



Cruise Report of TaiCOFI Surveys in 2010

2010年台灣周邊海域漁場環境監測航次報告



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序

近年來，海洋捕撈業面臨全球氣候變遷、海洋生態環境惡化及漁業資源銳減等多重衝擊，使得台灣的漁業經營環境愈顯嚴峻。基此，本所積極致力於海洋漁業相關試驗研究，追求漁業資源永續利用、健全漁業經營環境、創造優質且穩定的水產糧食供應，將台灣漁業與科研成果落實並推廣漁民。

如何有效監測海洋物理與化學環境，以便及時發現問題並提供解決對策，是海洋研究重要的工作。本所自 2003 年開始持續執行「台灣周邊海域漁場環境監測」計畫，針對周邊海洋環境進行大規模調查，在本所與各方努力之下已小有成果。然而試驗研究成果的價值在於漁業管理措施的制定與產業面之應用，本所當前的首要工作，即是加強試驗研究與行政機關的橫向聯繫與合作，讓漁業政策的制定與相關管理措施以試驗研究成果為基礎；使本所的研究與漁民的實際需求密切結合，讓漁民有感政府在漁業上的努力。此外，未來試驗研究應走向國際化，加強與國際學術研究的合作並掌握國際漁業發展動態。

本所自 2008 年開始陸續發行《台灣周邊海域漁場環境監測航次報告》，將歷年調查成果公開予漁業行政部門及其他學術研究單位參考。本年度接續編撰本刊，圖表除中文外並加上英文說明，目的在於讓國際學術單位亦能瞭解本計畫的研究成果，以提升本所的國際學術層面試驗成果交流的可能性，希冀本計畫對漁業資源相關政策制定與學術應用上有所貢獻，讓台灣周邊海域漁業資源永續利用有其科學根據可供依循，開創漁業永續發展之新頁。

所長

郭慶老

謹誌

中華民國一零一年十二月

Preface

In recent years, marine capture fishery of Taiwan encountered the challenge of climate change, deterioration of the marine environment and ecosystems, and the decline of fishery resources. Thus, Fisheries Research Institute (FRI) has dedicated to researches to achieve the goals of sustainable utilization of fishery resource, improving the competitiveness of the industry, providing superior quality and safe aquatic food supply, and promoting our scientific results to the industry.

How to monitoring our ocean to detect anomalies effectively and to find a way to deal with the situation is the priority for fishery researchers. Therefore, 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. However, the value of scientific results lies in being helpful to the fishery management as well as the industry. Therefore, there are some prospects of the future work of FRI. First, enhance the cooperation between research institute and administration department, for manage measures should be implemented on the basis of scientific studies. Second, result of the studies should be applicable to fulfill the need of the industry. Third, encourage our staff fellows to take part in international joint academic researches, to follow the global trend of fishery.

FRI published a series of cruise report of TaiCOFI surveys since 2008 to provide our investigation results to the public. This year we continued to publish “Cruise report of TaiCOFI surveys in 2010”, which was written bilingually, to promote international academic exchange. We hope this project will be helpful for fishery policy making and fishery researchers, contributing more to the society, and leading fisheries in Taiwan toward sustainability.

Director

A handwritten signature in black ink, appearing to read 'Chun-Lan Wu', with a stylized flourish underneath.

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 2010 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：99 農科-10.2.1-水-A3）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，利用 Surfer 軟體以圖示方式刊出台灣周邊海域之水溫、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。本計畫內容涉及廣泛專業領域，也由於人力及經驗的關係，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 during four cruises in 2010 of the Tai COFI program. Data from the cruises were collected and processed by personnel of FRI and Professor Cheng Shiue-Yuan of National Taiwan Ocean University participated in the analysis of primary productivity. 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. Finally, we will extent 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 2010 年 1 月、4 月及 9 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°C 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°C)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 January, April and September in 2010. 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、Na₂SO₃ 及 NaHSO₃ 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 °C）24 小時之後，將樣品置於冷凍離心機 4 °C、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/m^3).

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	助理研究員
農業委員會水產試驗所海洋漁業組	藍揚麒 Lan Yang-Chi	助理研究員
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	陳人平 Chen Zen-Pin	聘用助理研究員
農業委員會水產試驗所海洋漁業組	簡煌彬 Jen Hung-Bun	專業技工
農業委員會水產試驗所海洋漁業組	張玉真 Chan Yu-Cheng	專業技工
農業委員會水產試驗所海洋漁業組	蘇博堃 Su Bo-Kuan	研究助理
農業委員會水產試驗所海洋漁業組	張伯瑋 Chang Po-Wei	研究助理
國立台灣海洋大學環境生物與漁業科學系	鄭學淵 Cheng Sha-Yen	副教授
國立台灣海洋大學環境生物與漁業科學系	王河順 Wang Ho-Shen	研究助理

各航次出海採樣人員 Cruise personnel

2010-01-07 航次	所 內 人 員		所 外 人 員	
	陳郁凱	副研究員	王河順	海大環漁系研究助理
	陳威克	聘用副研究員	鍾偉銓	海大環漁系研究生
	莊世昌	聘用研究助理		
	王凱毅	研發替代役		
2010-04-08 航次	所 內 人 員		所 外 人 員	
	陳郁凱	助理研究員	王河順	海大環漁系研究助理
	潘佳怡	聘用研究助理	王采玉	海大環漁系研究生
	蕭聖代	聘用研究助理		
	梁宏彥	國防儲備役		
2010-09-27 航次	所 內 人 員		所 外 人 員	
	陳人平	聘用研究助理	王河順	海大環漁系研究助理
	潘佳怡	聘用研究助理	呂葶瑜	海大環漁系研究生
	陳玉姬	專業技工	林厚宇	海大環漁系研究生
水試一號試驗船人員	所 內 人 員		所 外 人 員	
	陳林耀	船長	高懷恩	大副
	林正雄	二副	朱振銘	三副
	許明仁	總輪機長	程秀同	大管
	翁建順	二管	鄭清波	三管
	廖介生	輪機員	丁振傑	輪機員
	謝耀瑩	輪機員	陳建良	大廚
	蔡嘉進	二廚	林文賢	漁航員
	羅勝義	漁航員	李堂炯	漁航員
	葉日信	漁航員	蔡安傑	漁航員
	林冠宏	漁航員	陳明展	漁航員
	許俊為	漁航員	何國銘	漁航員
	陳柏青	漁航員	蔡宏義	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	鄭學淵實驗室
浮游動物分類	簡煌彬、林芝仔、張玉真、潘佳怡

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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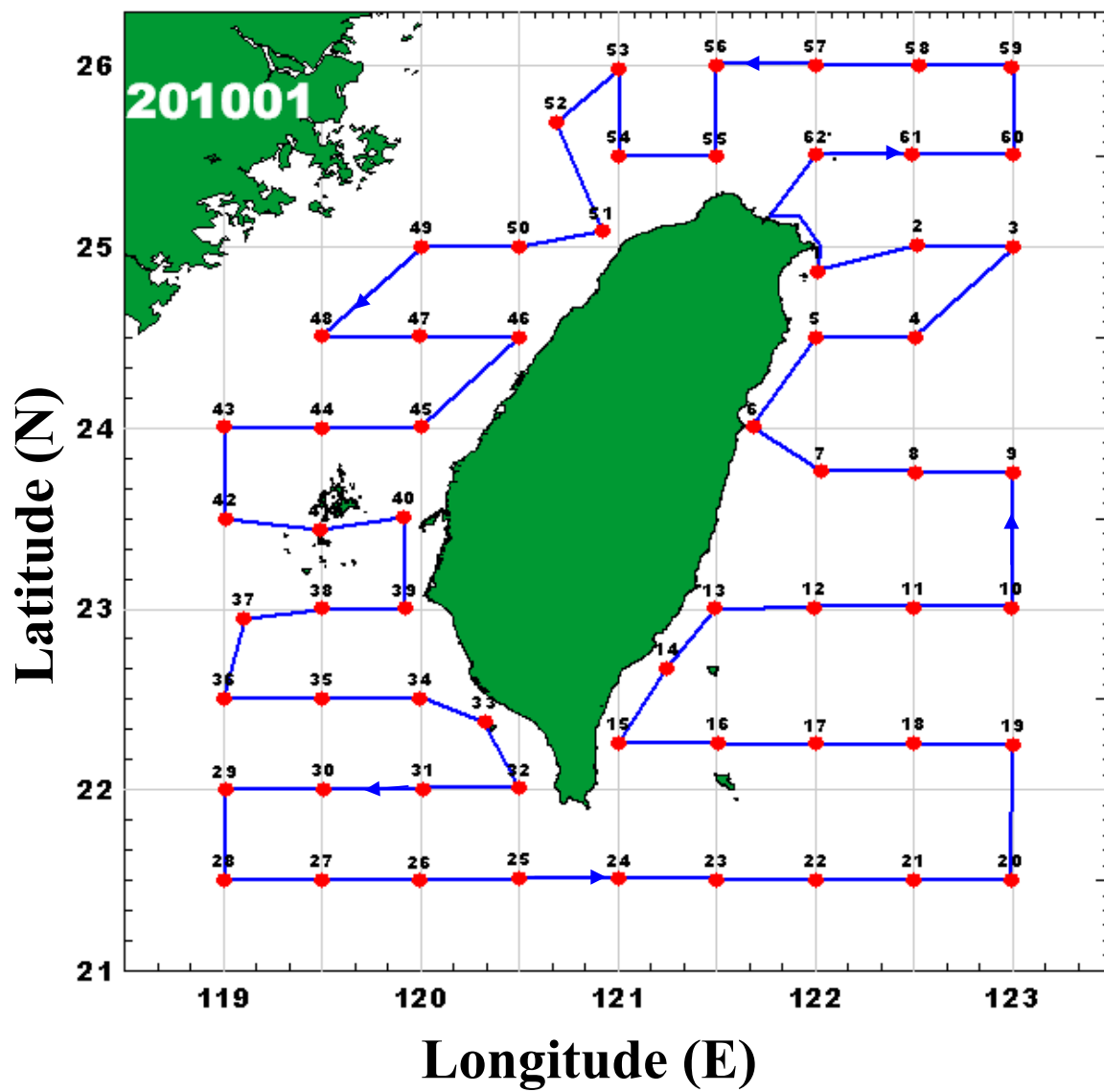


圖 01. 2010-01 航次航跡圖

Fig. 01. Stations and Cruise tracks for TaiCOFI Survey in Jan. 2010.

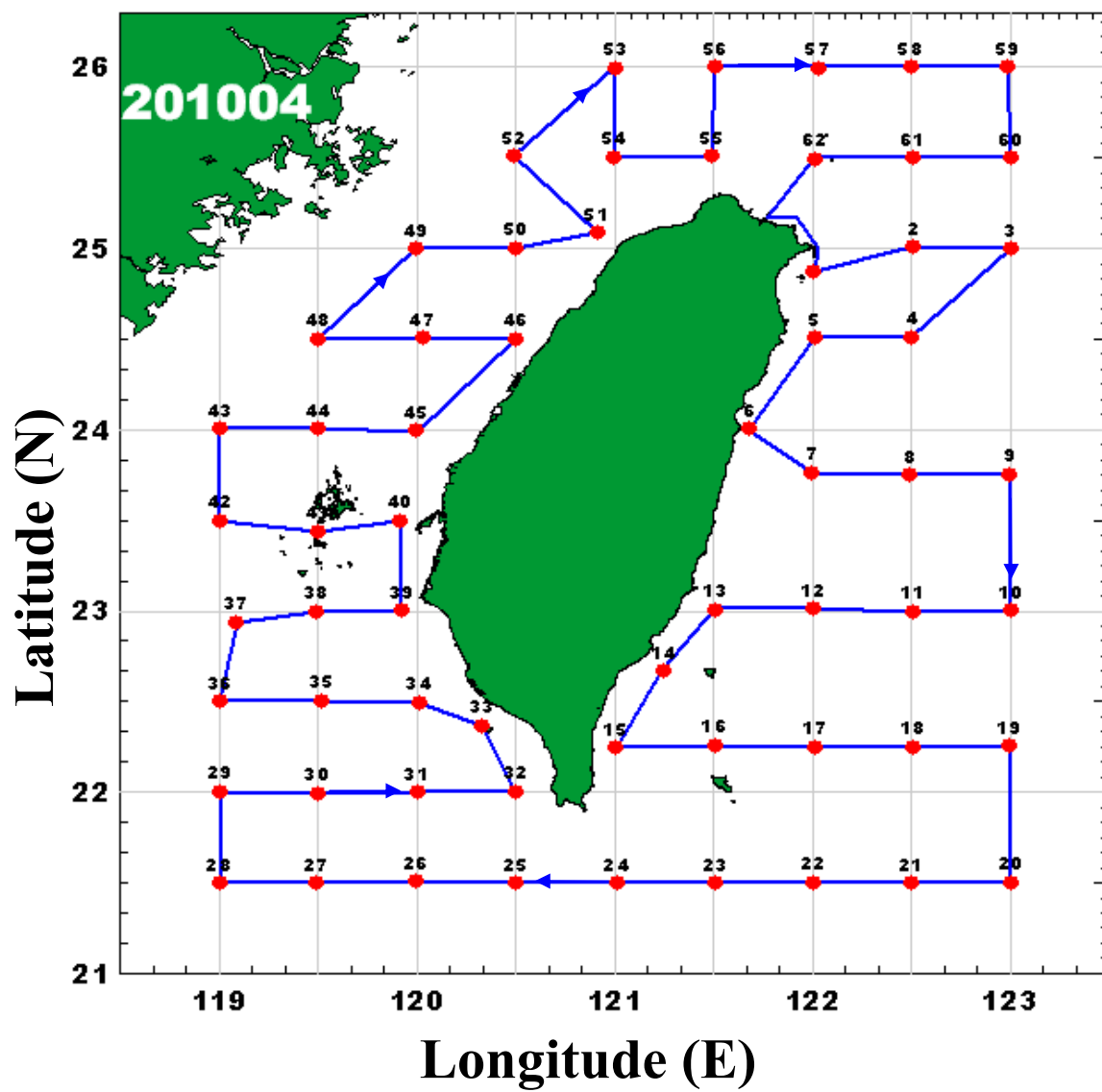


圖 02. 2010-04 航次航跡圖

Fig. 02. Stations and Cruise tracks for TaiCOFI Survey in Apr. 2010.

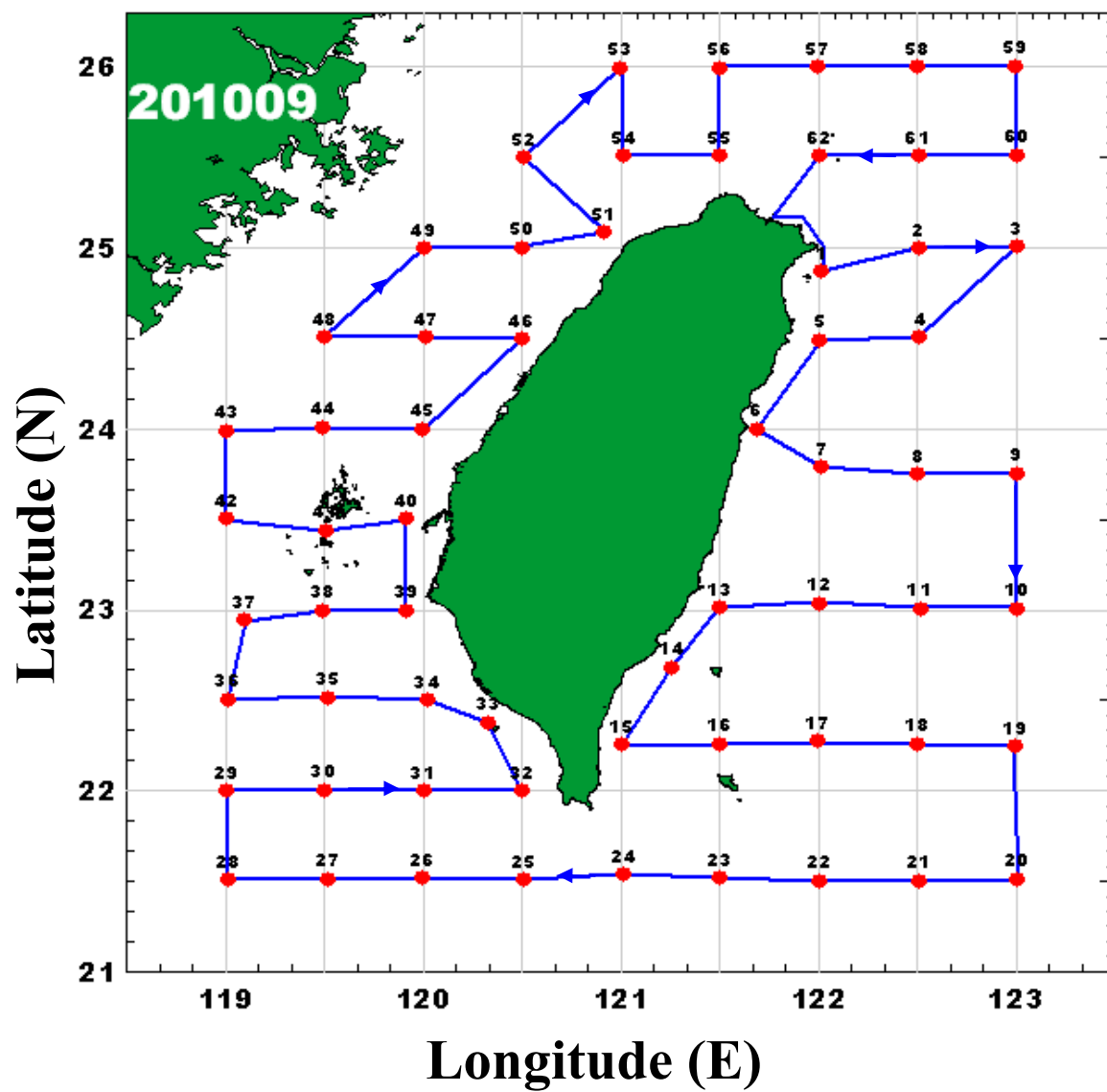


圖 03. 2010-09 航次航跡圖

Fig. 03. Stations and Cruise tracks for TaiCOFI Survey in Sep. 2010.

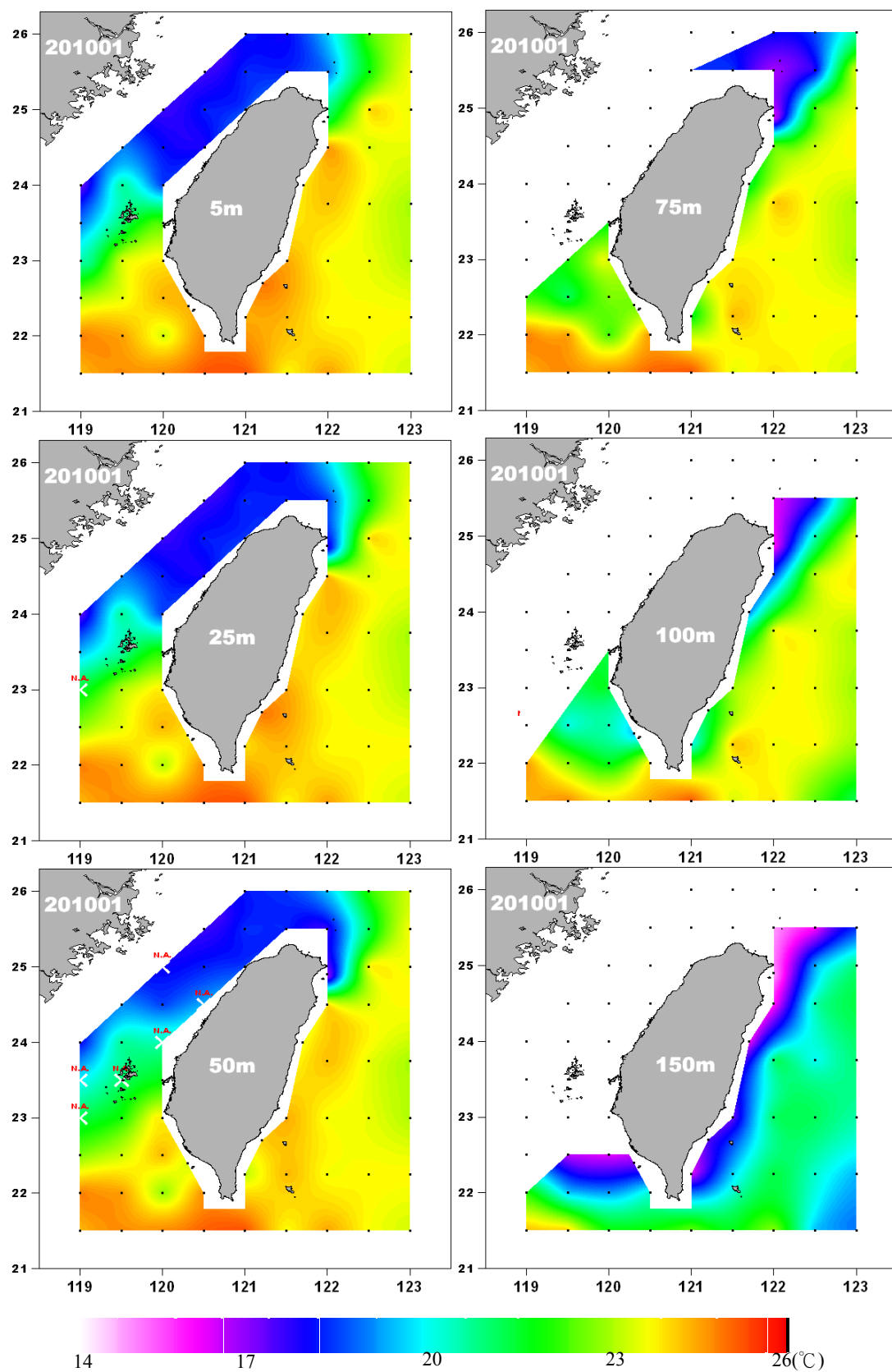


圖 04. 2010-01 航次水溫分布

Fig. 04. Temperature distribution in Jan. 2010.

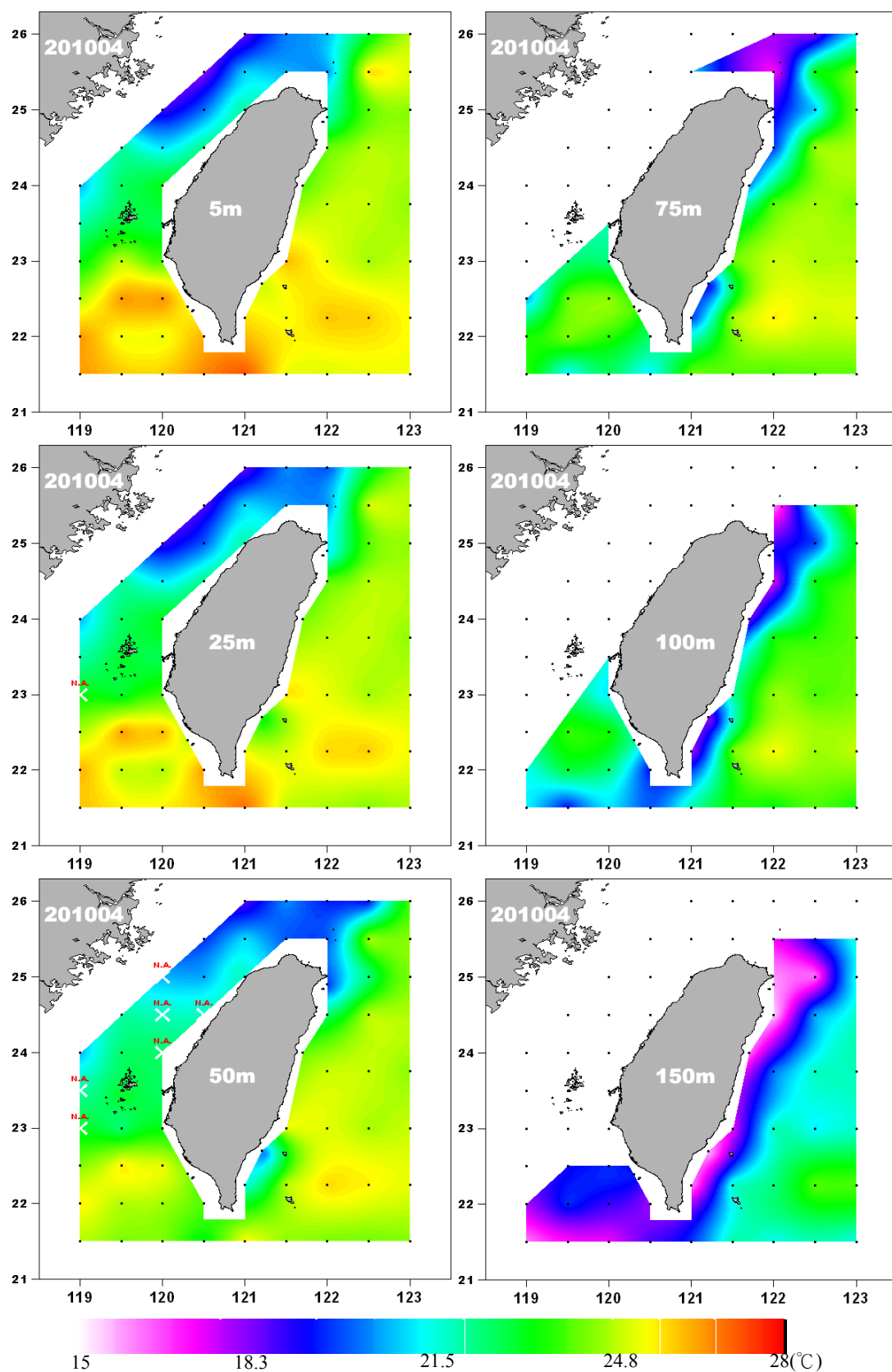


圖 05. 2010-04 航次水溫分布

Fig.05. Temperature distribution in Apr. 2010.

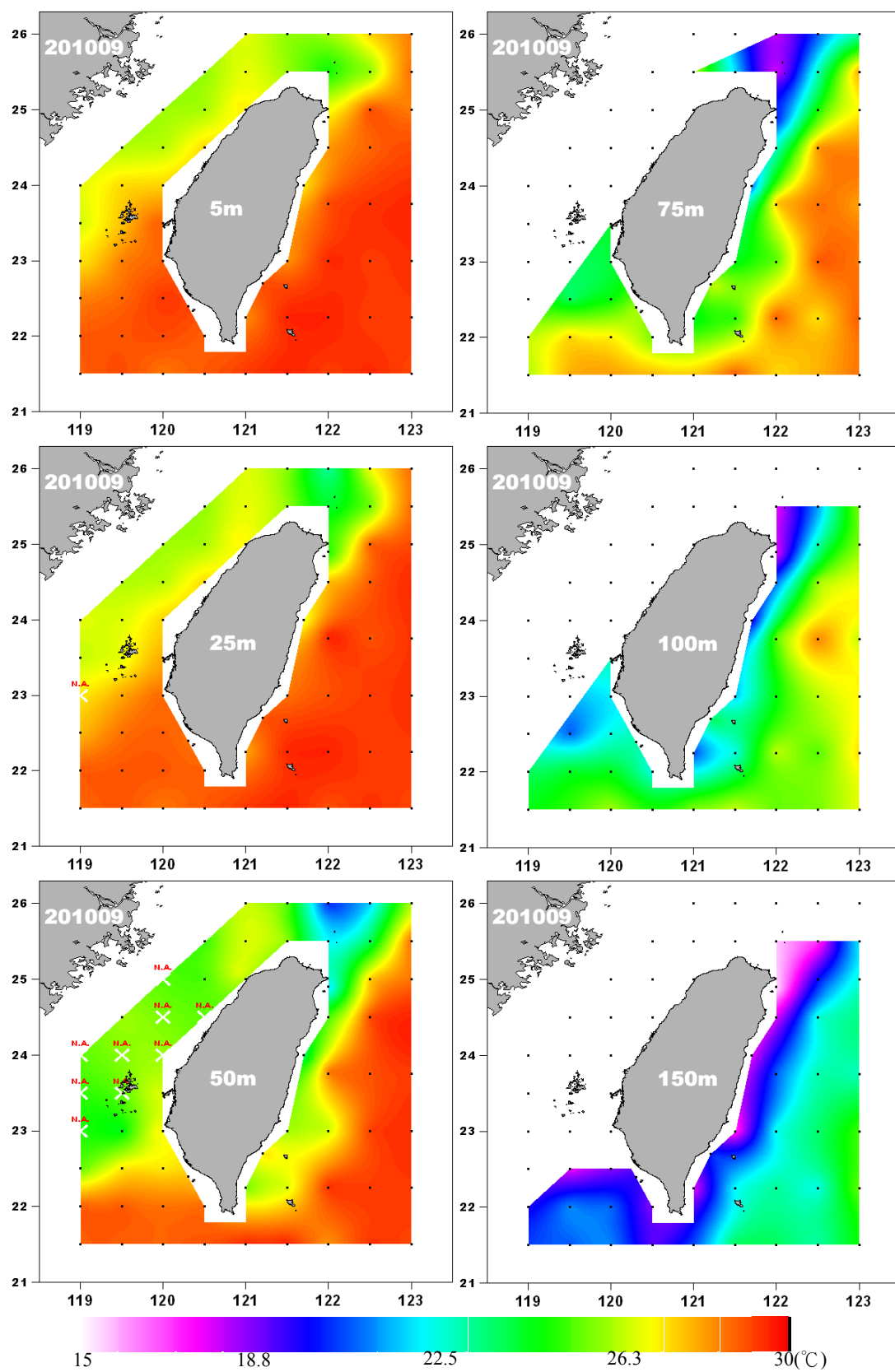


圖 06. 2010-09 航次水溫分布

Fig. 06. Temperature distribution in Sep. 2010.

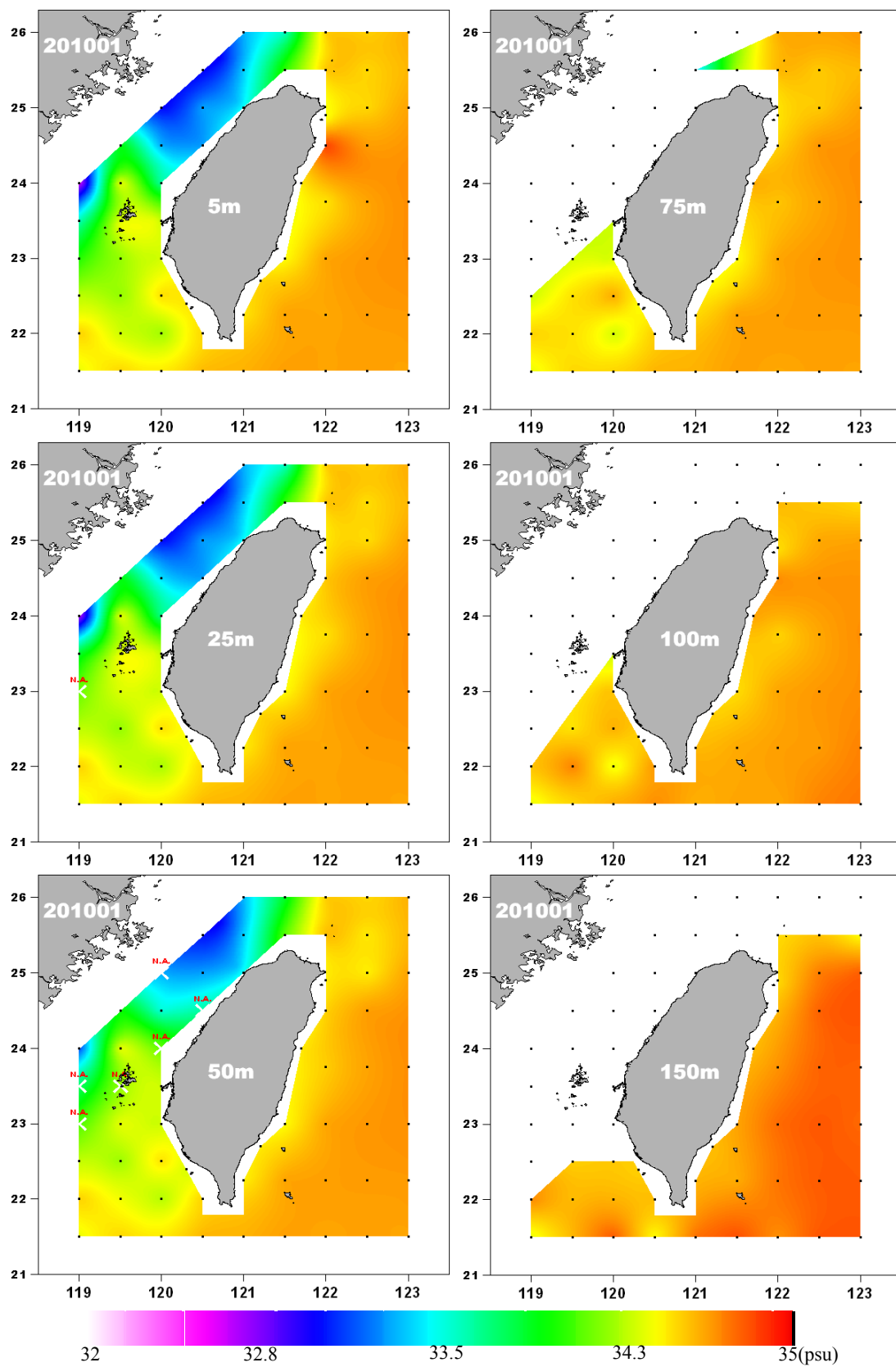


圖 07. 2010-01 航次鹽度分布

Fig. 07. Salinity distribution in Jan. 2010.

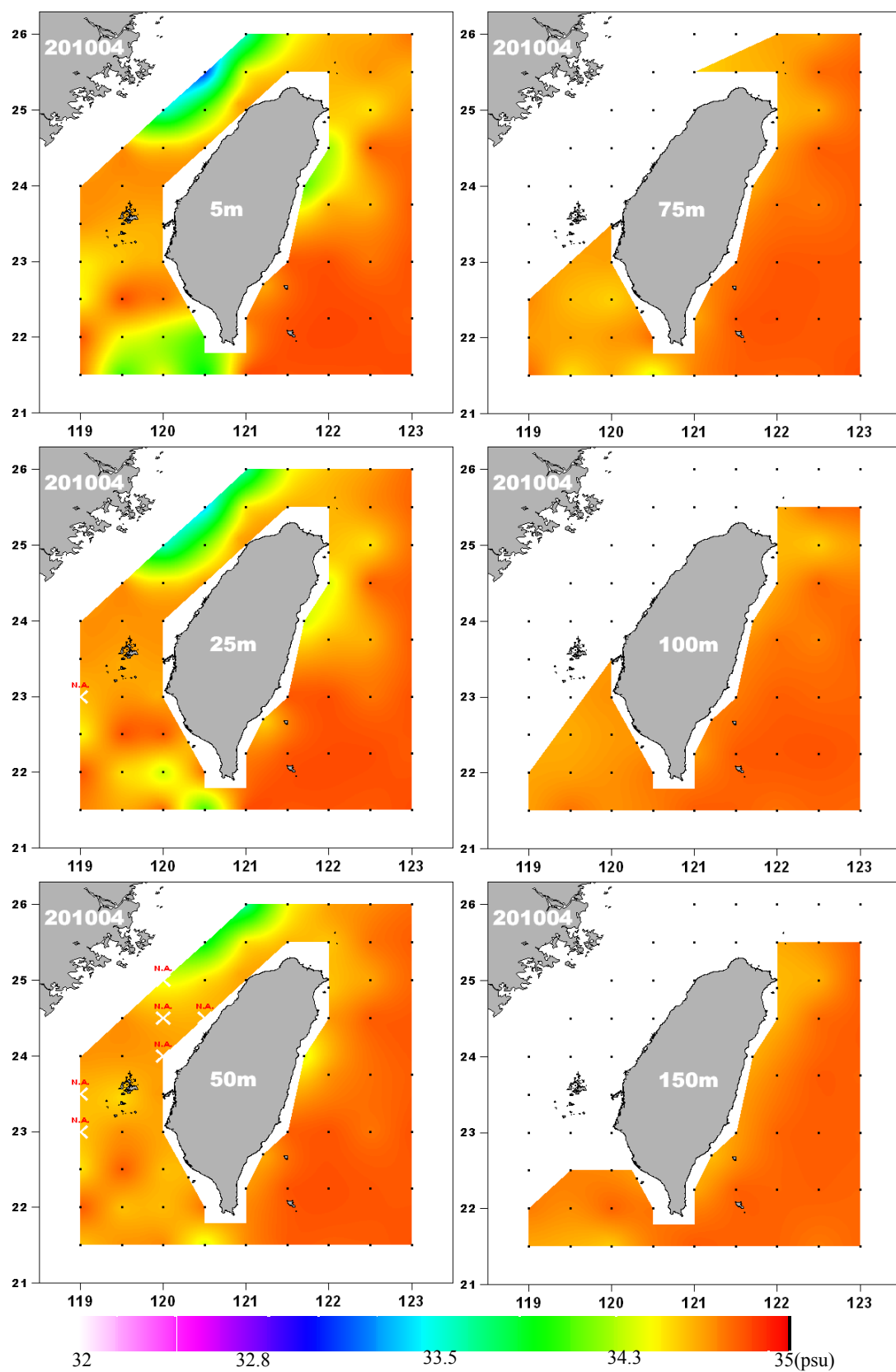


圖 08. 2010-04 航次鹽度分布

Fig. 08. Salinity distribution in Apr. 2010.

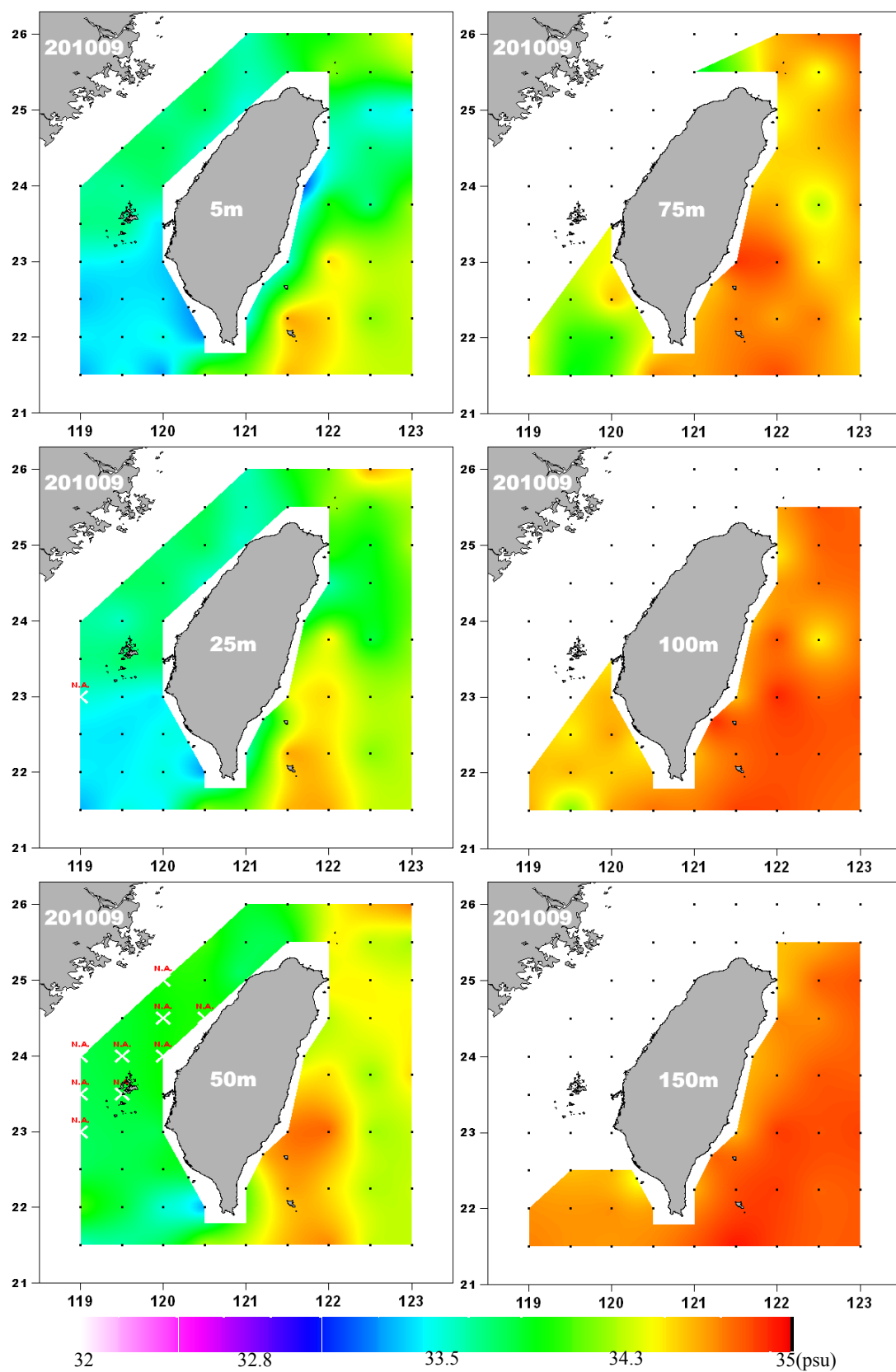


圖 09. 2010-09 航次鹽度分布

Fig. 09. Salinity distribution in Sep. 2010.

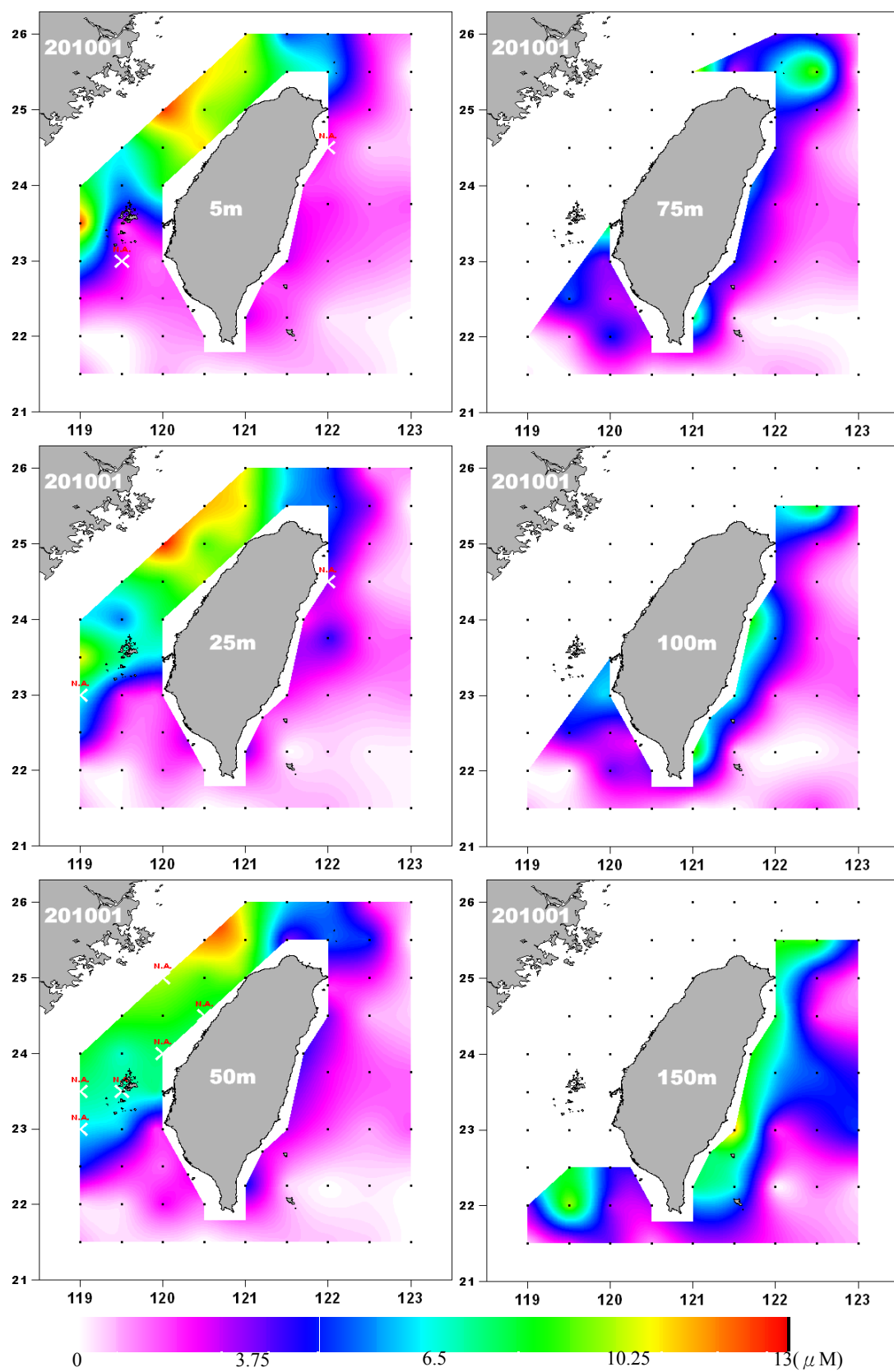


圖 10. 2010-01 航次硝酸鹽(NO_3^-)濃度分布

Fig. 10. Nitrate (NO_3^-) distribution in Jan. 2010.

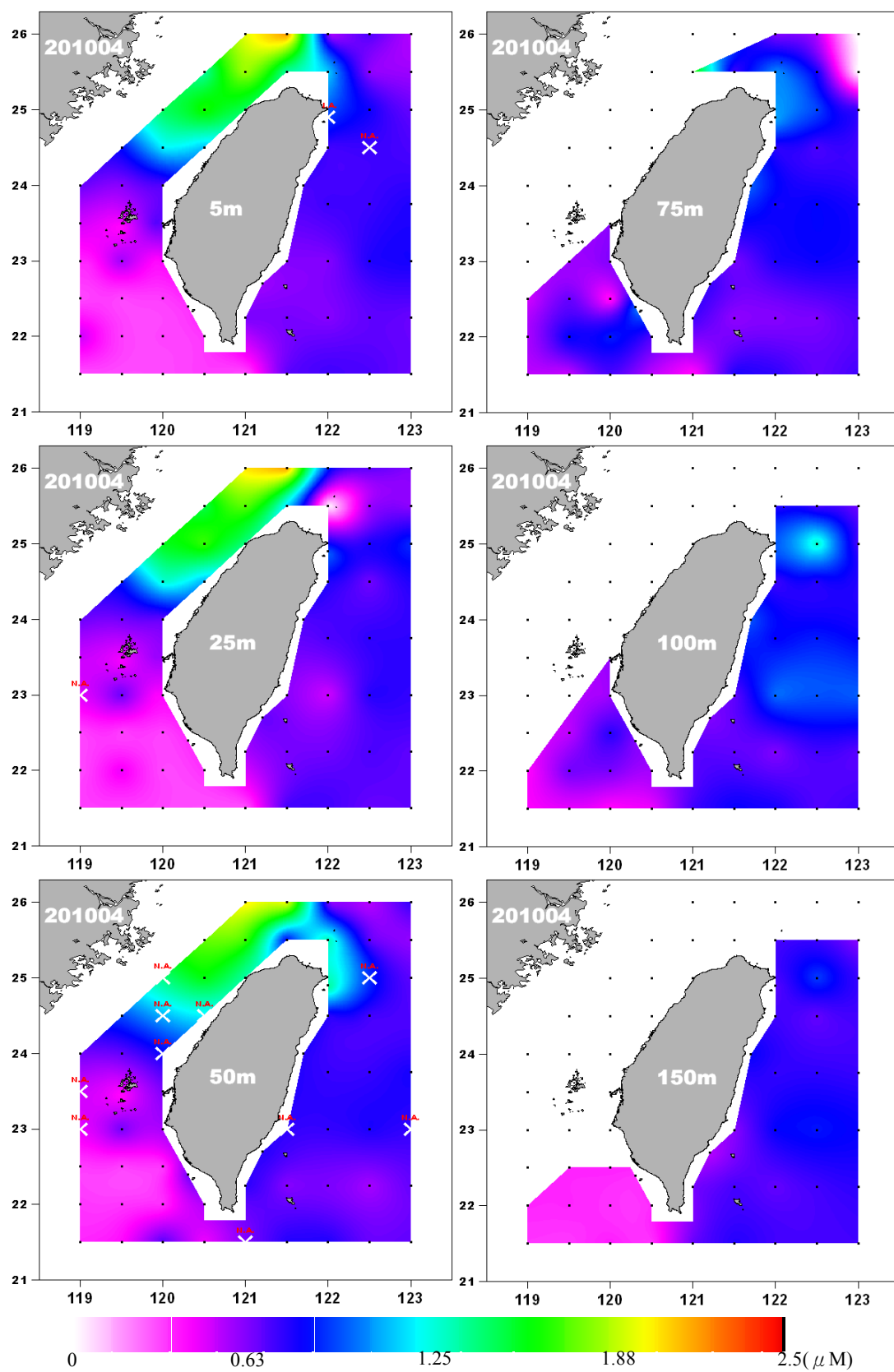


圖 11. 2010-04 航次硝酸鹽(NO_3^-)濃度分布

Fig. 11. Nitrate (NO_3^-) distribution in Apr. 2010.

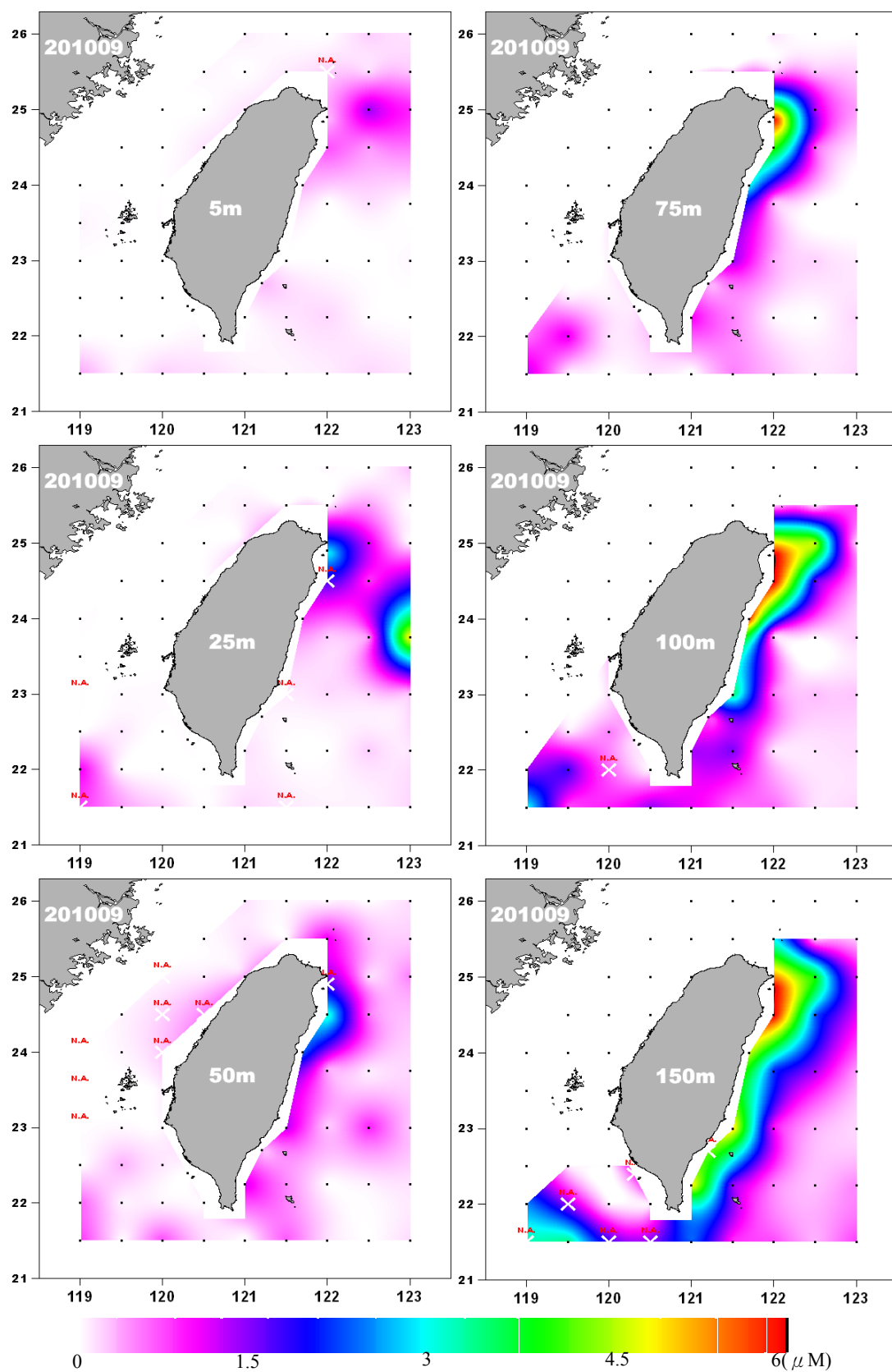


圖 12. 2010-09 航次硝酸鹽(NO_3^-)濃度分布

Fig. 12. Nitrate (NO_3^-) distribution in Sep. 2010.

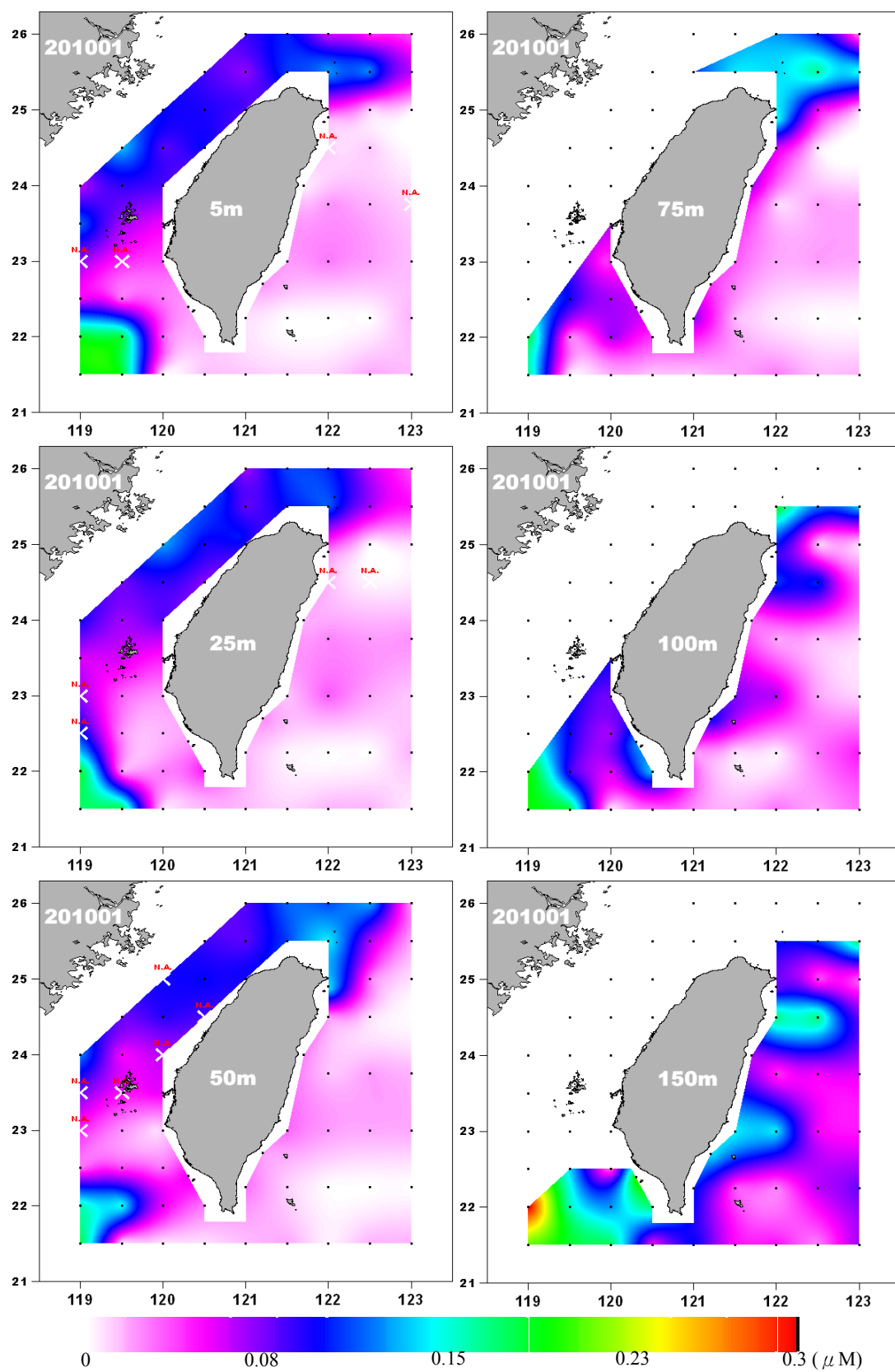


圖 13. 2010-01 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 13. Phosphate (PO_4^{3-}) distribution in Jan. 2010.

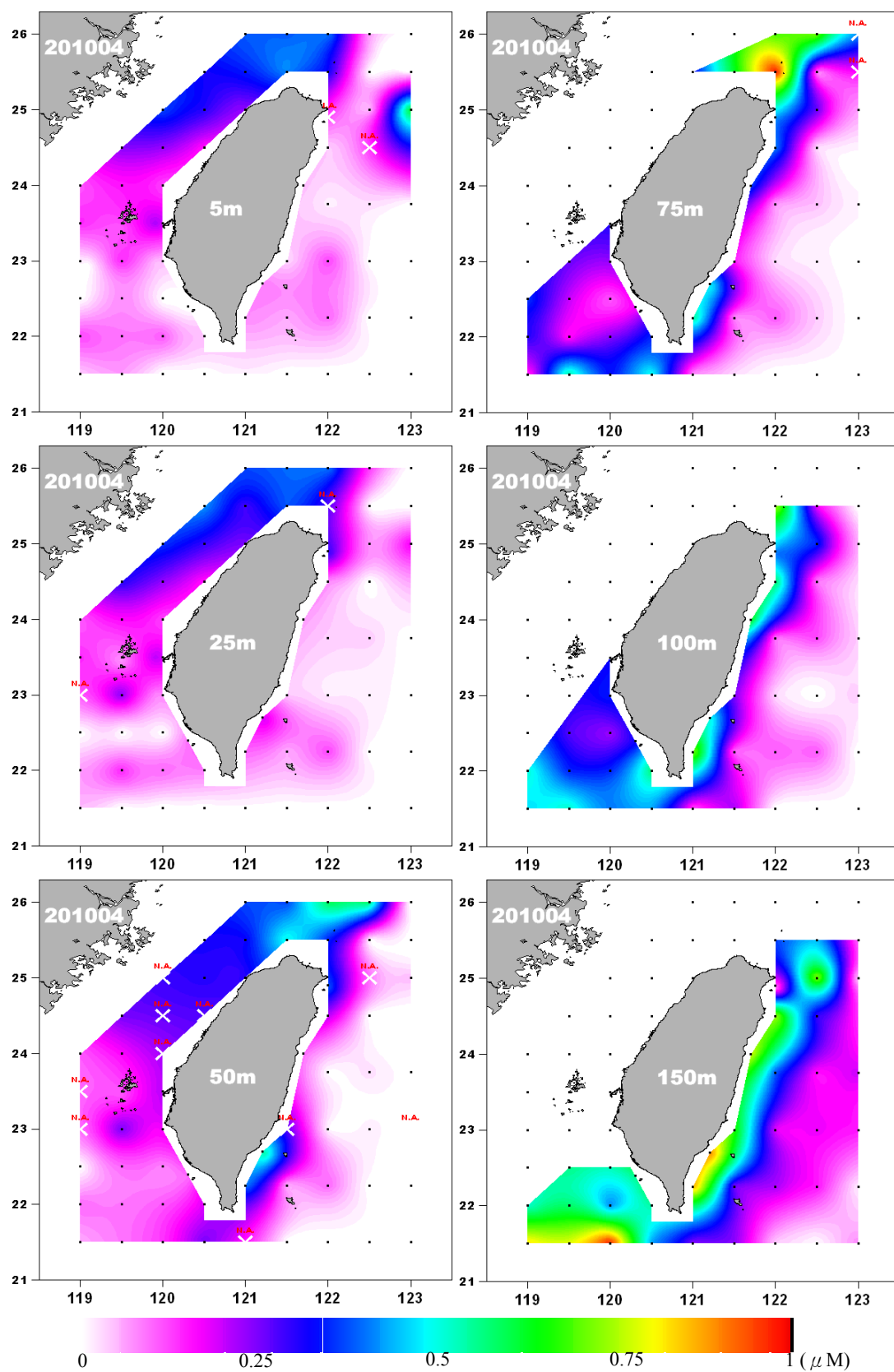


圖 14. 2010-04 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 14. Phosphate (PO_4^{3-}) distribution in Apr. 2010.

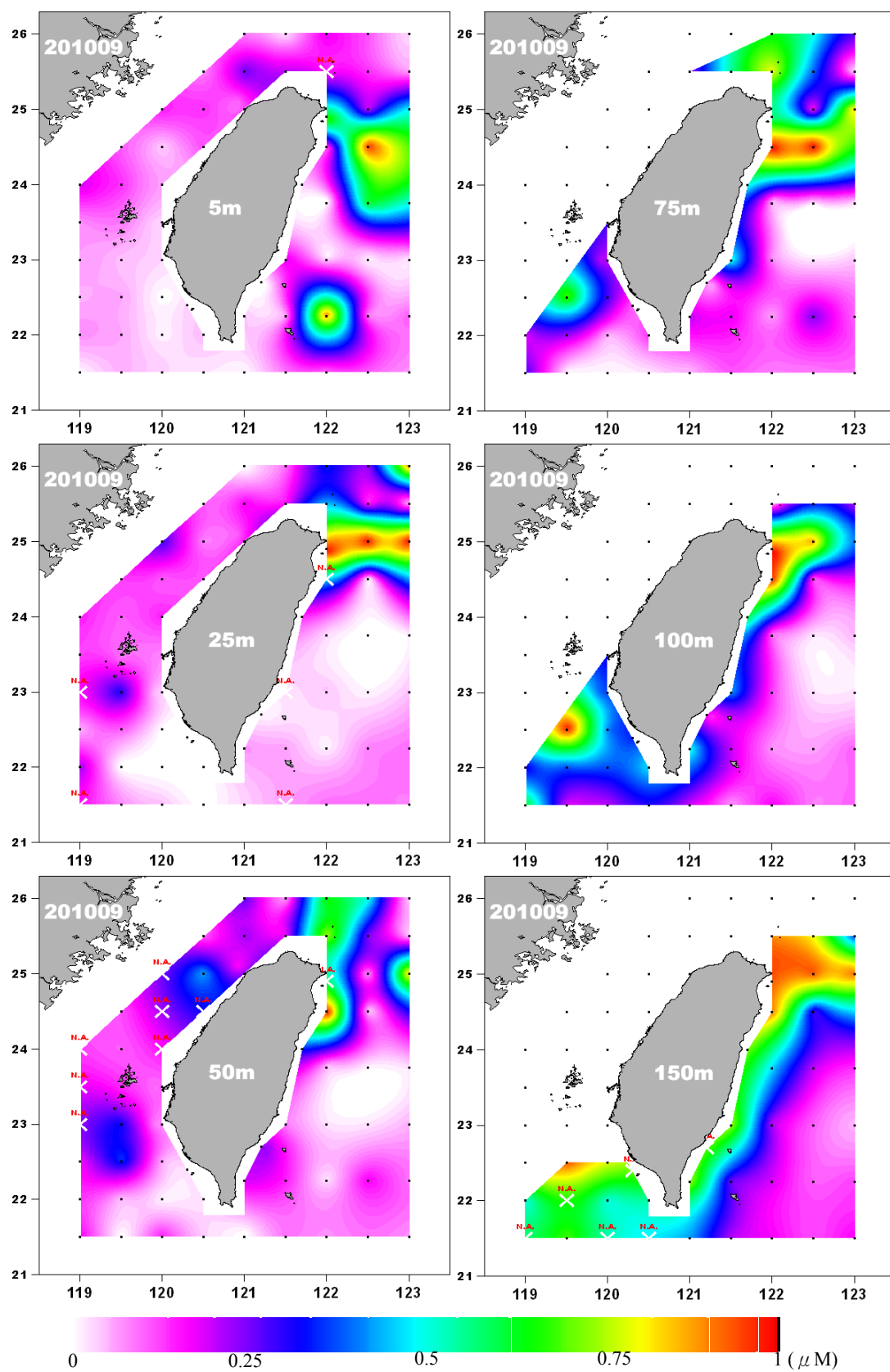


圖 15. 2010-09 航次磷酸鹽(PO_4^{3-})濃度分布

Fig. 15. Phosphate (PO_4^{3-}) distribution in Sep. 2010.

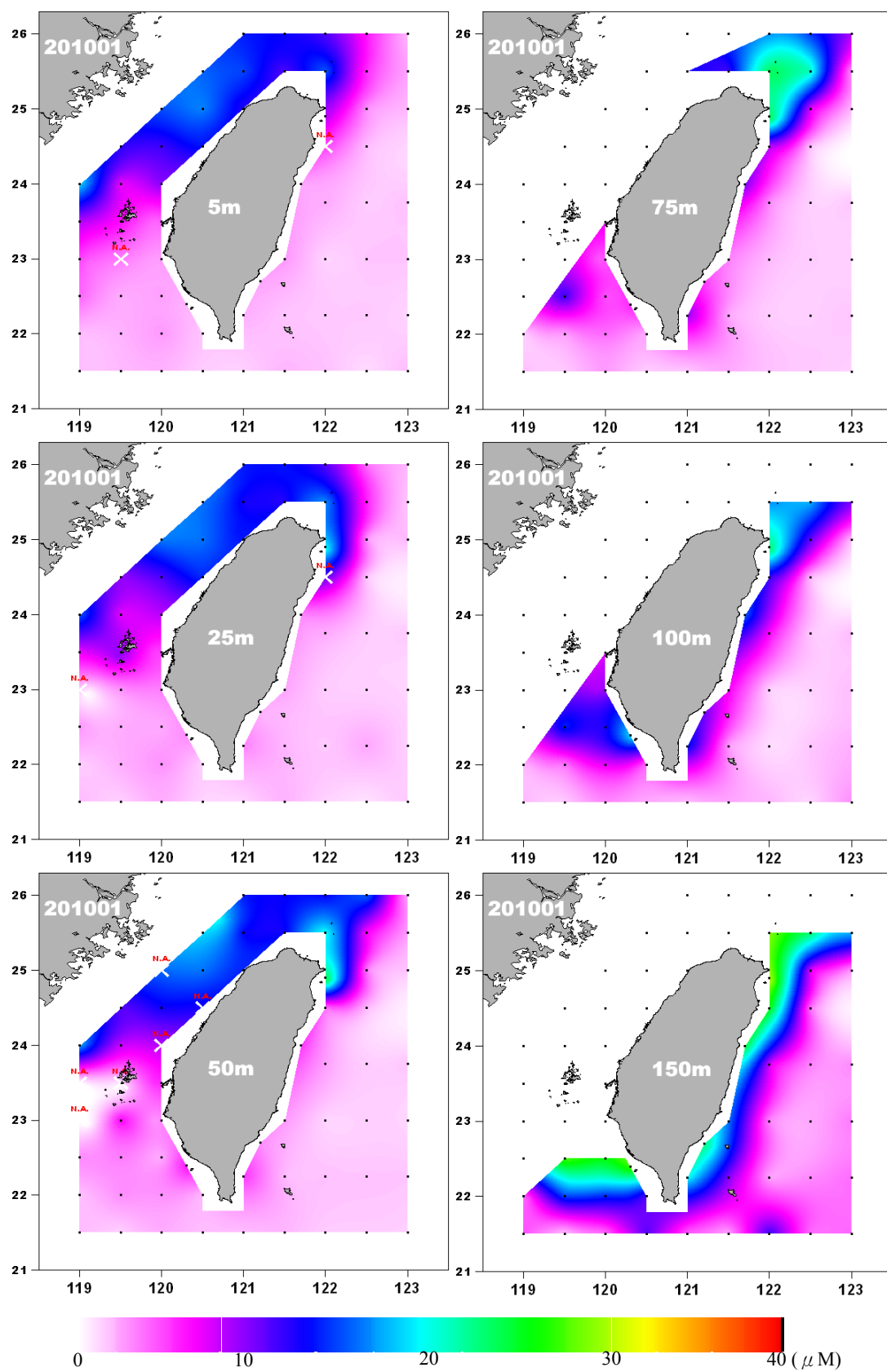


圖 16. 2010-01 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 16. Silicate (SiO_2^{2-}) distribution in Jan. 2010.

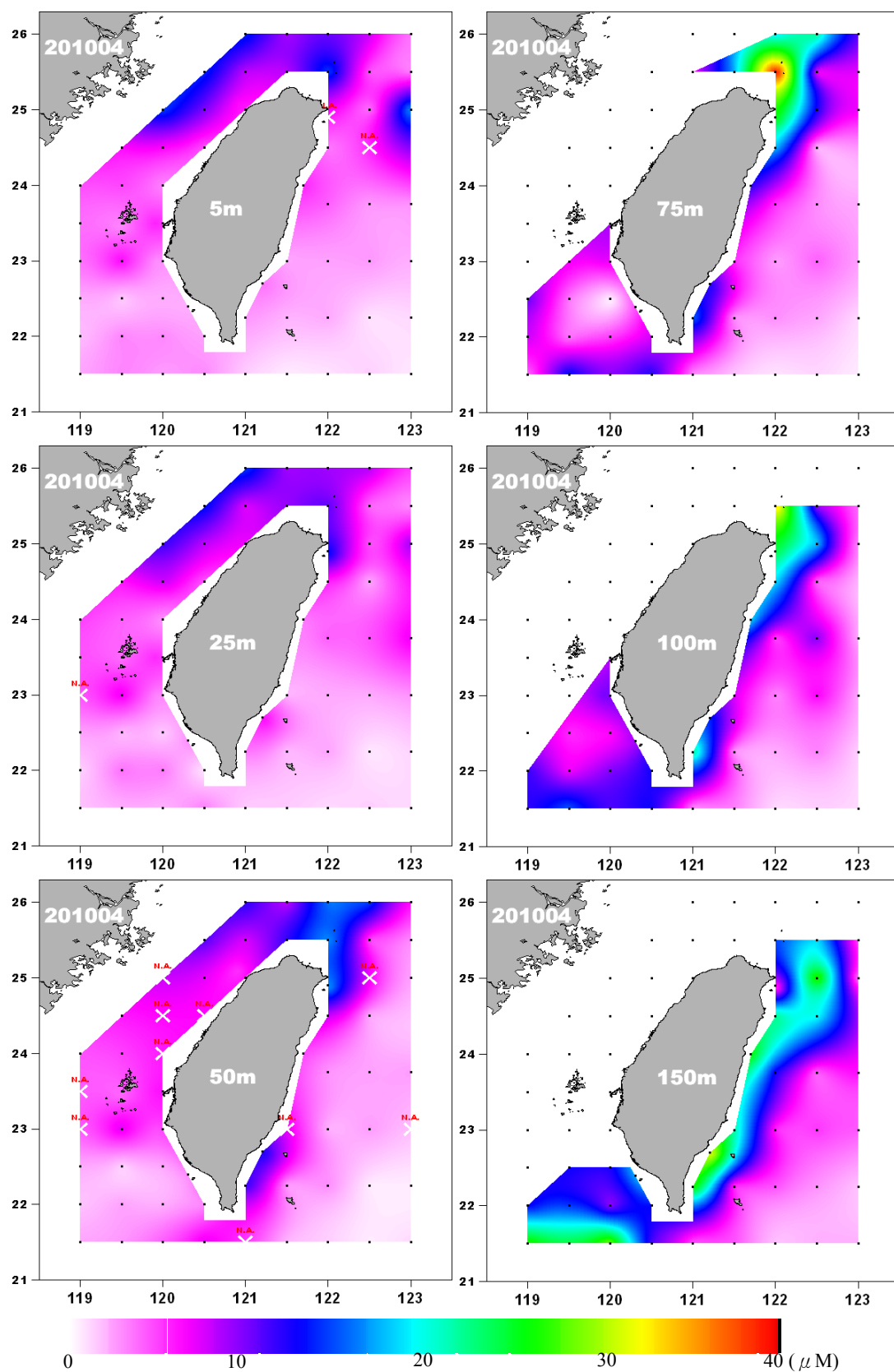


圖 17. 2010-04 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 17. Silicate (SiO_2^{2-}) distribution in Apr. 2010.

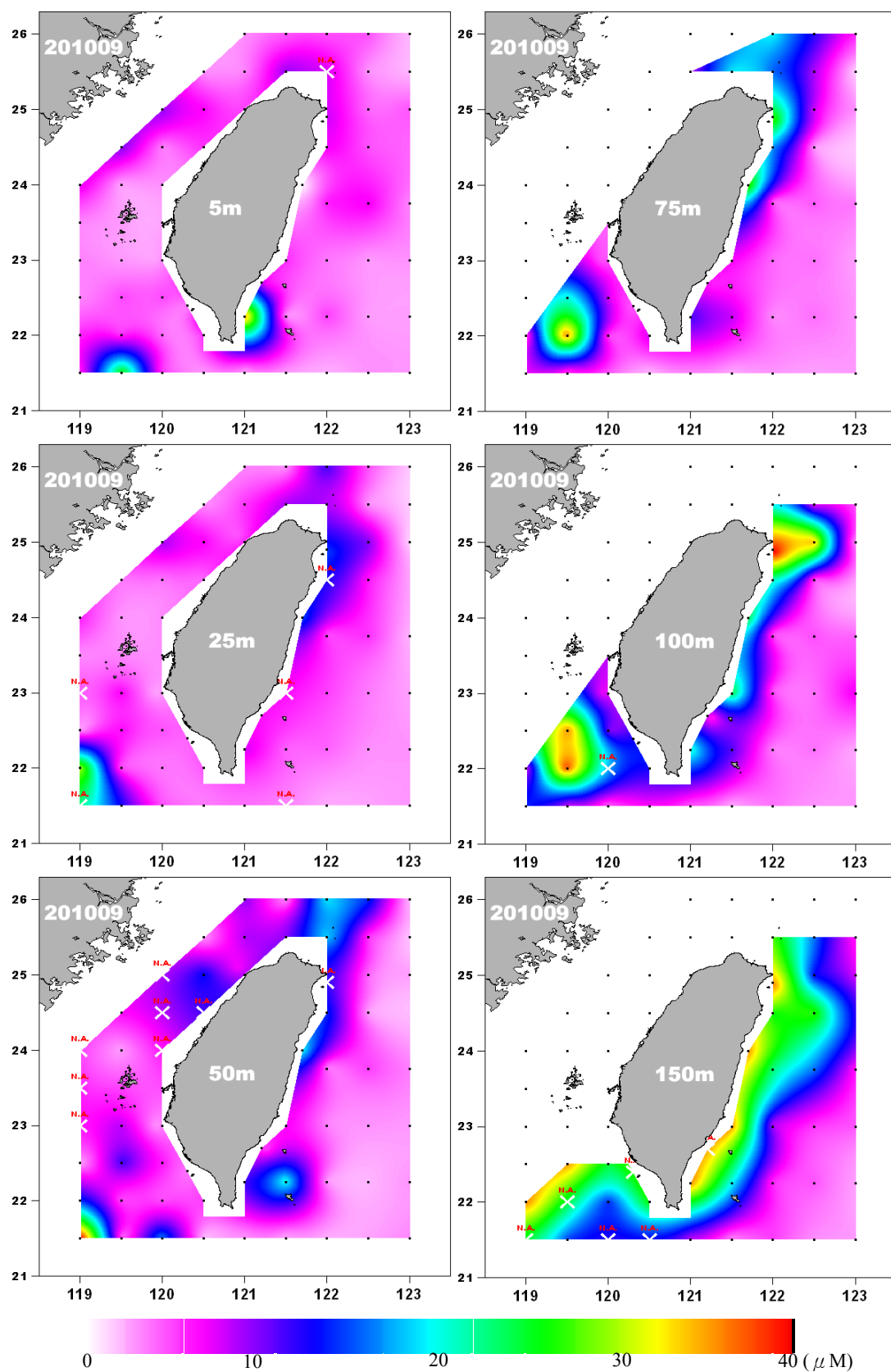


圖 18. 2010-09 航次矽酸鹽(SiO_2^{2-})濃度分布

Fig. 18. Silicate (SiO_2^{2-}) distribution in Sep. 2010.

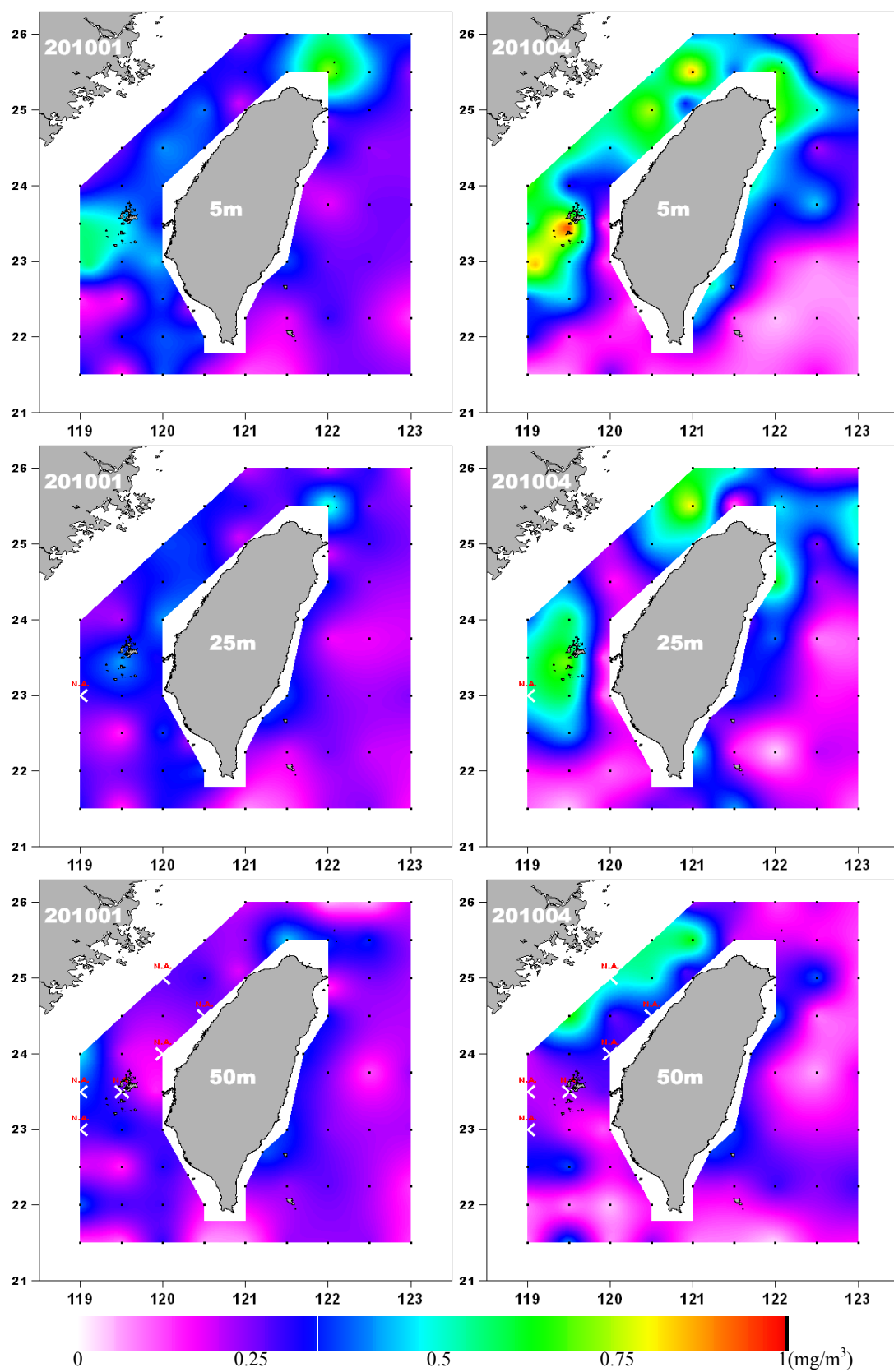


圖 19. 2010 年 1 月及 4 月葉綠素甲(chl-*a*)分布

Fig. 19. Chlorophyll-*a* (chl-*a*) distribution in Jan. and Apr. 2010.

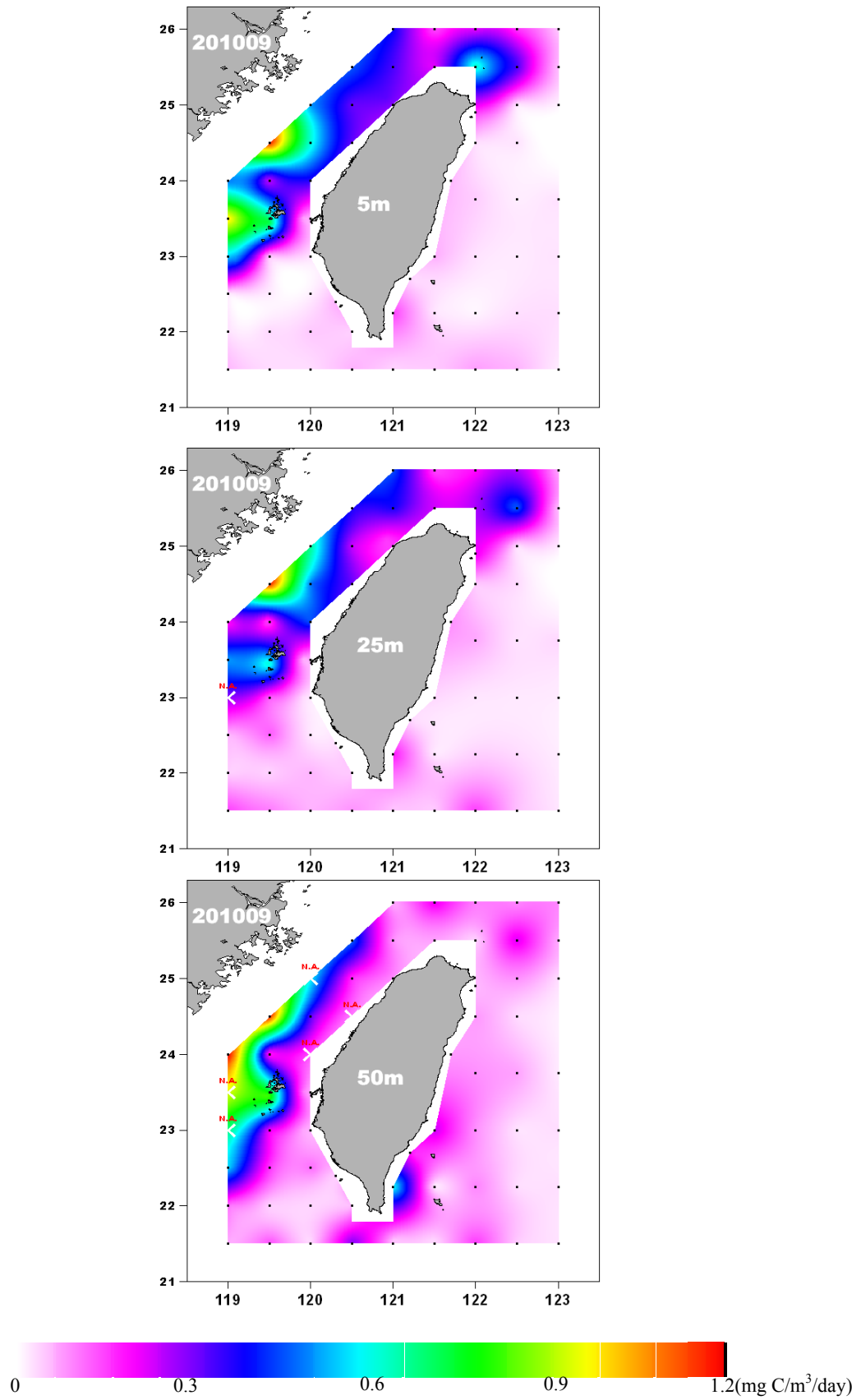


圖 20. 2010 年 9 月葉綠素甲(chl-a)分布

Fig. 20. Chlorophyll-*a* (chl-*a*) distribution in Sep. 2010.

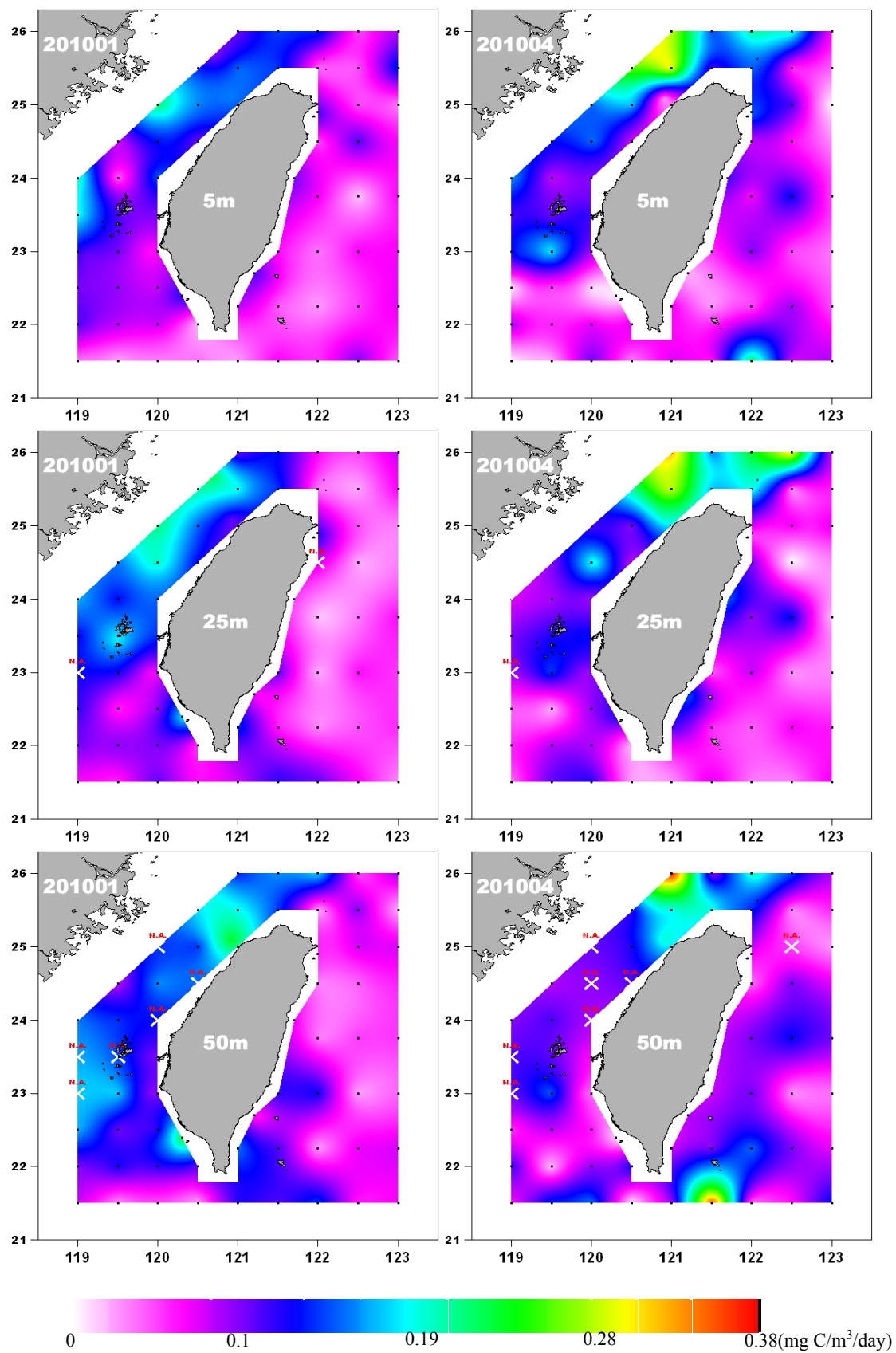


圖 21. 2010 年 1 月及 4 月基礎生產力分布

Fig. 21. Primary production distribution in Jan. and Apr. 2010.

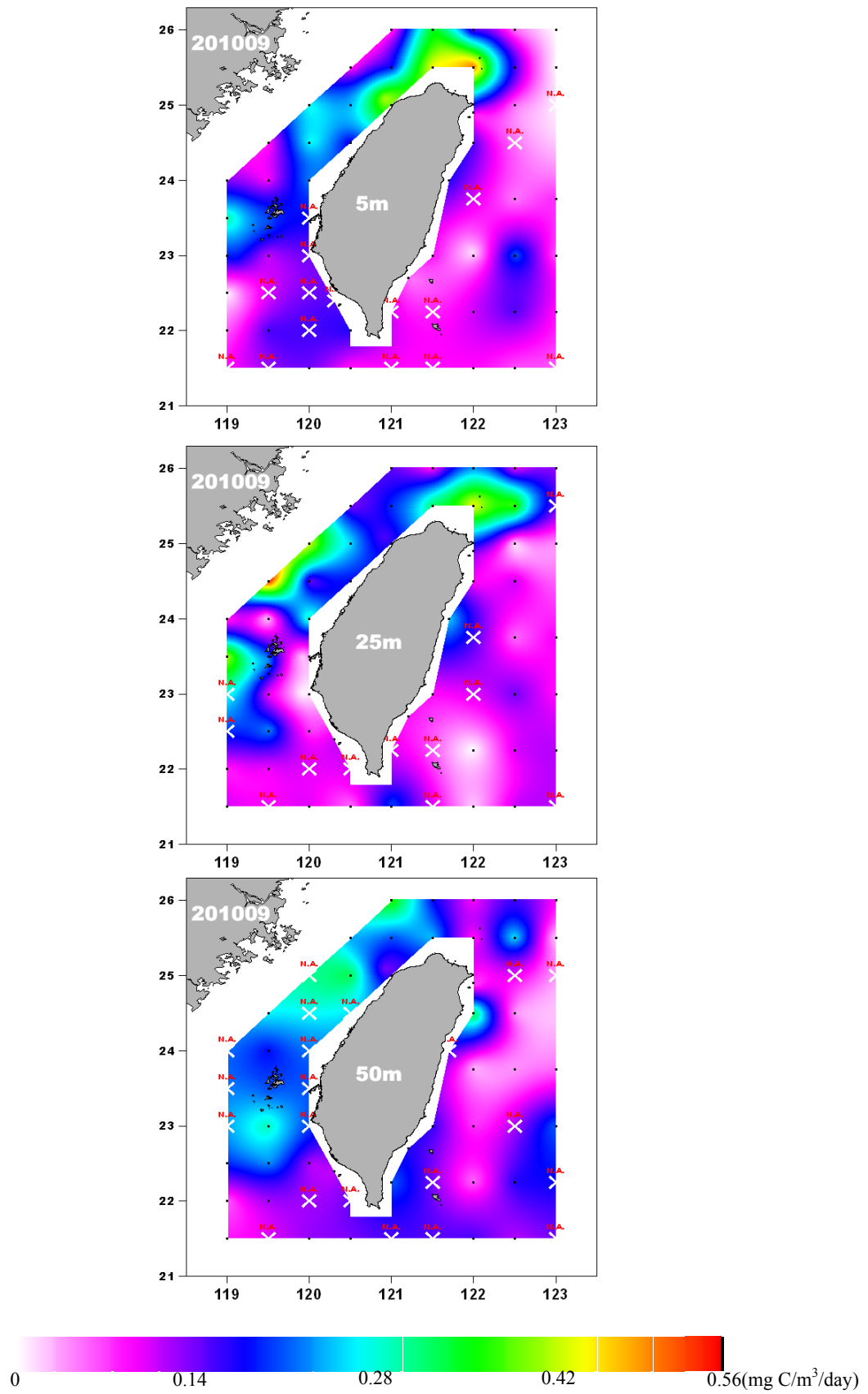


圖 22. 2010 年 9 月基礎生產力分布

Fig. 22. Primary production distribution in Sep. 2010.

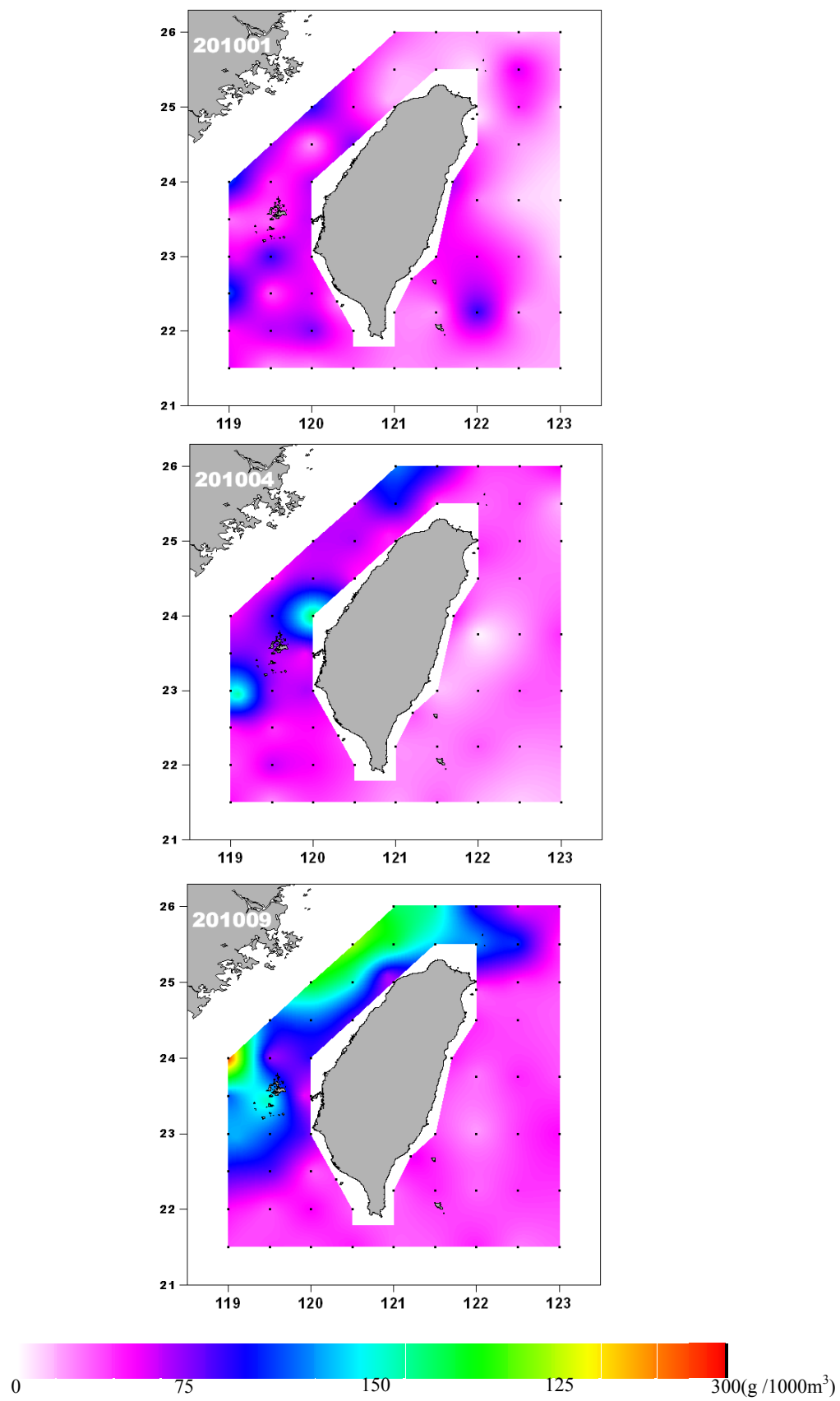


圖 23. 2010 年 1 月、4 月及 9 月浮游動物生物量分布

Fig. 23. Biomass of zooplankton sample in 2010.

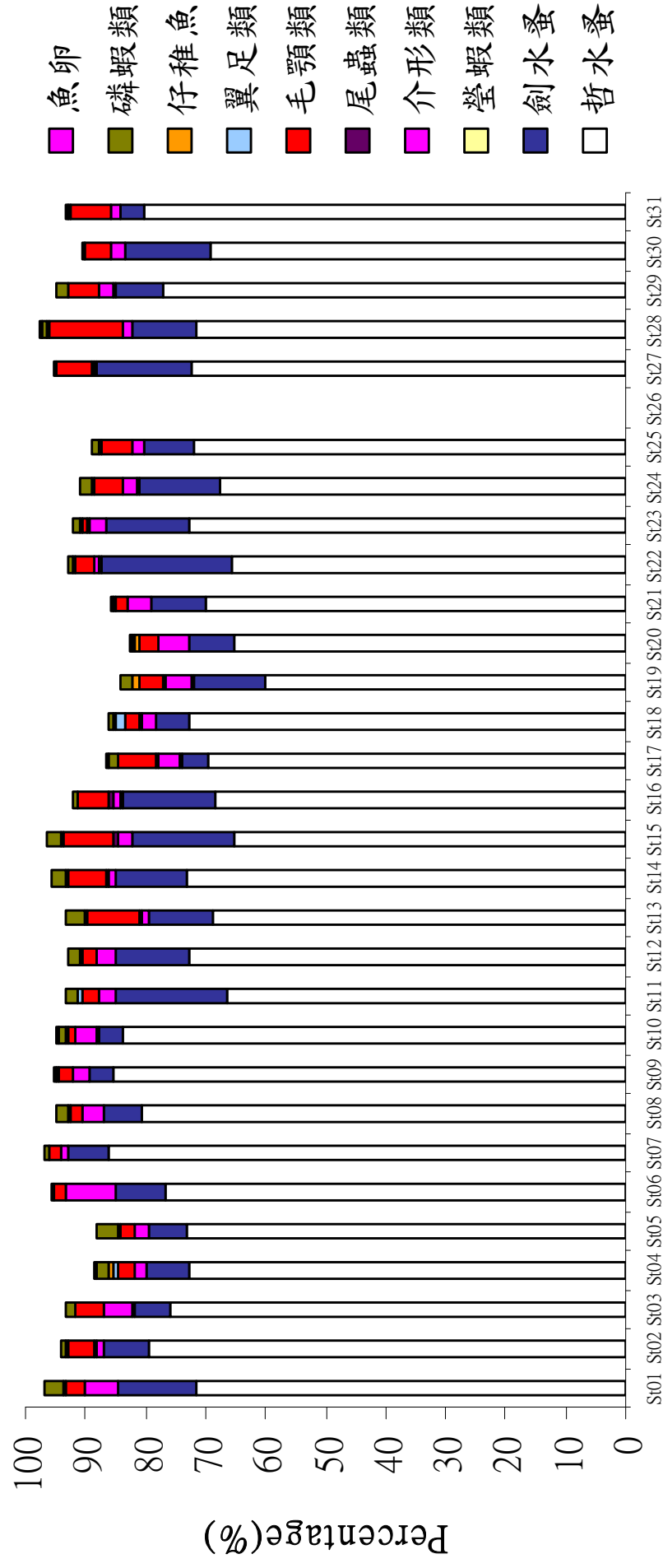


圖 24. 2010-01 航次浮游動物優勢大類出現百分率

Fig. 24. Percentage of the composition of zooplankton in Jan. 2010.

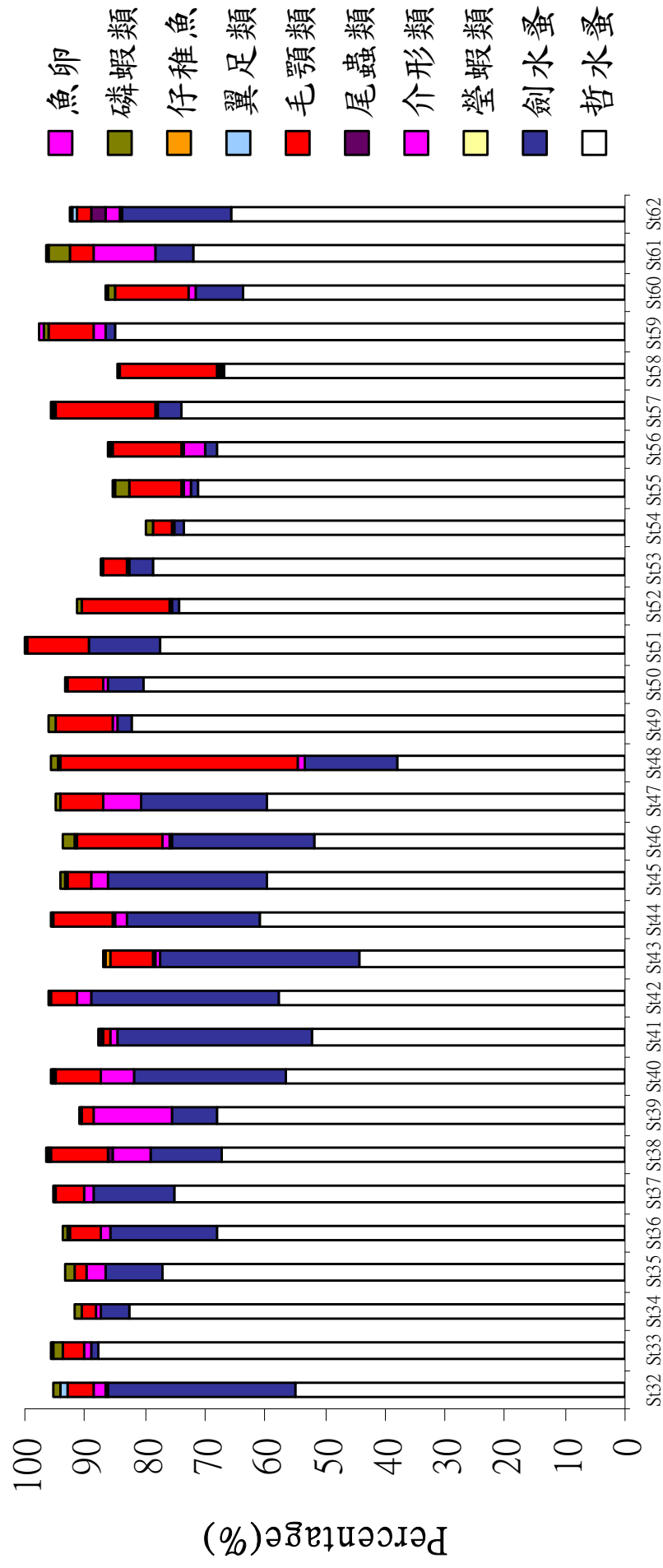


圖 25. 2010-01 航次浮游動物優勢大類出現百分率(續)

Fig. 25. Percentage of the composition of zooplankton in Jan. 2010.

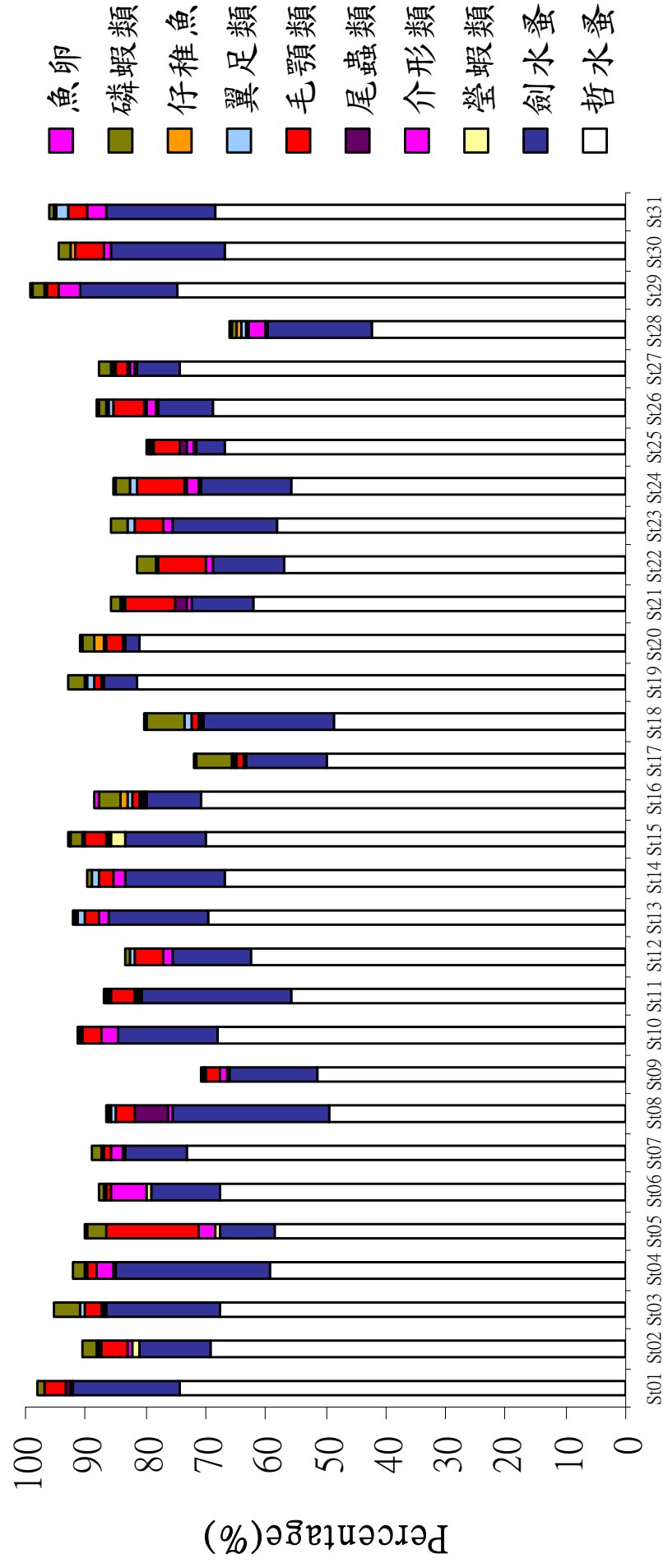


圖 26. 2010-04 航次浮游動物優勢大類出現百分率

Fig. 26. Percentage of the composition of zooplankton in Apr. 2010.

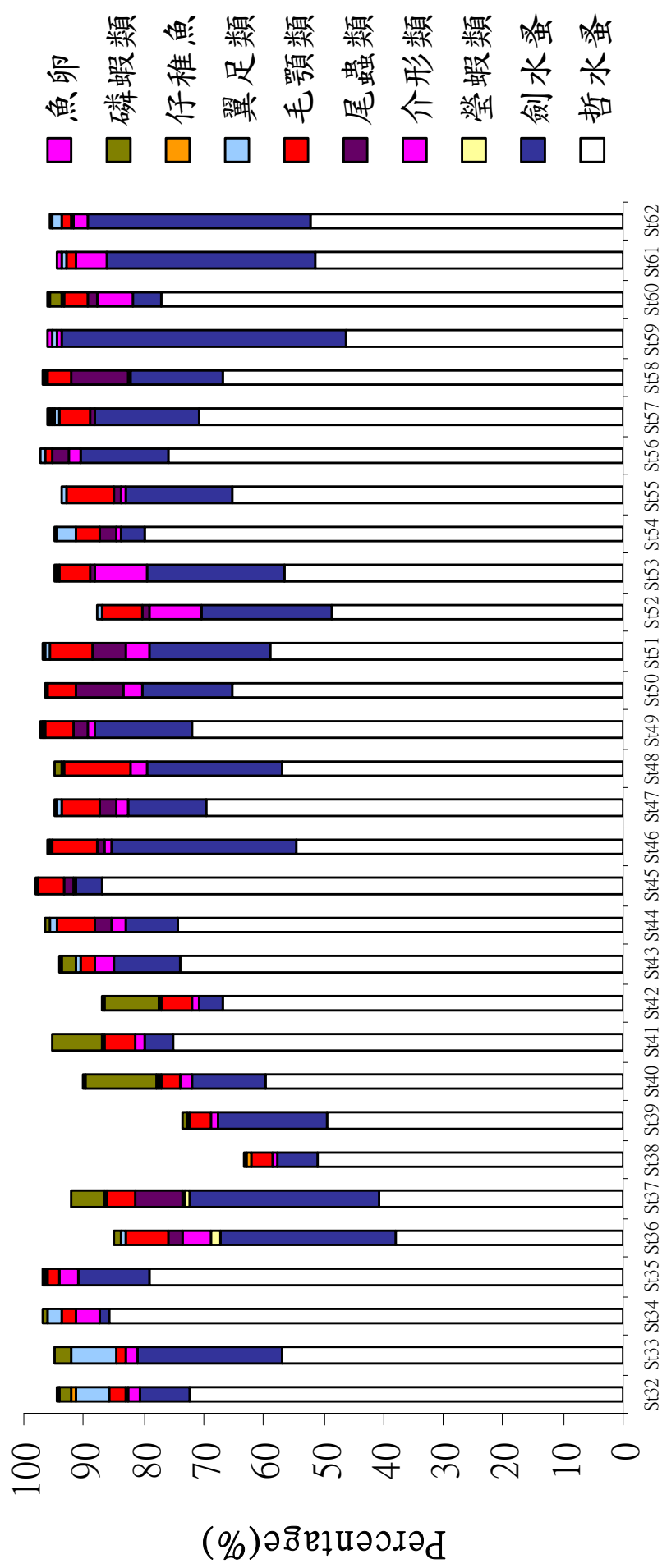


圖 27. 2010-04 航次浮游動物優勢大類出現百分率(續)

Fig. 27. Percentage of the composition of zooplankton in Apr. 2010.

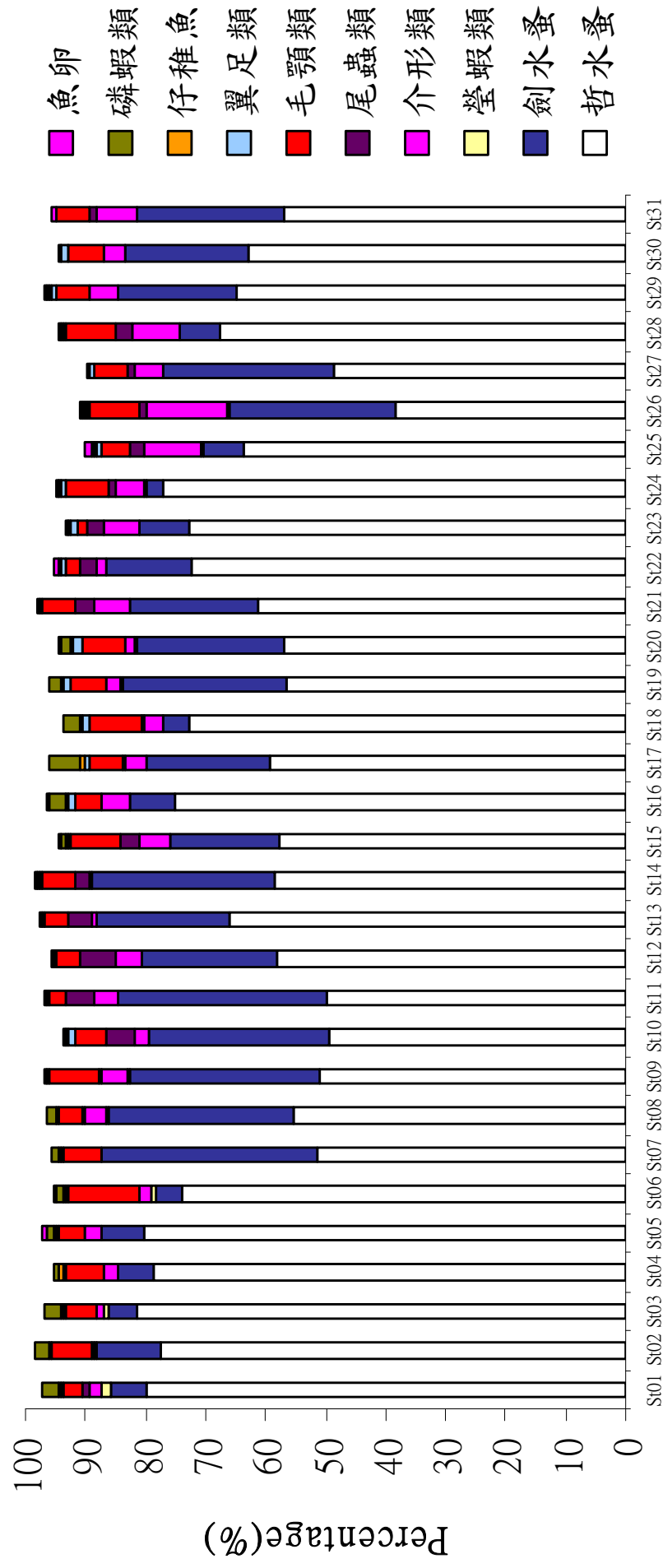


圖 28. 2010-09 航次浮游動物優勢大類出現百分率

Fig. 28. Percentage of the composition of zooplankton in Sep. 2010.

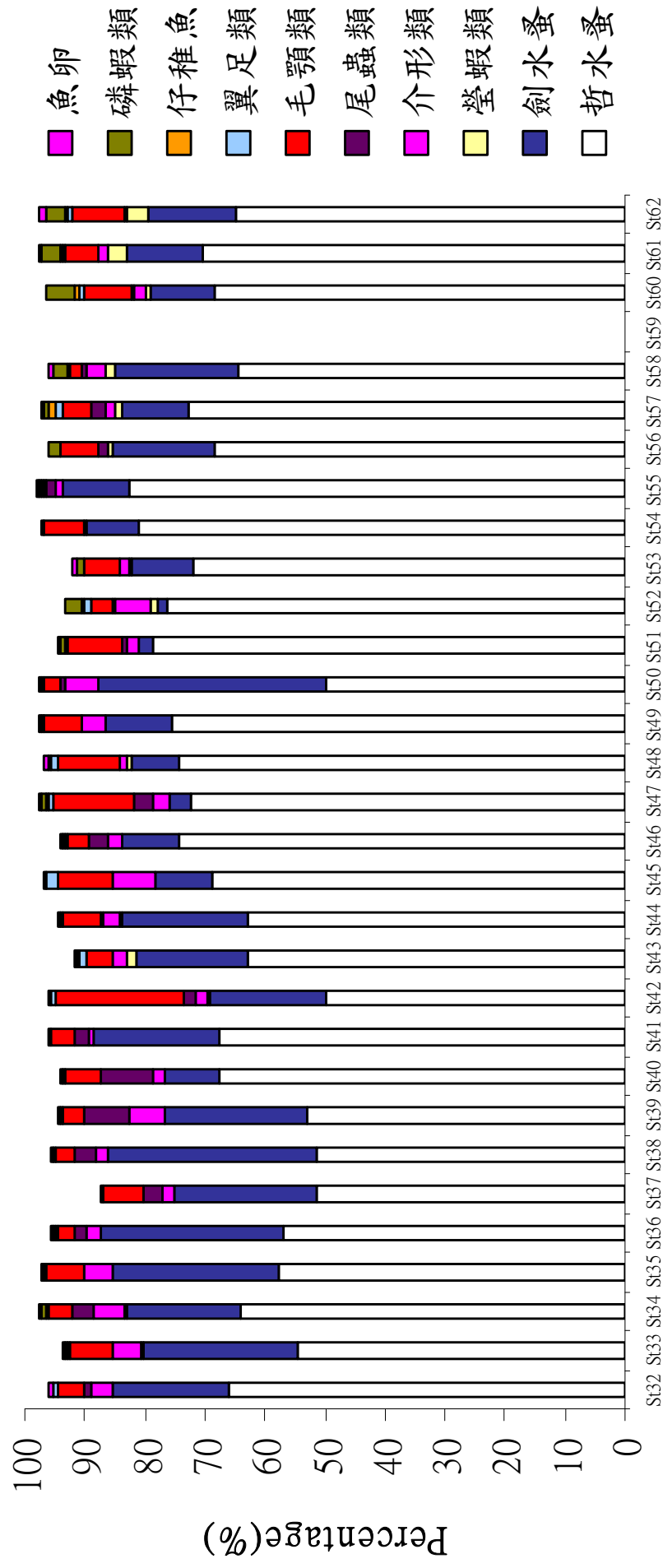


圖 29. 2010-09 航次浮游動物優勢大類出現百分率(續)

Fig. 29. Percentage of the composition of zooplankton in Sep. 2010.

表 01. 2010-01-07 航次基礎觀測資料

Table 01 Basic observation data in Jan. 2010

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	20100118	1418	24.87	122.01	375	24.8	21.4	1021.10	217	3.7	200	1262	757.2
St.02	20100118	0945	25.01	122.52	1433	25.2	21.0	1024.49	102	4.8	200	1341	804.6
St.03	20100118	0638	25.00	123.01	1599	24.3	20.4	1023.42	083	4.7	200	1306	783.6
St.04	20100118	0240	24.50	122.50	596	24.4	20.2	1022.71	086	9.0	200	1213	727.8
St.05	20100117	2323	24.50	122.00	2692	23.8	18.1	1024.49	174	0.0	200	1534	920.4
St.06	20100117	1953	24.01	121.68	350	23.9	17.5	1025.02	036	6.9	200	1297	778.2
St.07	20100117	1703	23.76	122.03	3329	24.7	20.3	1023.60	075	8.5	200	1000	600.0
St.08	20100117	1335	23.76	122.51	3166	24.2	19.8	1022.35	049	12.3	200	981	588.6
St.09	20100117	1024	23.75	123.00	5401	24.1	20.3	1024.31	068	10.0	200	933	559.8
St.10	20100117	0517	23.01	123.00	5399	24.2	20.9	1022.53	055	11.3	200	1366	819.6
St.11	20100117	0119	23.01	122.50	5506	24.4	20.6	1023.60	062	7.2	200	1094	656.4
St.12	20100116	2130	23.01	122.00	4867	24.4	21.0	1024.84	076	10.5	200	997	598.2
St.13	20100116	1750	23.00	121.49	1946	24.4	19.8	1022.53	045	10.8	200	1219	731.4
St.14	20100116	1356	22.67	121.25	1113	24.6	19.3	1021.82	049	9.6	200	1332	799.2
St.15	20100116	1035	22.26	121.00	1207	25.1	19.7	1023.24	047	14.3	200	1480	888.0
St.16	20100116	0727	22.26	121.51	741	24.9	21.1	1022.88	062	9.0	200	1373	823.8
St.17	20100116	0405	22.25	122.01	4580	24.5	20.9	1021.10	037	9.3	200	1146	687.6
St.18	20100116	0055	22.26	122.50	4843	24.7	20.9	1022.35	069	7.8	200	1323	793.8
St.19	20100115	2150	22.25	123.00	3578	24.5	20.9	1003.42	072	7.5	200	1515	909.0
St.20	20100115	1706	21.51	122.99	4749	24.5	20.9	1021.46	063	9.4	200	2236	1341.6
St.21	20100115	1328	21.50	122.50	4791	24.8	20.7	1021.46	052	7.7	200	1192	715.2
St.22	20100115	0115	21.50	122.01	5352	24.8	20.7	1023.60	062	11.0	200	1142	685.2
St.23	20100115	0550	21.51	121.50	2124	24.2	19.9	1022.35	065	12.5	200	1294	776.4
St.24	20100115	0210	21.51	121.00	1173	24.3	19.4	1021.46	052	14.7	200	1304	782.4
St.25	20100114	2240	21.51	120.50	1761	24.3	19.7	1022.88	073	16.0	200	1182	709.2
St.26	20100112	1051	21.50	119.99	2978	24.0	18.7	1017.01	352	12.5	200	1383	829.8
St.27	20100111	0730	21.50	119.50	2992	24.0	19.7	1016.30	000	11.4	200	1149	689.4
St.28	20100111	0400	21.51	119.00	5002	25.4	20.2	1014.54	012	11.0	200	1071	642.6
St.29	20100111	0034	22.00	119.01	1453	24.9	19.8	1014.87	014	11.3	200	1018	610.8
St.30	20100111	2050	22.00	119.51	2403	25.0	20.4	1013.98	007	10.1	200	1000	600.0
St.31	20100111	1650	22.01	120.01	1190	25.1	20.9	1012.38	352	7.6	200	1242	745.2
St.32	20100111	1344	22.01	120.50	256	25.8	22.2	1011.67	330	2.4	200	1356	813.6
St.33	20100111	1101	22.38	120.32	519	24.5	19.5	1014.16	335	8.1	200	1415	849.0
St.34	20100111	0822	22.51	120.00	702	23.9	18.1	1014.70	003	9.6	200	1116	669.6
St.35	20100111	0455	22.50	119.50	223	23.9	20.0	1013.63	041	12.4	200	1241	744.6
St.36	20100111	0200	22.51	119.00	83	24.1	20.0	1013.98	023	10.0	78	559	335.4
St.37	20100110	2334	22.95	119.11	21	23.3	19.4	1015.41	031	5.4	25	192	115.2
St.38	20100110	2111	23.00	119.50	74	23.9	19.6	1014.87	013	7.2	68	496	297.6
St.39	20100110	1835	23.00	119.92	126	24.4	20.1	1013.27	003	13.7	121	656	393.6
St.40	20100110	1429	23.51	119.91	119	22.5	19.6	1012.92	008	9.5	115	721	432.6
St.41	20100110	1202	23.44	119.49	55	22.0	18.2	1015.05	354	10.5	45	369	221.4
St.42	20100110	0923	23.50	119.01	54	20.3	17.7	1017.19	051	6.3	49	360	216.0
St.43	20100110	0615	24.01	119.00	61	19.4	15.9	1016.30	045	9.6	57	431	258.6
St.44	20100110	0330	24.00	119.50	61	20.3	15.7	1016.48	037	9.6	53	307	184.2
St.45	20100110	0034	24.01	120.00	38	19.5	16.3	1017.90	028	8.8	30	147	88.2
St.46	20100109	2029	24.50	120.50	53	19.1	16.0	1017.72	009	7.6	58	391	234.6
St.47	20100109	1740	24.50	120.00	62	18.4	14.0	1016.83	013	10.7	57	424	254.4
St.48	20100109	1440	24.51	119.50	66	18.6	13.6	1016.48	356	2.8	51	365	219.0
St.49	20100109	1035	25.00	120.01	53	18.4	12.8	1018.97	001	10.6	41	257	154.2
St.50	20100109	0737	25.00	120.50	78	19.3	15.6	1016.65	023	13.3	72	428	256.8
St.51	20100109	0505	25.09	120.92	80	19.2	17.2	1016.30	048	14.4	75	489	293.4
St.52	20100109	0117	25.69	120.69	72	18.3	12.7	1019.86	023	15.0	58	443	265.8
St.53	20100108	2122	25.98	121.01	78	18.4	13.3	1020.57	032	11.5	68	329	197.4
St.54	20100108	1752	25.50	121.00	91	18.5	13.2	1018.79	043	12.2	86	509	305.4
St.55	20100108	1501	25.50	121.50	114	19.3	13.2	1017.90	012	13.2	100	509	305.4
St.56	20100108	1155	26.01	121.50	69	18.4	11.9	1020.21	022	16.0	62	492	295.2
St.57	20100108	0907	26.01	122.00	99	20.1	13.0	1020.21	023	9.6	85	440	264.0
St.58	20100108	0600	26.00	122.52	106	21.2	13.4	1019.15	030	10.0	100	550	330.0
St.59	20100108	0314	26.00	123.00	95	21.4	14.5	1017.72	020	9.9	90	683	409.8
St.60	20100107	2327	25.51	123.01	776	21.3	15.9	1018.79	036	13.8	200	1202	721.2
St.61	20100107	2011	25.51	122.49	390	20.5	15.5	1020.39	030	10.8	200	1495	897.0
St.62	20100107	1700	25.51	122.00	118	19.5	14.8	1019.86	046	11.7	114	739	443.4

表 02. 2010-04-08 航次基礎觀測資料

Table 02 Basic observation data in Apr. 2010

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	20100408	1410	24.87	122.01	315	22.7	19.3	1011.31	267	3.6	200	1199	719.4
St.02	20100408	1714	25.01	122.51	1440	23.9	19.3	1010.96	121	6.1	200	1425	855.0
St.03	20100408	2019	25.00	123.00	1617	24.3	0.8	1013.45	156	1.7	200	1654	992.4
St.04	20100409	0131	24.51	122.50	594	24.8	20.09	1010.60	357	7.6	200	1488	892.8
St.05	20100409	0503	24.51	122.01	954	24.4	20.0	1010.25	353	8.6	200	1140	684.0
St.06	20100409	0910	24.00	121.68	404	24.9	21.1	1011.49	254	3.7	200	1208	724.8
St.07	20100409	1213	23.76	122.00	3181	25.6	22.0	1010.60	040	7.2	200	1154	692.4
St.08	20100409	1549	23.75	122.49	3145	25.4	21.6	1008.47	095	3.6	200	1479	887.4
St.09	20100409	1920	23.75	123.00	3644	25.4	22.0	1010.78	049	7.6	200	1132	679.2
St.10	20100410	0052	23.00	123.00	5388	26.0	23.0	1010.78	094	5.4	200	1196	717.6
St.11	20100410	0401	23.00	122.51	5534	26.4	23.2	1009.89	110	6.6	200	1235	741.0
St.12	20100410	0716	23.01	122.01	4880	26.7	23.4	1011.31	096	7.2	200	1189	713.4
St.13	20100410	1051	23.01	121.51	2046	26.9	23.6	1011.85	045	10.8	200	1250	750.0
St.14	20100410	1422	22.67	121.24	1067	27.8	25.7	1009.53	049	9.6	200	1261	756.6
St.15	20100410	1814	22.25	121.01	1178	27.8	24.7	1009.71	047	14.3	200	1277	766.2
St.16	20100410	2129	22.26	121.50	434	27.5	25.1	1011.67	062	9.0	200	1286	771.6
St.17	20100411	0031	22.25	122.01	4602	27.6	25.1	1011.14	117	6.0	200	1314	788.4
St.18	20100411	0336	22.25	122.51	4862	27.8	24.8	1010.25	109	7.8	200	1186	711.6
St.19	20100411	0658	22.25	123.00	3577	27.5	24.7	1010.96	120	7.1	200	1145	687.0
St.20	20100411	1214	21.50	123.00	4931	27.9	26.1	1009.36	162	6.7	200	1240	744.0
St.21	20100411	1527	21.50	122.50	4789	27.6	25.6	1007.22			200	1154	692.4
St.22	20100411	1842	21.50	122.00	3464	25.5	25.7	1008.11	168	6.1	200	1276	765.6
St.23	20100411	2215	21.50	121.51	2091	27.3	25.4	1007.53	179	5.5	200	1115	669.0
St.24	20100412	0158	21.50	121.01	938	28.6	26.7	1007.93	187	8.3	200	1366	819.6
St.25	20100412	0532	21.50	120.50	1729	28.3	26.1	1008.82	240	3.0	200	1274	764.4
St.26	20100412	0855	21.51	120.00	2959	28.0	25.7	1011.14	334	2.0	200	1332	799.2
St.27	20100412	1200	21.50	119.49	2985	28.6	26.6	1009.89	251	2.2	200	1328	796.8
St.28	20100412	1503	21.50	119.00	2780	29.7	27.3	1108.29	287	0.0	200	1373	823.8
St.29	20100412	1840	22.00	119.01	1426	29.5	26.7	1008.82	051	3.0	200	1130	678.0
St.30	20100412	2245	21.99	119.49	2297	28.3	25.8	1010.96	255	2.4	200	1282	769.2
St.31	20100413	0300	22.00	120.00	1080	27.6	25.3	1010.78	290	2.8	200	1249	749.4
St.32	20100413	0710	22.00	120.50	270	28.0	26.2	1013.63	136	0.0	200	1092	655.2
St.33	20100413	1054	22.37	120.33	406	28.5	26.1	1013.98	204	3.6	200	1307	784.2
St.34	20100413	1350	22.49	120.01	606	28.8	25.5	1011.85	320	503.0	200	706	423.6
St.35	20100413	1751	22.50	119.51	240	27.1	22.6	1012.20	016	10.3	200	1533	919.8
St.36	20100413	2200	22.50	119.00	84	25.7	21.2	1015.76	023	11.5	81	565	339.0
St.37	20100414	0823	22.94	119.09	20	24.8	20.2	1015.23	037	13.5	5	45	27.0
St.38	20100414	1153	23.00	119.49	77	25.2	20.9	1014.87	020	13.0	72	412	247.2
St.39	20100416	1835	23.00	119.92	126	24.2	19.8	1016.12	007	10.7	119	696	417.6
St.40	20100416	2126	23.50	119.91	121	24.3	19.8	1017.54	014	9.2	109	970	582.0
St.41	20100417	0004	23.44	119.50	56	24.1	19.3	1017.01	013	11.3	45	261	156.6
St.42	20100417	0300	23.50	119.00	54	23.1	17.0	1017.19	022	13.7	45	231	138.6
St.43	20100417	0700	24.01	119.00	58	21.5	15.5	1019.15	029	13.8	51	336	201.6
St.44	20100417	1003	24.01	119.50	63	22.2	16.4	1020.21	011	13.7	56	297	178.2
St.45	20100417	1317	23.99	120.00	42	23.2	18.6	1017.37	013	11.8	37	172	103.2
St.46	20100417	1816	24.50	120.50	51	23.9	20.5	1016.48	001	7.8	45	322	193.2
St.47	20100417	2105	24.50	120.03	58	22.2	16.0	1017.72	355	11.7	53	386	231.6
St.48	20100418	0006	24.50	119.50	65	21.9	16.2	1017.19	014	13.9	54	278	166.8
St.49	20100418	0529	25.00	119.99	53	20.5	15.2	1015.41	019	13.4	45	269	161.4
St.50	20100418	0822	25.00	120.50	76	21.6	18.9	1016.65	014	6.6	65	259	155.4
St.51	20100418	1054	25.09	120.91	76	23.1	20.5	1016.83	343	6.6	69	513	307.8
St.52	20100418	1417	25.51	120.49	64	21.4	16.0	1014.52	342	11.2	59	453	271.8
St.53	20100418	1822	26.00	121.00	78	20.8	17.7	1013.45	043	6.2	65	445	267.0
St.54	20100418	2125	25.50	120.99	89	22.1	18.9	1013.98	332	6.7	85	624	374.4
St.55	20100419	0053	25.51	121.49	114	23.0	22.3	1012.38	151	4.1	112	1012	607.2
St.56	20100419	0400	26.00	121.51	70	22.6	19.2	1010.56	352	9.7	51	375	225.0
St.57	20100419	0656	26.00	122.03	100	22.8	19.7	1011.85	150	4.2	95	600	360.0
St.58	20100419	0952	26.00	122.49	105	24.3	22.8	1012.30	192	9.3	95	592	355.2
St.59	20100419	1228	26.00	122.99	97	26.4	24.6	1011.14	175	12.4	93	512	307.2
St.60	20100419	1548	25.50	123.00	772	27.8	24.7	1010.07	180	12.6	200	1255	753.0
St.61	20100419	1941	25.50	122.51	461	25.4	25.2	1011.60			200	1361	816.6
St.62	20100419	2240	25.50	122.01	110	24.1	22.3	1011.14	230	5.3	115	624	374.4

表 03. 2010-09-27 航次基礎觀測資料

Table 03 Basic observation data in Sep. 2010

Station	Date	SMT	Lat.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D.	Fl. Cr.	V.M.S.
St.01	20100927	1327	24.87	122.02	411	29.4	28.5	1010.96	153	2.4	200	1410	846.0
St.02	20100927	1638	25.00	122.50	1452	30.4	27.7	1011.31	097	3.6	200	1316	789.6
St.03	20100927	1930	25.01	123.00	1610	30.1	27.7	1012.38	095	5.5	200	1246	747.6
St.04	20100928	0033	24.51	122.51	576	29.8	27.5	1012.38	110	4.2	200	1136	681.6
St.05	20100928	0350	24.49	122.01	874	29.7	26.9	1011.85	216	0.0	200	1038	622.8
St.06	20100928	0755	24.00	121.69	383	29.3	26.3	1013.45	247	3.3	200	1116	669.6
St.07	20100928	1040	23.79	122.01	689	30.6	27.8	1012.72	041	4.0	200	1197	718.2
St.08	20100928	1404	23.75	122.50	3080	30.8	28.0	1010.78	053	4.3	200	1259	755.4
St.09	20100928	1716	23.75	123.00	3640	30.3	27.3	1011.67	058	5.0	200	1166	699.6
St.10	20100928	2206	23.01	123.00	5558	30.3	27.7	1012.74	058	6.3	200	1108	664.8
St.11	20100929	0115	23.01	122.51	5510	30.3	27.7	1011.85	046	5.4	200	1103	661.8
St.12	20100929	0428	23.04	122.00	4868	30.6	28.0	1011.85	023	7.0	200	1319	791.4
St.13	20100929	0820	23.01	121.50	2009	30.2	27.8	1013.09	050	6.7	200	1470	882.0
St.14	20100929	1152	22.68	121.26	1092	31.7	28.3	1011.14	042	7.4	200	1142	685.2
St.15	20100929	1520	22.25	121.00	1206	31.1	27.6	1010.07	074	7.4	200	1070	642.0
St.16	20100929	1825	22.26	121.50	439	30.5	28.4	1011.67	058	7.3	200	896	537.6
St.17	20100929	2129	22.27	122.00	4562	30.7	28.2	1011.50	041	8.4	200	1265	759.0
St.18	20100930	0113	22.26	122.50	4846	30.3	28.3	1010.42	059	8.3	200	983	589.8
St.19	20100930	0439	22.25	122.99	3497	30.6	27.9	1010.96	062	6.0	200	1240	744.0
St.20	20100930	0942	21.51	123.01	4441	30.3	27.8	1011.31	048	7.7	200	1459	875.4
St.21	20100930	1255	21.50	122.51	4783	30.9	28.6	1009.36	063	8.0	200	1057	634.2
St.22	20100930	1610	21.50	122.00	3464	30.6	28.2	1008.82	060	8.6	200	1003	601.8
St.23	20100930	1954	21.52	121.50	2018	30.8	28.3	1010.78	058	10.6	200	1258	754.8
St.24	20100930	2324	21.54	121.01	954	31.0	28.2	1009.18	052	11.8	200	1109	665.4
St.25	20101001	0350	21.51	120.51	1798	30.7	28.4	1008.47	055	13.0	200	1239	743.4
St.26	20101001	0735	21.52	119.99	2974	30.4	28.6	1010.07	059	9.5	200	1325	795.0
St.27	20101001	1154	21.51	119.51	2998	31.1	28.8	1009.00	066	9.1	200	1390	834.0
St.28	20101001	1550	21.51	119.01	2780	31.0	29.0	1007.93	067	7.6	200	1249	749.4
St.29	20101001	1958	22.00	119.01	1434	30.4	27.5	1010.42	023	7.9	200	1225	735.0
St.30	20101001	2343	22.01	119.49	2351	30.2	27.6	1009.00	013	6.2	200	1051	630.6
St.31	20101002	0405	22.00	120.00	1126	30.2	28.5	1007.93	079	7.5	200	1132	679.2
St.32	20101002	0814	22.00	120.50	279	30.8	28.4	1010.07	082	11.0	200	1148	688.8
St.33	20101002	1143	22.38	120.33	440	31.2	28.6	1009.53	307	4.0	200	1255	753.0
St.34	20101002	1431	22.50	120.02	571	31.0	28.4	1008.82	329	5.3	200	1273	763.8
St.35	20101002	1823	22.52	119.52	237	30.4	27.5	1009.89	013	6.5	200	1183	709.8
St.36	20101002	2230	22.50	119.01	85	29.9	27.0	1010.96	036	5.2	70	419	251.4
St.37	20101003	0144	22.94	119.10	29	29.8	26.6	1009.89	020	6.3	25	188	112.8
St.38	20101003	0427	23.00	119.49	77	29.7	27.0	1009.89	348	3.0	72	465	279.0
St.39	20101003	0713	23.00	119.91	126	29.8	28.1	1011.31	043	0.0	120	844	506.4
St.40	20101003	1057	23.50	119.91	122	30.7	28.5	1011.31	043	0.0	100	659	395.4
St.41	20101003	1340	23.44	119.50	55	30.3	27.8	1009.89	000	0.0	45	256	153.6
St.42	20101003	1655	23.50	119.00	52	28.9	26.6	1009.53	027	8.6	45	296	177.6
St.43	20101003	2100	23.99	119.00	59	28.3	25.8	1011.49	048	14.5	50	424	254.4
St.44	20101004	0159	24.01	119.49	60	27.9	25.8	1010.25	034	15.2	50	250	150.0
St.45	20101004	0628	24.00	120.00	43	27.9	25.5	1010.70	034	17.2	36	294	176.4
St.46	20101004	1435	24.50	120.50	50	28.2	25.2	1009.89	030	18.4	38	298	178.8
St.47	20101004	1720	24.51	120.01	61	27.9	24.2	1010.96	031	15.2	57	577	346.2
St.48	20101004	1959	24.51	119.50	66	30.0	24.5	1012.56	047	12.9	62	340	204.0
St.49	20101005	0250	25.00	120.00	52	27.8	24.4	1012.74	048	12.9	45	267	160.2
St.50	20101005	0647	25.01	120.50	80	26.9	24.3	1012.20	043	15.0	75	541	324.6
St.51	20101005	1018	25.09	120.92	79	27.3	24.6	1013.45	052	14.8	72	391	234.6
St.52	20101005	1358	25.50	120.51	61	27.2	24.2	1012.74	045	11.4	55	366	219.6
St.53	20101005	1922	26.00	121.00	79	27.8	24.0	1014.70	053	10.1	75	381	228.6
St.54	20101005	2254	25.51	121.01	89	27.7	24.3	1013.63	053	13.0	85	710	426.0
St.55	20101006	0237	25.51	121.50	110	27.2	24.4	1013.09	058	9.1	98	612	367.2
St.56	20101006	0603	26.00	121.50	68	27.1	23.5	1014.70	052	8.7	57	516	309.6
St.57	20101006	0903	26.00	121.99	100	27.3	24.2	1015.94	055	9.0	96	638	382.8
St.58	20101006	1236	26.00	122.50	104	28.2	24.8	1013.98	066	8.5	95	735	441.0
St.59	20101006	1551	26.01	123.00	96	28.3	24.9	1013.27	059	7.3	90	488	292.8
St.60	20101006	2038	25.51	123.00	771	29.0	25.8	1013.81	064	8.0	200	1312	787.2
St.61	20101007	0036	25.51	122.50	369	28.8	25.4	1012.92	064	8.8	200	1461	876.6
St.62	20101007	0409	25.51	122.00	116	27.4	24.5	1011.85	079	10.7	110	702	421.2

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發行人：郭慶老

編輯顧問：劉富光

總編輯：劉燈城

編輯委員：吳繼倫、曾振德、鄭學淵

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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