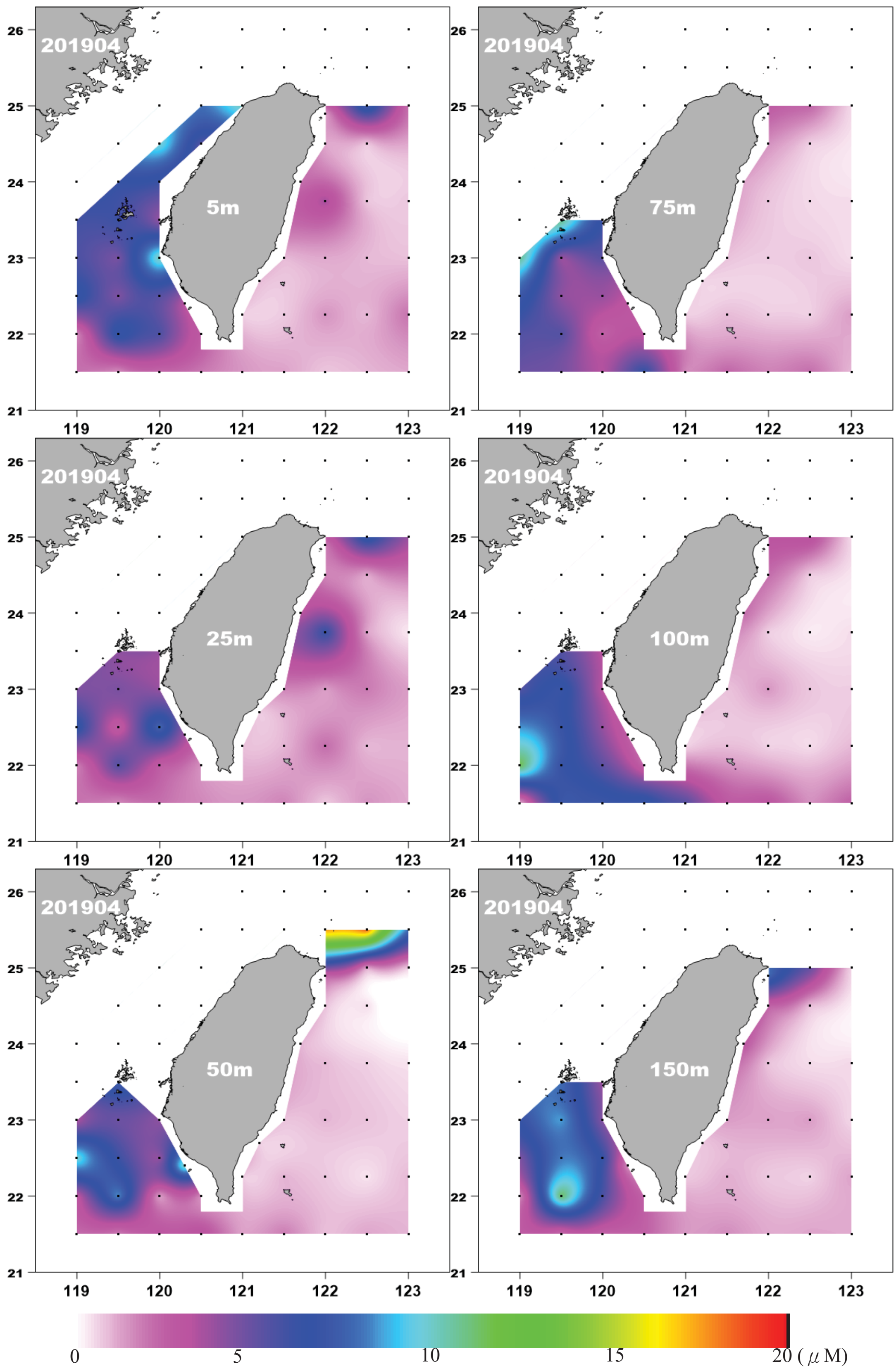

圖 11. 2019 年 4 月航次海面矽酸鹽(SiO_2^{2-})濃度分布
Fig. 11. Sea surface silicate (SiO_2^{2-}) concentration in April 2019.

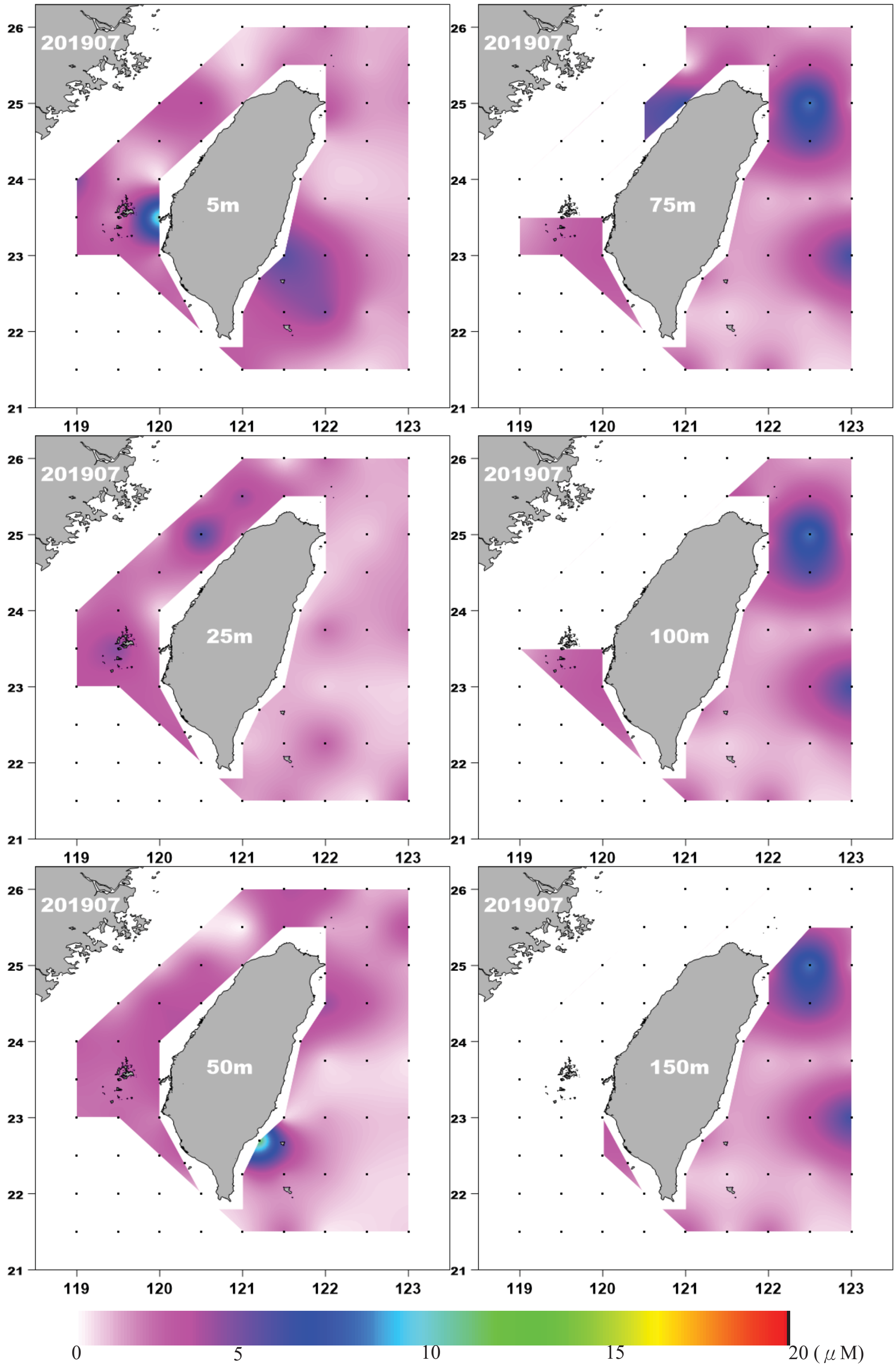

圖 12. 2019 年 7 月航次海面矽酸鹽(SiO_2^{2-})濃度分布

Fig. 12. Sea surface silicate (SiO_2^{2-}) concentration in July 2019.

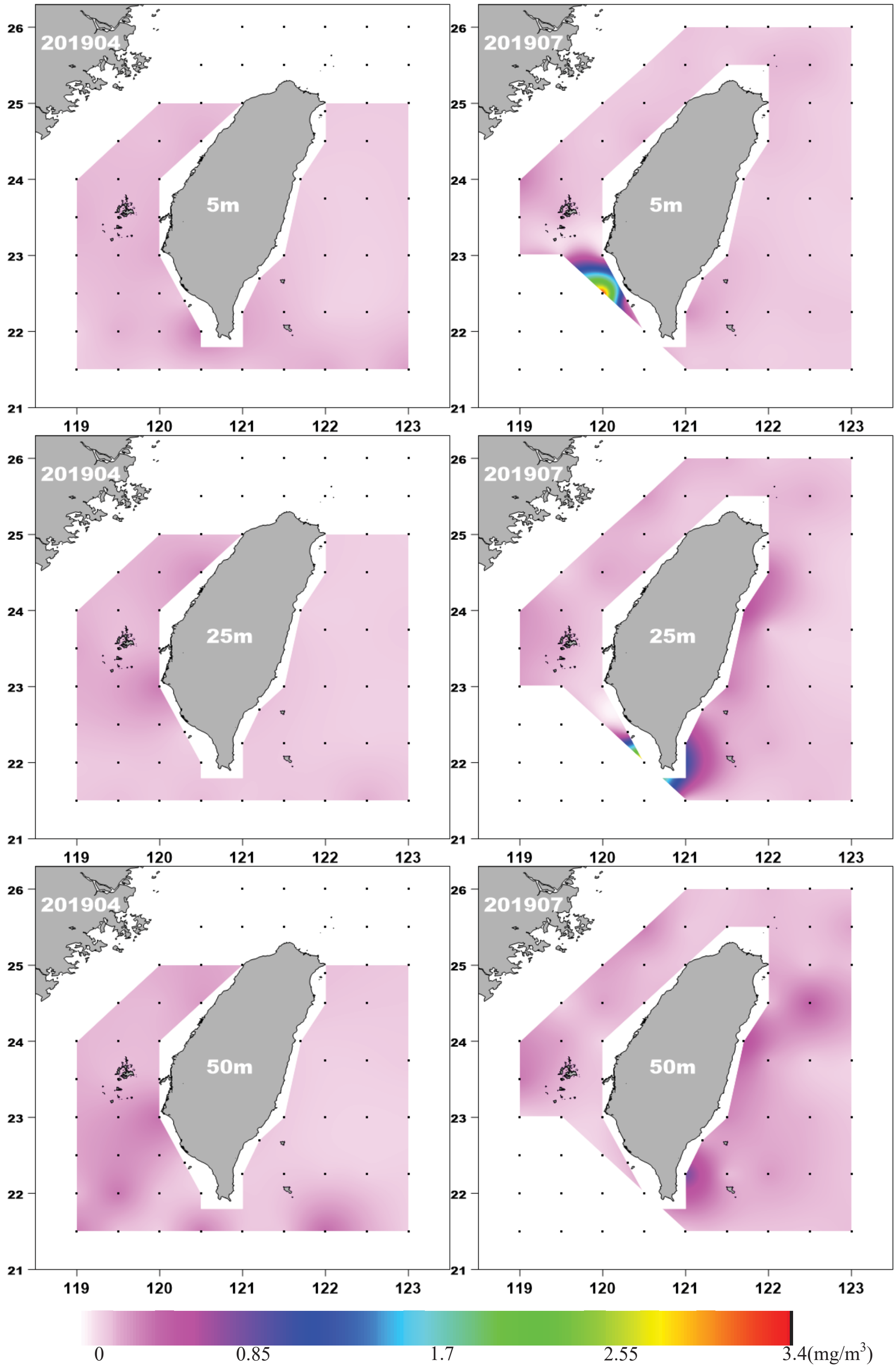

圖 13. 2019 年 4 月及 7 月海面葉綠素甲(chl-*a*)分布
Fig. 13. Sea surface chlorophyll-*a* in April and July 2019.

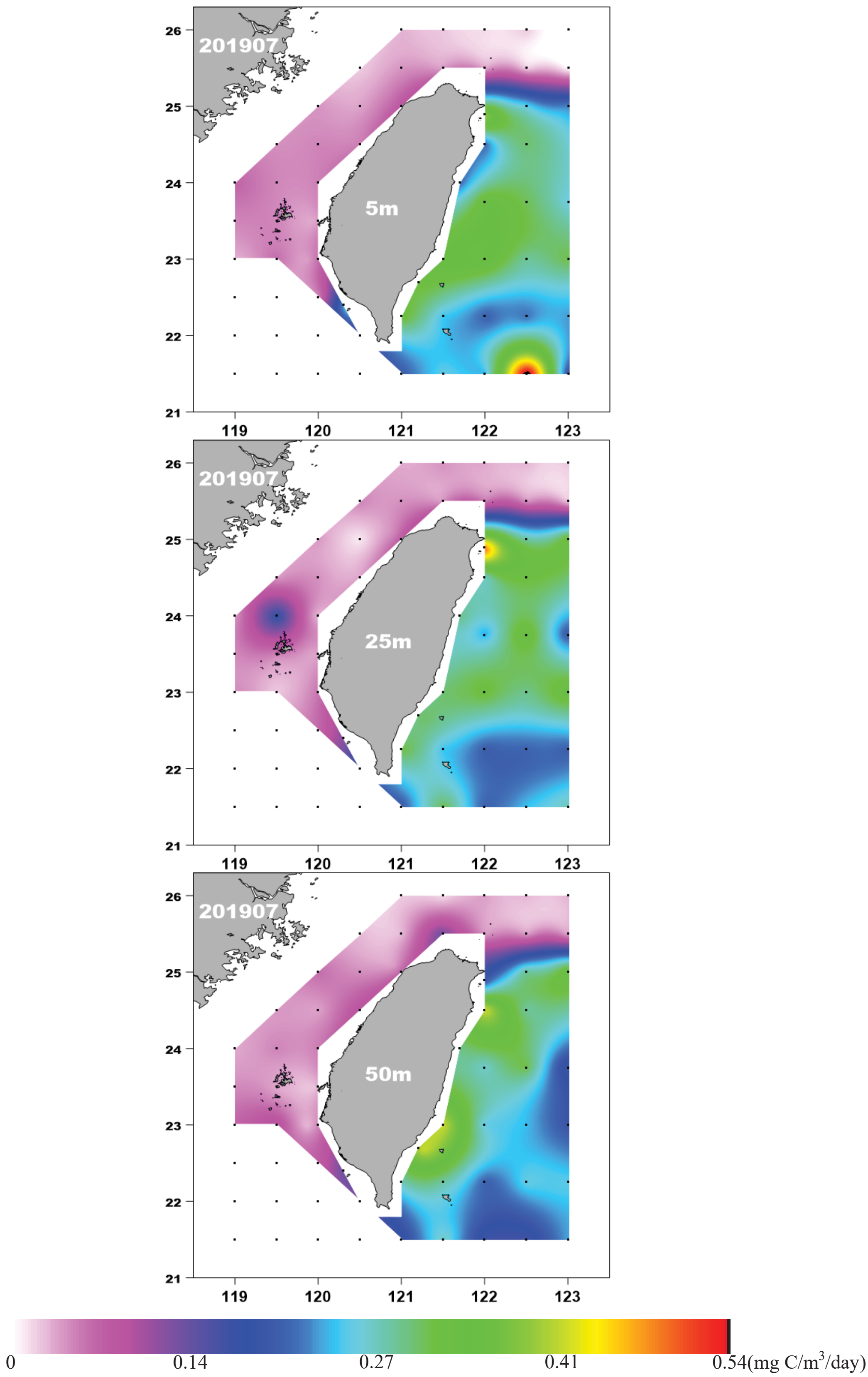

圖 14. 2019 年 7 月海面基礎生產力分布
Fig. 14. Sea surface primary production in July 2019.

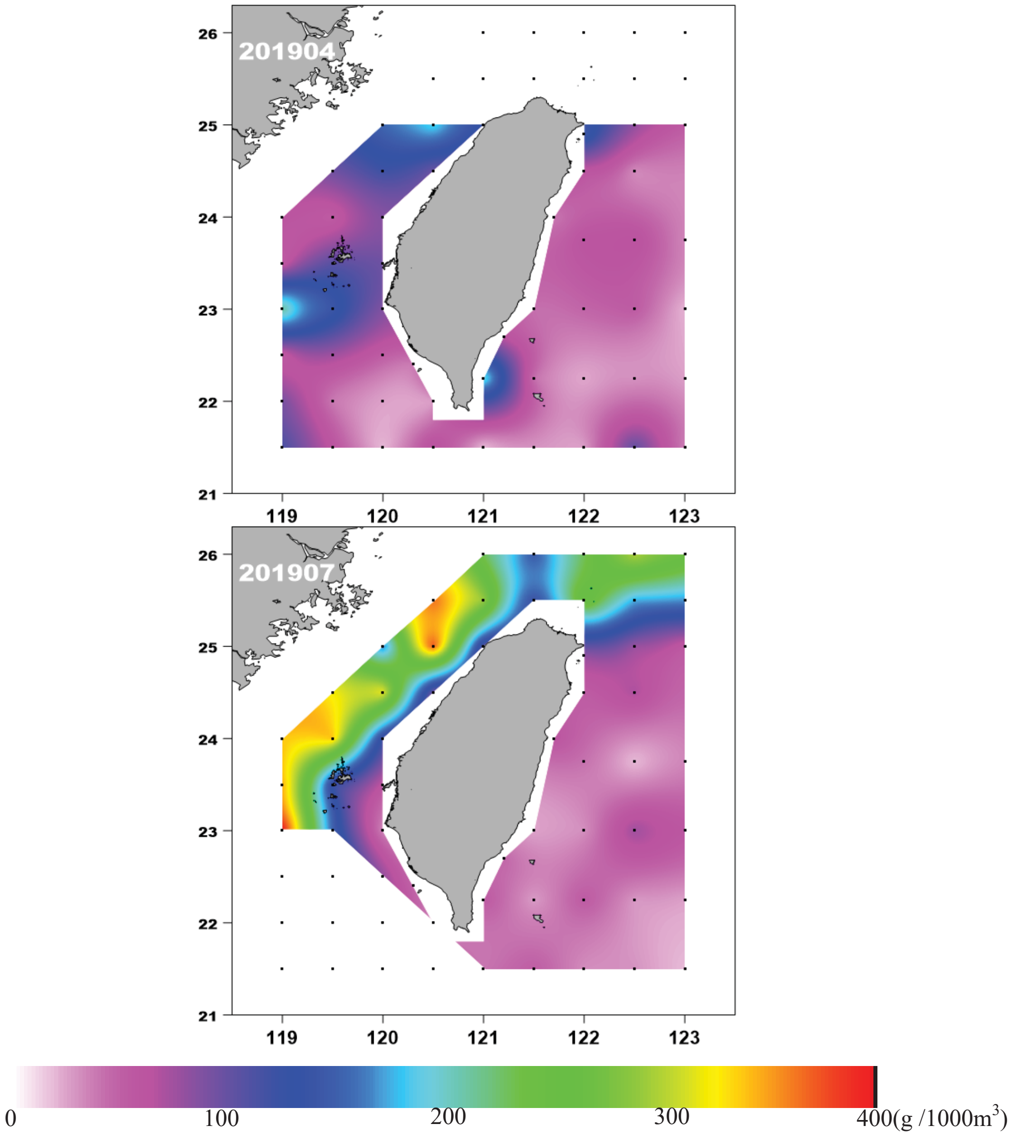

圖 15. 2019 年 4 月及 7 月浮游動物生物量分布
Fig. 15. Biomass of zooplankton in April and July 2019.

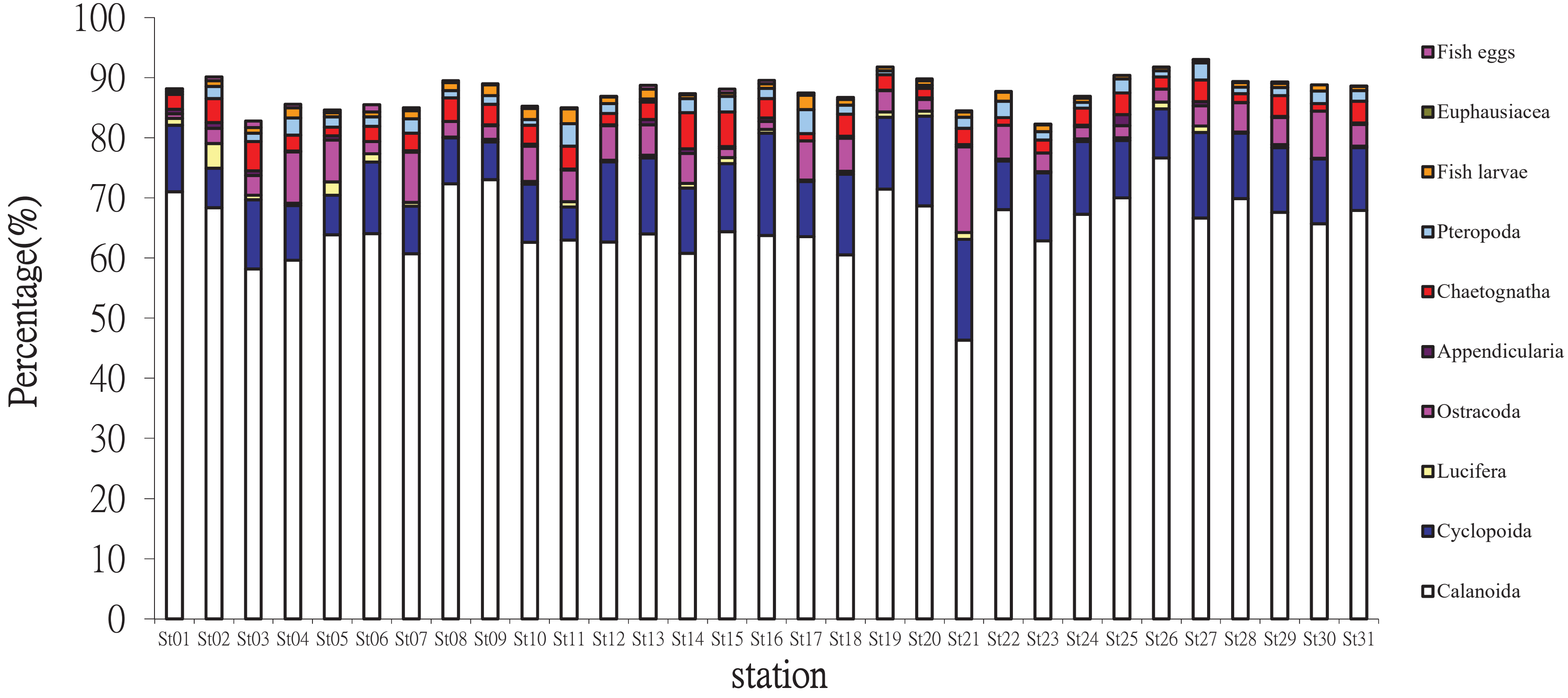

圖 16. 2019 年 4 月航次浮游動物優勢大類出現百分率

Fig. 16. Composition of dominant zooplankton taxa in April 2019.

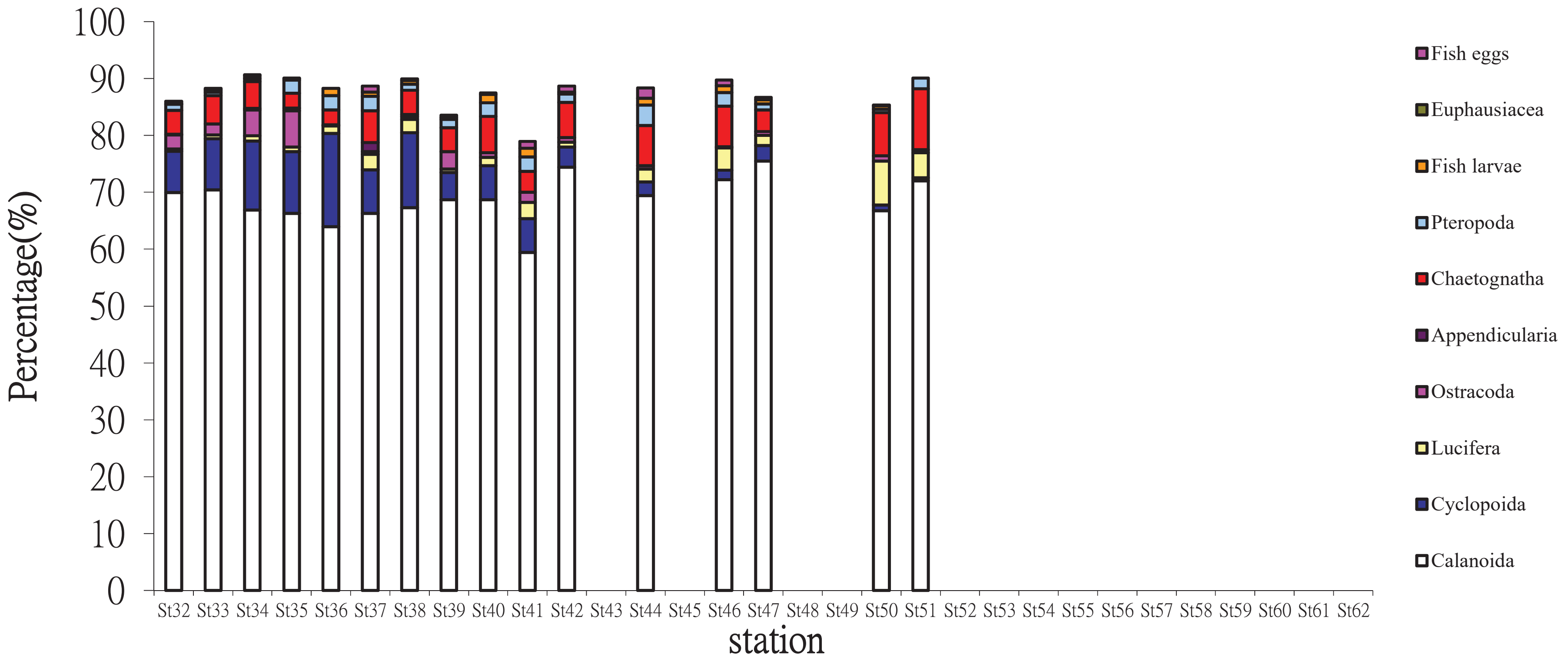

圖 17. 2019 年 4 月航次浮游動物優勢大類出現百分率(續)
Fig. 17. Composition of dominant zooplankton taxa in April 2019 (continued).

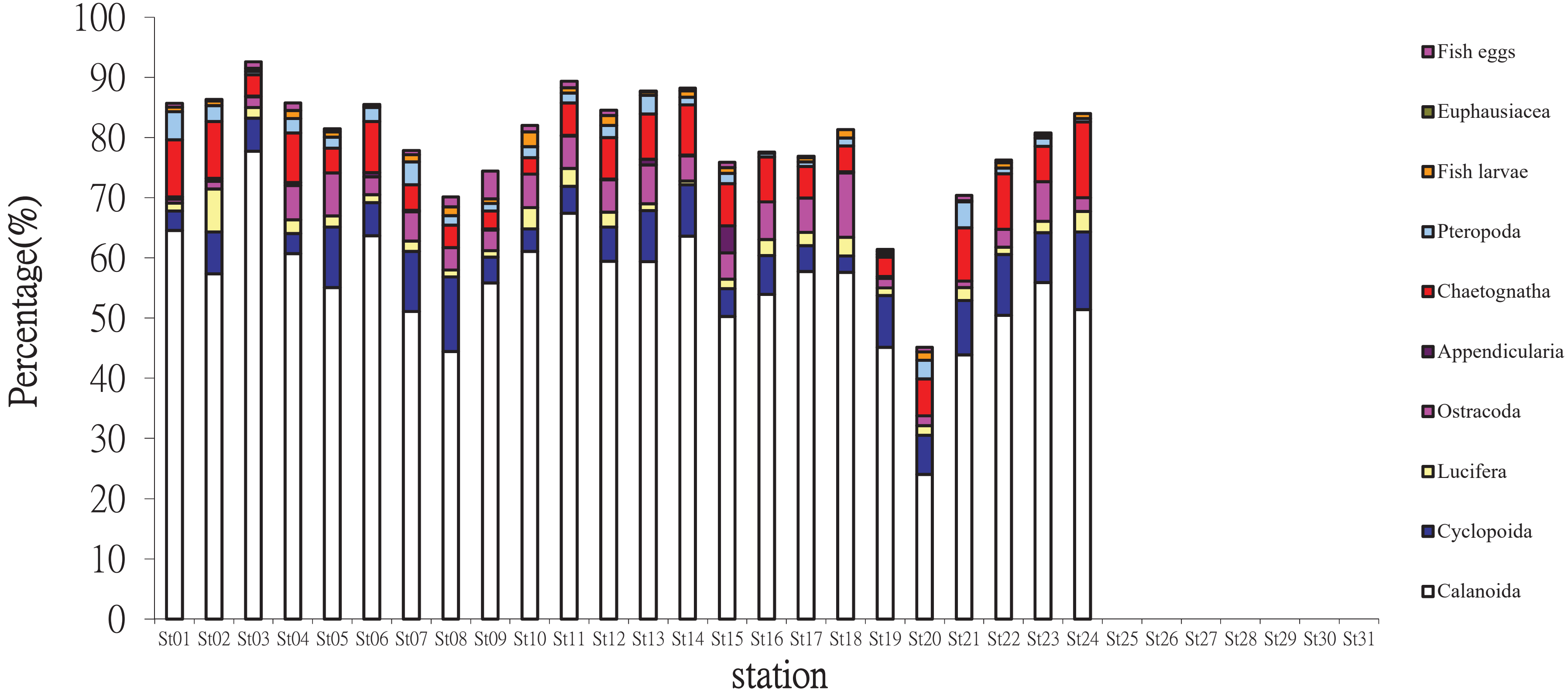

圖 18. 2019 年 7 月航次浮游動物優勢大類出現百分率
Fig. 18. Composition of dominant zooplankton taxa in July 2019.

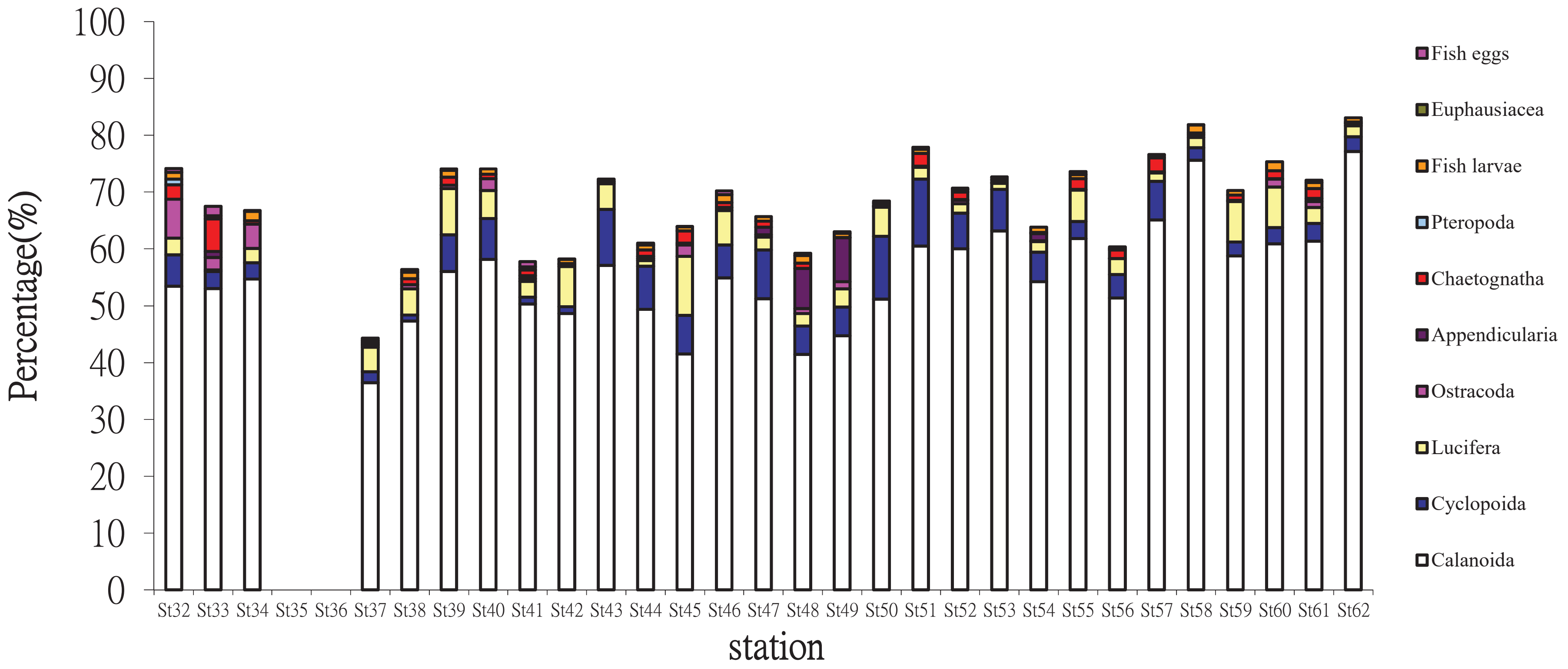

圖 19. 2019 年 7 月航次浮游動物優勢大類出現百分率(續)
Fig. 19. Composition of dominant zooplankton taxa in July 2019 (continued).

表 1. 2019 年 4 月航次基礎觀測資料
Chart 1. Sea observation data in April 2019

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	20190417	1300	24.87	122.00	318	25.0	22.6	1013	41	4.0	200	1221	732.6
St.02	20190420	1202	25.01	122.50	1475	26.3	24.9	1009	333	8.0	200	687	412.2
St.03	20190420	1518	25.01	123.00	>1500	26.2	25.3	1009	320	8.5	200	798	478.8
St.04	20190420	2043	24.51	122.48	673	26.2	25.5	1018	62	2.0	200	1333	799.8
St.05	20190419	2015	24.50	122.00	769	25.7	22.6	1009	304	1.3	200	1010	606.0
St.06	20190412	1519	24.01	121.68	423	26.3	21.3	1015	25	10.0	200	1161	696.6
St.07	20190421	0335	23.76	122.00	3361	27.6	26.1	1006	82	3.1	200	929	557.4
St.08	20190421	0653	23.76	122.50	2806	26.5	25.7	1010	69	3.2	200	676	405.6
St.09	20190421	1013	23.75	123.01	3450	26.5	26.3	1011	297	3.3	200	782	469.2
St.10	20190421	1525	23.00	123.01	>4000	27.9	25.7	1007	220	3.7	200	1288	772.8
St.11	20190421	1908	23.00	122.51	>5000	27.5	27.5	1007	203	4.6	200	968	580.8
St.12	20190421	2252	23.00	122.00	>4000	27.9	27.4	1008	160	3.6	200	996	597.6
St.13	20190422	0240	22.99	121.49	1853	27.5	26.3	1007	130	5.1	200	1128	676.8
St.14	20190422	0704	22.67	121.25	1215	26.6	26.0	1009	111	3.7	200	785	471.0
St.15	20190422	1807	22.26	121.00	1241	27.0	28.1	1010	243	6.8	200	336	201.6
St.16	20190422	1142	22.25	121.49	670	23.9	22.8	1017	152	7.2	200	977	586.2
St.17	20190411	1850	22.25	122.01	4837	26.8	25.3	1014	208	16.2	200	1070	642.0
St.18	20190411	1511	22.25	122.50	4857	27.0	24.6	1017	180	7.0	200	829	497.4
St.19	20190411	1159	22.25	122.99	2391	27.1	26.6	1011	122	1.2	200	926	555.6
St.20	20190411	0706	21.51	123.01	3882	27.2	25.9	1012	19	5.7	200	1192	715.2
St.21	20190411	0315	21.50	122.49	4731	27.1	27.0	1011	13	8.0	200	1127	676.2
St.22	20190410	2311	21.49	121.99	3358	27.0	25.8	1012	11	9.9	200	1325	795.0
St.23	20190410	1957	21.50	121.50	2176	27.5	27.2	1013	358	8.2	200	974	584.4
St.24	20190410	1651	21.51	121.00	1226	26.4	27.0	1010	307	7.3	200	836	501.6
St.25	20190410	1339	21.51	120.49	1805	27.1	27.1	1012	291	5.6	200	848	508.8
St.26	20190410	1010	21.50	119.99	3000	26.4	26.7	1012	253	2.7	200	1078	646.8
St.27	20190410	0623	21.50	119.49	2969	26.2	25.8	1012	287	4.7	200	895	537.0
St.28	20190410	0251	21.50	118.99	2752	26.3	25.9	1013	268	3.8	200	1056	633.6
St.29	20190409	2316	22.00	119.00	1478	26.0	26.2	1013	269	3.1	200	854	512.4
St.30	20190409	1954	22.00	119.50	2375	26.9	26.4	1013	226	3.1	200	762	457.2
St.31	20190409	1636	22.00	120.00	1203	26.8	27.5	1013	216	2.4	200	1010	606.0
St.32	20190409	1334	22.00	120.50	278	26.9	27.2	1012	153	4.4	200	790	474.0
St.33	20190409	1042	22.38	120.34	210	26.4	27.1	1013	164	5.8	200	615	369.0
St.34	20190501	0605	22.50	120.00	734	28.1	27.9	1007	261	5.2	200	1083	649.8
St.35	20190501	0018	22.50	119.49	226	27.9	27.8	1009	237	5.8	200	676	405.6
St.36	20190430	2124	22.50	119.00	90	27.1	27.3	1007	89	5.1	80	806	483.6
St.37	20190429	2017	22.94	119.10	30	25.7	26.1	1008	45	2.6	25	173	103.8
St.38	20190429	1753	23.00	119.50	79	26.2	25.9	1015	177	1.9	70	443	265.8
St.39	20190504	1354	22.99	119.93	129	26.8	24.8	1012	186	4.1	130	400	240.0
St.40	20190504	1740	23.49	119.92	123	27.4	24.3	1011	325	7.8	110	568	340.8
St.41	20190504	2019	23.44	119.49	50	26.3	23.3	1012	8	353.2	49	366	219.6
St.42	20190505	0749	23.54	119.08	54.6	24.9	23.9	1015	25	7.9	52	319	191.4
St.43	-	-	-	-	-	-	-	-	-	-	-	-	-
St.44	20190508	1035	24.01	119.50	63	24.6	23.1	1009	33	6.3	60	578	346.8
St.45	-	-	-	-	-	-	-	-	-	-	-	-	-
St.46	20190509	0724	24.63	120.67	53	25.3	22.3	1010	30	8.4	50	331	198.6
St.47	20190509	0415	24.49	120.32	67	25.2	23.6	1009	32	7.0	55	398	238.8
St.48	-	-	-	-	-	-	-	-	-	-	-	-	-
St.49	-	-	-	-	-	-	-	-	-	-	-	-	-
St.50	20190509	1110	24.96	120.55	70	22.9	25.2	1011	344	7.4	70	308	184.8
St.51	20190509	1415	25.09	120.92	82	25.3	22.2	1010	58	5.6	70	344	206.4
St.52	-	-	-	-	-	-	-	-	-	-	-	-	-
St.53	-	-	-	-	-	-	-	-	-	-	-	-	-
St.54	-	-	-	-	-	-	-	-	-	-	-	-	-
St.55	-	-	-	-	-	-	-	-	-	-	-	-	-
St.56	-	-	-	-	-	-	-	-	-	-	-	-	-
St.57	-	-	-	-	-	-	-	-	-	-	-	-	-
St.58	-	-	-	-	-	-	-	-	-	-	-	-	-
St.59	-	-	-	-	-	-	-	-	-	-	-	-	-
St.60	-	-	-	-	-	-	-	-	-	-	-	-	-
St.61	-	-	-	-	-	-	-	-	-	-	-	-	-
St.62	-	-	-	-	-	-	-	-	-	-	-	-	-

表 2. 2019 年 7 月航次基礎觀測資料
Chart 2. Sea observation data in July 2019

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	20190817	1130	24.87	122.00	340	27.9	29.5	1004	179	5.3	200	845	507.0
St.02	20190817	1441	24.99	122.51	>1423	28.5	29.4	1003	181	3.3	200	1011	606.6
St.03	20190817	1744	25.00	123.00	>1500	29.5	28.9	1004	333	2.8	200	946	567.6
St.04	20190817	2309	24.50	122.49	604	29.2	26.8	1005	321	1.0	200	888	532.8
St.05	20190818	0231	24.50	122.00	700	25.3	27.4	1004	301	2.9	200	459	275.4
St.06	20190818	0649	24.00	121.69	515	26.2	27.1	1005	252	3.6	200	893	535.8
St.07	20190818		23.76	121.99	>3000	29.7	27.0	1007	28	3.7	200	1105	663.0
St.08	20190818	1305	23.75	122.50	>3500	29.7	28.4	1004	303	2.6	200	426	255.6
St.09	20190818	1628	23.75	122.99	3460	27.5	29.1	1003	70	8.5	200	1022	613.2
St.10	20190818	2153	23.09	123.01	>4000	28.7	29.4	1004	66	4.8	200	951	570.6
St.11	20190819	0128	22.99	122.51	>5000	28.9	28.3	1007	221	7.4	200	1011	606.6
St.12	20190819	0503	23.01	122.01	>4000	29.0	27.9	1007	252	4.2	200	1062	637.2
St.13	20190819	0845	23.01	121.51	>2000	27.8	29.2	1006	41	2.6	200	1031	618.6
St.14	20190819	1237	22.67	121.25	1147	25.3	28.7	1007	238	4.3	200	858	514.8
St.15	20190819	1652	22.25	121.01	1242	26.0	25.1	1004	184	4.8	200	1011	606.6
St.16	20190819	1958	22.25	121.50	570	28.7	27.1	1005	32	1.8	200	1092	655.2
St.17	20190819	2247	22.25	122.00	>1000	26.1	29.2	1008	279	1.9	200	873	523.8
St.18	20190820	0217	22.25	122.50	>4000	27.1	29.1	1006	204	1.9	200	1081	648.6
St.19	20190820	0522	22.25	122.99	>4000	28.9	28.3	1004	216	5.4	200	1030	618.0
St.20	20190820	1038	21.50	123.00	3882	29.2	28.9	1005	244	6.7	200	1053	631.8
St.21	20190820	1415	21.50	122.51	1260	29.1	28.9	1005	212	7.6	200	914	548.4
St.22	20190820	1749	21.51	122.01	>1000	29.1	27.2	1006	70	2.3	200	908	544.8
St.23	20190820	2143	21.50	121.51	1392	28.6	26.1	1006	171	5.7	200	1028	616.8
St.24	20190821	0133	21.50	121.00	1197	28.2	27.6	1004	210	0.8	200	910	546.0
St.25	-	-	-	-	-	-	-	-	-	-	-	-	-
St.26	-	-	-	-	-	-	-	-	-	-	-	-	-
St.27	-	-	-	-	-	-	-	-	-	-	-	-	-
St.28	-	-	-	-	-	-	-	-	-	-	-	-	-
St.29	-	-	-	-	-	-	-	-	-	-	-	-	-
St.30	-	-	-	-	-	-	-	-	-	-	-	-	-
St.31	-	-	-	-	-	-	-	-	-	-	-	-	-
St.32	20190821	0617	21.99	120.51	418	28.4	27.1	1006	117	2.3	200	1101	660.6
St.33	20190821	0905	22.37	120.34	150	28.6	27.4	1007	100	5.3	140	718	430.8
St.34	20190729	1939	22.51	120.01	623	30.0	30.1	1008	117	10.4	200	805	483.0
St.35	-	-	-	-	-	-	-	-	-	-	-	-	-
St.36	-	-	-	-	-	-	-	-	-	-	-	-	-
St.37	20190730	0250	22.94	119.10	33	27.8	29.0	1008	115	5.2	25	201	120.6
St.38	20190730	0511	23.00	119.50	85	29.2	29.1	1007	97	4.9	80	255	153.0
St.39	20190730	0736	23.00	119.91	129	29.4	28.9	1008	55	3.7	120	759	455.4
St.40	20190730	1031	23.50	119.92	125	29.5	29.0	1008	350	3.1	110	659	395.4
St.41	20190730	1307	23.43	119.50	59	29.1	28.6	1007	348	3.8	60	324	194.4
St.42	20190730	1600	23.51	119.00	58	27.7	28.3	1006	47	4.5	50	322	193.2
St.43	20190730	1844	24.00	119.00	62	28.2	28.7	1007	17	5.2	55	375	225.0
St.44	20190730	2135	24.00	119.50	69	-	30.2	1007	6	3.6	60	290	174.0
St.45	20190731	0030	24.00	120.00	46	29.5	29.0	1007	320	3.5	35	286	171.6
St.46	20190731	0415	24.50	120.50	56	29.5	29.5	1008	155	0.4	45	333	199.8
St.47	20190731	1025	24.50	120.00	65	29.4	28.4	1007	13	2.3	55	288	172.8
St.48	20190731	1321	24.50	119.51	68	29.2	28.2	1007	357	5.8	64	344	206.4
St.49	20190731	1654	25.00	120.00	56	28.9	29.3	1006	16	2.5	52	268	160.8
St.50	20190731	1933	25.00	120.50	81	29.3	30.2	1006	301	2.6	70	384	230.4
St.51	20190731	2214	25.09	120.93	84	29.3	29.1	1008	117	9.9	75	443	265.8
St.52	20190801	0145	25.50	120.50	65	29.4	29.4	1007	130	1.7	65	206	123.6
St.53	20190801	0525	26.00	120.99	78	29.2	28.8	1008	105	5.6	70	558	334.8
St.54	20190801	0850	25.50	121.00	93	29.4	29.3	1008	75	1.8	93	459	275.4
St.55	20190801	1142	25.50	121.50	118	29.2	29.0	1008	100	7.5	110	364	218.4
St.56	20190801	1453	25.99	121.51	74	29.2	29.0	1008	122	8.4	60	238	142.8
St.57	20190801	1750	26.00	121.99	107	29.2	29.0	1008	126	7.9	103	439	263.4
St.58	20190801	2055	26.01	122.49	112	29.6	29.0	1007	114	5.6	111	491	294.6
St.59	20190801	2355	26.00	123.00	102	29.5	28.9	1008	129	5.1	90	503	301.8
St.60	20190802	0249	25.51	123.01	773	29.4	29.2	1008	120	2.9	200	984	590.4
St.61	20190802	0606	25.50	122.50	429	29.2	28.9	1008	87	2.7	200	813	487.8
St.62	20190802	0856	25.51	121.99	119	29.2	29.0	1008	85	2.4	110	431	258.6

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