陸慕珍海洋環境保護文集

MARINE ENVIRONMENT PROTECTION: ESSAYS

BY
MUZHEN LU
2005

恆順眾生　利益社會

FOREWORD

I am honored to write this foreword to the professional work of Muzhen Lu. We met in the early 1980s at the Virginia Institute of Marine Science (VIMS), which is the School of Marine Science for the College of William and Mary, where she was obtaining her Masters degree. I was a faculty member and researcher at VIMS and she signed up for a research project with me on oil spill response and contingency planning. All her work shared a common theme: using science to understand and manage the effects of energy projects, and other types of industry, on coastal environments, which are among the most ecologically productive and sensitive places that we all value for a wide range of uses, including commercial and recreational fishing, tourism, parks and wildlife refuges, in addition to maritime commerce and industry.

The first paper in this publication Muzhen wrote while at VIMS. It analyzes sediment contamination in the Elizabeth River, a river in southern Virginia, a state which is on the Atlantic coast of the US. The Elizabeth River is a tributary for the Chesapeake Bay that is famous for its blue crabs, clams, oysters and striped bass. Petrochemical terminals lined the river shoreline and, due to many years of poor environmental practices, the river became so highly contaminated that it was regarded as "dead." In this paper, Muzhen investigates PAHs (polycyclic aromatic hydrocarbons) which are highly persistent and toxic contaminants and shows that the levels are four orders of magnitude higher than in nearby rivers. This work was important because it provided a factual record of the high levels of contamination, which helped the environmental managers and industry understand the problem that they needed to remedy. Her research contributed to the Elizabeth River Project, which is the catalyst for restoring the environmental health of this great harbor river through government, business and community partnerships.

The other three papers in this volume represent her work in Vancouver, a beautiful coastal city on the Pacific Ocean in British Columbia, Canada. These papers examine the effects of the operating activities of one of the energy generating stations of the British Columbia Hydro Company. In two studies, Muzhen examines the environmental impact of using chlorine to control organisms (mussels and barnacles) that can foul the water intakes which supply cooling water to the Burrard Generating Station. Her papers

focus on *balance*: finding the optimal combination of chemicals and temperature to minimize the environmental impact of chlorinated waters while maximizing the effectiveness of the cooling water intakes. The last paper in this volume examines another important issue associated with the Burrard Generating Station: the adverse environmental effects on juvenile salmon from the cooling water when it is discharged. This important research provided evidence that the heated cooling water that was discharged into Port Moody Arm can result in decreased in the growth of young salmon, which is a very important fishery in the Pacific Northwest, if they remain in the thermal plume.

Muzhen's work remains timely and relevant. The need for clean energy is increasing. Unfortunately, cooling water is used and the impacts of the warmed cooling water discharge on coastal fisheries, particularly on larvae and juveniles, are being closely examined. Industry is challenged to find environmentally compatible solutions to energy generating and government is challenged to protect the coastal environment and assure its citizens can sustain their desired lifestyles. Muzhen Lu was the best kind of professional – one who would work to find a way to balance competing needs and priorities, using the objective tools of science. Her work is a tribute to her positive philosophy and a valuable contribution to her profession.

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序

我很榮幸為慕珍的這本專業書籍寫序。80 年代初期我們在弗吉尼亞海洋科學學院(VIMS)認識了。當時她正在威廉.瑪麗學院的海洋科學學校讀取碩士學位。在VIMS我是大學教員和研究員。她報名參加了我的一個關於溢油反應和意外事件計劃的研究項目。她的所有工作分享了一個共同主題：科學地瞭解和管理能源和其它工業對沿海環境的影響。沿海地區是生態學上最具繁殖力且敏感的地方。這裏有我們的漁業和娛樂釣魚活動、旅遊業、公園和野生生物保護區，更有海洋商務和工業活動，具有極大價值。

本書的第一篇是慕珍在VIMS時寫的。它分析了伊麗莎白河的沉積物，這條河在南弗吉尼亞，美國大西洋沿海地區。它流入Chesapeake海灣，那裏是著名的藍色螃蟹、蛤蜊、牡蠣和鱸魚的產地。沿河有許多石油化工產業，由於多年缺乏環保，該河高度汙染成為了"死"河。在本文裏，慕珍調查的PAHs (多環芳香烴) 是難分解的高毒性汙染物，研究指出它在該河中的含量是附近河流的四個數量級。這項工作的重要性是在於它提供了具體的污染紀錄，幫助環保部門經理和相關產業認識到他們必須補救的問題。她對伊麗莎白河研究項目的貢獻促成了政府、企業和社區對這條偉大的港口河環境的合作治理。

本書的其它三篇文章反映了她在溫哥華的工作，那是一個在太平洋沿岸位於加拿大BC省的美麗的沿海城市。這些文章是研究BC省的一個水電站的日常生產活動對環境的影響。在兩項研究中，慕珍評估了在Burrard水電站的冷卻水管道中使用氯去垢法對有機體(蚌類和藤壺)的影響。她的目標在於尋找平衡: 找出化學用品和溫度的最佳組合使氯化水對環境的影響最小化，對冷卻水管道去垢最有效。最後一篇文章是研究Burrard 水電站的另一個重要議題: 排放的冷卻水對三文魚幼魚的有害影響。研究證明排放進入Port Moody灣的加熱了的冷卻水水流可能減緩幼小三文魚的成長，而該海灣是太平洋西北部一個非常重要的漁場。

慕珍的工作時至今日仍是及時的並有針對性的。對乾淨能源的需求與日俱增。不幸地， 排放溫暖的冷卻水對沿海漁場，特別對幼蚌和幼魚有

重大影響。產業界努力尋求環保的發電方法，同時政府盡力保護沿海環境，保證公民所需的生活方式。陸慕珍是這方面最佳的專家之一 ——使用客觀的科學工具，尋求各方需求和優先保證的最佳平衡點。她的工作是對她的正面人生觀的印證，是對她的行業的可貴的貢獻。

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2005

作者簡介

陸慕珍女士，幼名慕貞。英文名：Doris.

碩士，高級工程師，海洋科學家。中國海洋環境科學學會常務理事等學術學銜。

1941 年 7 月 12 日（農曆 6 月 18 日）生，中國上海市崇明縣人。

1960 年畢業於上海市崇明中學，同年考取北京大學化學系，學習六年，畢業于物理化學專業，獲學士學位。

其後，在第六機械工業部第七研究院第 18 所、第 14 所及院部工作十餘年。

1980 年 39 歲，被授予工程師職稱。同年考取“文化大革命” 之後第一批自費（獲得全額獎學金）留學生，赴美國威廉.瑪麗學院攻讀兩年，獲海洋化學碩士學位。她的論文獻辭是：“獻給我的祖國和善良、公正的人們。”之後婉言謝絕朋友們挽留的美意，毅然返回祖國服務。

1983 年至 1990 年服務於新組建的中國海洋石油總公司，從事海洋環境保護領域工作七年間，成績斐然。多次率領或參加海洋環保考察團組赴英國、挪威、丹麥、美國、加拿大等國考察和專業交流；聘請外國專家來華講學；組織國內專家論證並製訂中國海洋石油總公司海上油污染應急措施條例、法規等加以實施；協助和指導南黃海、東海、南海等地區石油分公司環境保護部門工作。多次出席國際環境保護研討會，于 1989 年休斯

頓召開的國際環境學術研討會議上發表論文，首次報告中國海洋石油總公司為保護海洋生態環境所作的種種努力和今後尚需解決的問題。

在中國海洋石油總公司工作期間，被晉升為高級工程師，任職環境保護處長。並被中國海洋環境科學學會選舉為常務理事及成為多種專業機構會員。

1990 年間移居加拿大溫哥華市，先後服務於卑詩省電力公司、E.V.S. 環境保護諮詢公司以及C.X.Y.化學公司。獨立研究成功並實施的控制氯氣排放量，有效改善海水生物環境的系統工程，廢棄氯排放標準從原先的 100 個PPB提高為 10 個PPB，大幅度提升發電廠附近領域海水質量，對魚類貝殼類及各種微生物的不良影響減少到最低狀態。這項研究成果並令電力公司每年節省數百萬加元。不久，卑詩省政府推廣使用此研究成果。這其間，被授予海洋科學家銜，為加拿大海外開發署無償援助中國項目工作，改善上海、青島、秦皇島等地港口水質，兩度回中國遴選並協調中國水科學研究工作者及上述港口專業領導人赴加拿大實習培訓和開展交流活動。

她一生從事並十分熱愛海洋環境科學工作，堅信環境保護並無文化的歷史的種族的地域的國家的甚至意識形態的界限，而實實在在地同我們這個小小星球上每一個生命息息相關。

1999 年初退休後，創立「粒子學會」，潛心探索生命真諦，出版「粒子學會通訊」，舉辦講座，傳播未知生命形態轉變和人體生命學的訊息。並熱心做義工服務社區公眾，如: 圖書館、食品救濟所、社區安全警訊所、社區服務中心等等。

2003 年 10 月 16 日（農曆 9 月 21 日）下午三時正因患急性腦中樞血管破裂不幸仙逝，享年 62 歲。安葬於加拿大溫哥華市海景（Ocean view）墓園。她和她的先生張薔合墓銅碑上鐫刻著一副對聯：

往生大自在　　存一同逍遙

她的座右銘：做人做事，問心無愧；　與人為善，助人最樂。

INTRODUCTION OF AUTHOR

Lu (Doris) Muzhen, with a master degree of Arts, was a senior engineer and marine scientist who held several academic titles such as Committee Member, China Marine Environment Science Organization. She was born on the twelfth of July, 1941 (eighteenth of June in the Lunar Calendar) in Chongming county, Shanghai, China.

After graduating from Shanghai Chongming High School, she was accepted by the Department of Chemistry at Peking University in 1960, and after six years of study, graduated with a Bachelors Degree in Physical Chemistry. For the next ten years, she worked with the Seventh Research Institute of the Sixth Department of Mechanical Industry, specifically in the 14^{th} and 18^{th} Divisions and the Institute Headquarters.

In 1980, at the age of thirty-nine, Lu Muzhen was granted the title of Engineer. In the same year, she became a member of the first group of scholars to study overseas since the end of the Cultural Revolution. Studying under a full scholarship, she spent two years at the College of William and Mary in Virginia, U.S., and received the degree of Master of Arts from the School of Marine Science. She decided, without hesitation, to come back to China and serve her mother country in spite of the fact that friends were strongly encouraging her to stay in the U.S.

It was a very fruitful period from 1983 to 1990 when Lu Muzhen was employed at the newly-founded China National Offshore Oil Corp. (CNOOC) in the field of marine environment protection. On numerous occasions, she either joined or led professional groups to Great Britain, Norway, Denmark, the U.S., and Canada for technical exchanges. She invited foreign scholars to teach in China and organized domestic scholars to discuss and set up regulations under The Marine Oil Spill Emergency Act and to implement the Act within the company. As well, Lu Muzhen assisted and directed regional departments' environment protection practices in the south Yellow Sea, East Sea, and South Sea where the company's subdivisions were. While taking part in many international symposiums, Lu Muzhen, for the first time ever, reported the future problems that CNOOC would face in its great effort to protect the marine environment. During her service at CNOOC, she was

promoted to Senior Engineer and Director of Environment Protection. She became a member of several technical organizations, and was elected Committee Member of the China Marine Environment Science Organization.

After immigrating to Vancouver, Canada, she worked at BC Hydro, E.V.S. Environmental Consultants, and C.X.Y. Chemical Inc. Through her own initiative, she studied and implemented the control of chlorine discharge to effectively improve the marine bio-environment at one of BC Hydro's generation plants. In these studies, the chlorine discharge set point was effectively reduced from 100 p.p.b. to 10 p.p.b., resulting in minimal harmful chemical effects on fish, mussels and other marine organisms living in nearby ocean water habitats. This successful project saved millions of dollars for BC Hydro and was introduced to others generation plants by the BC Provincial Government.

Lu Muzhen received the title of Marine Scientist by the Canadian International Development Agency and took part in its aid program, advising China on multiple environmental projects including: the improvement of harbour water quality in Shanghai, Qingdao, and Qinghuangdao; the selection and coordination of managers and scholars from the above harbours; and the training and coordinating of technical exchanges with the Waterborne Transportation Institute, the Ministry of Communications, P. R. China. She loved her work in marine environment protection, believing that it affected everyone's living conditions, and that its importance lay beyond all national boundaries.

After her retirement in 1999, she organized a "Particle Exchange Committee" to search for the true meaning in life, published booklets for the Committee, and organized lectures to share information on unknown life form changes and studies of the human body and soul. At the same time, she volunteered for numerous local community organizations, including a library, a food bank, a police station, and a local community centre.

At 3pm, on the sixteenth of October, 2003 (twenty-first of September in the lunar calendar), at the age of 62, Lu Muzhen suffered a fatal cerebral hemorrhage. She was buried in Ocean View Cemetery in Vancouver, Canada. Her tomb will eventually be joined with her husband's, and will share a brass marker with the engraving: Be totally free in the afterlife;
Be always together in the same belief.

Her motto was: Always act with a clear conscience in doing and being;
Be kind to others; service begets happiness.

編輯緣起

這次將陸慕珍關於海洋環境保護領域的幾種文稿放在一起，會集成一個本子印刷出來，說誠實話，並不是她生前所願。自她離開我們往生西方淨土世界之後，我們悲痛悼惜不已，因循古人之蹤，集結親人的遺文佚稿加以流傳，籍以寄託我們心中綿延不斷的哀思。據以如此理念，遂由我主持其事，將四個文本按原貌編輯成這冊「陸慕珍海洋環境保護文集」呈現在您面前。

今我就編輯本集有關的一些話寫在下面，僅供您閱覽時參考：

首先，要交待的是為什麼用英文而不用中文印刷？慕珍當時成文用的是英文，家庭成員中又缺乏該專業的知識（明兒是注冊會計師CGA，蔚兒是軟件工程師），因而很難下手翻譯成中文，這是原因之一；第二個原因是聽取了一些朋友的意見：估計不從事該專業的人很少會去涉獵，讀者面不廣，翻譯成中文，費心費力多而收效微；換個角度說，專攻海洋環境保護專業者，又對本文集內容感興趣的話，那麼他的知識水準應已達相當程度，閱讀英文的能力一定也會具備的了，不需譯文而讀原作英文更佳。有這些理由的支持，所以本文集就採用英文印刷了。不過考慮到方便讀者瞭解梗概，已將每個文本的提要譯成中文，附在各個文本之首。

其次，我想向您提供一點關於慕珍寫作文集中各個文本的些許背景資料，興許對您有些助益。

第一個文本「弗吉尼亞州伊麗莎白河沉積物中的有機物分析」是慕珍於 1980-1982 年秋季兩年間攻讀碩士學位的論文。她曾為我講到留學的種種艱辛和欣喜：剛去學校按規定還要修海洋化學、海洋生物等課程的學分，那些音節又長又難發音又難記憶的生物學英文詞彙，對她來說非常之困難，要知道當年她的年齡已屆 39 歲，開始連聽導師課堂講解都不容易理解，更不用說做好課堂筆記，唯一的辦法就是課餘找同學補筆記，同學中有美國本國的，也有來自埃及的、韓國的、和其他亞洲國家的，而且他們大多來美不止一年或多年，對她一個新來的中國留學生都很友善，願意借筆記給她補齊。尤為使她難以忘懷的是瑞士裔教授魯道夫·盧理，特別

耐心幫她校正、批註書面報告上的文句，甚至文法。盧理發現她認真專心、聰慧好學。他歡喜這樣的學生，安慰她不要因一時的困難而著急，語言的困難不是大問題，過一陣子就會改善。並把自己的經驗告訴她，他剛到美國來一樣也有語言問題，直到現在廿多年過去了，還講不了地道美國英語，鼓勵她要有信心。慕珍每每和我談及盧理教授時都深懷感激之情。論文指導教授蘇紀武先生，早年自台赴美求學，學成後受聘於該校。他給予慕珍許多專業指導幫助，書不盡言，蘇教授的妻子姜品女士又和她成了好友，十分投契。

有一年，那是慕珍自美完成學業之後回國工作期間，系主任勃魯士應山東青島海洋學院邀請講學結束後來北京觀光，他對故宮龐大的古建築群及陳列的青銅、石刻藝術，以及古瓷器、書畫藝術特別的讚賞不已。慕珍是他們系裏也是威廉．瑪麗學院來自中國大陸第一位也是唯一的留學生，作為系主任的他很理解留學生們不同的文化背景和剛進入美國學習生活的不適應，所以都給予相當的關心和扶助。慕珍為準備寫這篇論文，要出海至大西洋底搜取伊麗莎白河口幾米深的淤泥沉積物，需要採樣船、鋼套管等一系列設備、器材，還要船舶駕駛員、採樣技工等人員一起出海採樣。勃魯士給以顧問和關照。可是預定的採樣日，天氣不怎麼好，行船到海上預定地域，風浪驟增，採樣船噸位小，船身晃蕩劇烈，顛簸不已，沒能如期完成採樣任務，空手而歸。採樣是為獲取第一手研究資料，是論文基礎工作中最最重要的基石。採樣失敗，惶論做實驗、寫論文，而且系裏再沒有第二次出海採樣的預算經費，有經驗的人知道，美國的人工、設備、器材費用都不菲。正在這進退維谷不知所措的時刻，忽然有一天，副院長約翰先生請慕珍去他們家吃晚飯，席間閒談，約翰先生問及碩士論文的準備和進展程度。慕珍心直口快，將採樣失敗經過說了一遍。想不到約翰聽了十分驚訝：那你的論文怎麼進行？一時大家沉默無言。約翰夫人用勸餐方式緩和稍感不安的氛圍。稍停，約翰先生說：讓我來想想辦法，我還有一部分科研經費可以使用。真是“柳暗花明又一村” 。不久，慕珍第二次出海順利採到所需樣品，開始進入實驗、分析階段。她夜以繼日地在實驗室工作，早去晚回，從沒有在夜間十二點之前休息過。她是典型的A型血者，做事專心致志，絕不旁騖，鍥而不捨。真像A字型楔子一般鑽勁，不達成目標誓不罷休。生活又節儉如此，常以三明治充飢，有時煮一鍋肉菜，放入冰箱，可供一週七天食用了。長時間的實驗室工作，來回往返的

穿梭走動，從國內帶去的膠底鞋被磨損得薄如綿紙而捨不得化錢換一雙新鞋，腳掌底生了繭子仍忍痛工作。與泰國女留學生合租的活動火車房，鐵皮頂篷，冬季寒冷而夏天炎熱。在另一方面，精神上的寂莫更是難以忍受，整整兩年間，她和我、明兒、蔚兒只通過一回電話，我們之間的聯繫方式就是借郵寄信件。

1982 年 9 月通過了碩士論文答辯，達成她的心頭宿願。她回國後多次對我說起：在美國學習的兩年補上了北京大學的失缺，經歷了從選題、閱讀文獻、搜集資料，到確立研究目標、價值評估，以及自己動手操作實驗、分析、篩選、驗證、成文，……所有一切寫作論文全過程的訓練。

第二、三、四個文本是十年以後，即 90 年代初開始在加拿大工作時期形成的。這些文本是為解決熱電廠在應用海水作為冷卻水過程中，打入氯氣以控制水管中貝殼類生物結垢問題。殘餘氯氣隨冷卻水排放回海洋對海洋生物產生不良影響，可能破壞生態平衡。她的研究目標是尋找出輸入氯氣的數量，如何既能防止冷卻水管結垢又使殘餘氯氣排放回海洋後對海洋生物的負面影響降低到最低水平。她從 1993 年現狀分析起始，到理論研究、可行性探討、及進行三文魚苗生長監測裝置設計和實際監測試驗，直至最後寫出成果報告圓滿完成，她都盡心盡力去做。工作量決非一天八小時，回到家裡晚飯後，常常又思考她的研究課題。監測裝置設計和實施不是學理科出身的她的強項，動手能力差是普遍的問題，她所遭遇的困難是相當嚴重的。除了夜班監測三文魚苗生長由助手代勞外，她都親躬不假他人之手。時常勞頓一天，疲憊不堪，在回家的車上打瞌睡了。或是回到家中，先躺下打個小盹以恢復體力。長此以往過度超支，日積月累，大大損耗了她的心力和體力，嚴重損傷了她的健康。誠如有位美國專家看到她的研究文本時感觸頗深地說：不可思議，她在短時間裡獨立完成的這個項目，如果在美國研究所裡須有一個項目組的人員需要更多的投入方可完成。

慕珍真誠待人，常念古人言：“滴水之感，當以湧泉相報。”從不忘記他人對己的點滴幫助，所以在第三、四個本子完成時，她不忘在研究、實施過程中曾和Al Brotherston 討論以及助手J. D. Greenbank、R. P. Fink的幫助和支持，因此都綴上他們的名字以見尊重和感謝。

慕珍，她猶如一支熠熠燭光，過度過旺的放光令她過早地燃盡了生命之火，然而，她的生命質量和總量數值已然大大超越了平常紀年歲月許多許多。

張　薔　謹記於溫哥華淨虛齋　　2005 年 5 月

*附言：*衷心感激 Ms. Ann Hayward Walker忙裏抽暇為文集撰寫序文。十分感謝 Ms.Heather O'Hagan 校閱中譯英部分文字。我們的孩兒海明、海蔚倆兄弟盡心盡力做好文集重排、翻譯、校訂、編輯、直至交付印刷等工作，一切應化在純淨心願之中：永遠緬懷我們的媽媽!*

***文中所記倘有不甚確切之處，實為我年老力衰記憶減退所誤。祈求諸君原諒並賜教、糾正。*

EDITOR'S WORDS

It was not her plan to compile her thesis and essays on marine environment protection and print them as a collection here. Since her leaving us for the peaceful afterworld, we could not stop the sorrow. In order to remember her, following the practice of our ancestors, we have collected four of her works in an effort to share them. I led this project and edited this book, *Marine Environment Protection: Essays* by Lu Muzhen, which is in front of you now.

There are some notes I'd like to explain about this book, as a reference for your reading.

First of all, let me tell you why the book was printed in English, and not in Chinese. Muzhen's original version was in English, and our family now lacks the technical background (Ming is a CGA, and Wei is a software engineer), to translate the text into Chinese. That's the first reason. Secondly, we listened to our friends' suggestions. This publication will unlikely be read by non-technical people, hence it has a limited reach in terms of its readers. Translating it into Chinese is laborious work. If someone in the field of marine environment protection is interested in this book, (s)he would likely have enough technical background and sufficient English language skills to read the original English version. For these reasons, this book was printed in English only.

At the beginning of each essay, a summary has been translated into English so that readers can easily know what each essay is about. In addition, I have offered background information on the essays written by Lu Muzhen. Hopefully, it will aid you in your reading of these collected works.

The first article, "Organic Compound Levels in a Sediment Core from the Elizabeth River of Virginia", was the Masters Degree thesis Muzhen wrote from 1980 to the Fall of 1982. She used to tell me about the hardship and happiness in studying overseas. The first round of courses the school asked her to take were Marine Chemistry and Marine Biology which involved many long words with terminology that was difficult to pronounce. For a thirty-nine year old, it was very challenging to not only comprehend lectures, but also to take notes. After classes, she would borrow the notes from classmates who

were very kind in lending them. These fellow students were either Americans, Egyptians, Koreans, or other Asians who came to the U.S. for more than a year and understood what language hurdles a newcomer faced.

Swiss Professor, Rudolf Bieri, made a great impression on Muzhen with his patient help and correction of language and grammar errors on her reports. Prof. Bieri found her to be hard working, smart and eager to learn -- the type of student he really admired. He advised her not to worry too much about her language abilities since her skills in this area would improve as time went by. To encourage her, he shared the experience that he had when first went to the U.S. He also had language issues, and some twenty years later, he still could not speak the local American dialogue. Every time Muzhen mentioned his name to me, her face showed appreciation.

Lu Muzhen's thesis advisor was Prof. Chih-Wu Su, who had previously come from Taiwan to study in the U.S., becoming a professor after graduation. He provided countless hours of technical help to Muzhen. His wife, Mrs. Chiang Ping, became a very close friend of hers.

One year when Muzhen was working in China after graduating in the U.S., Prof. Bruce Neilson, her University Department Head, visited Beijing after being invited to lecture at the Marine Institute in Qingdao, Shangdong Province. He took a special interest in the old architecture of the Forbidden City -- its bronze and stone sculpture, and in the ancient Chinese and more contemporary fine arts paintings. Muzhen was the very first and the only Chinese student in his department, as well as at William and Mary College. As a department head, Prof. Neilson understood different cultural backgrounds and the adjustment new students had to make. He provided a great deal of assistance.

To prepare for her thesis, Muzhen needed to collect sediment samples from the Elizabeth River. This task required a sample collecting boat, steel tubing and other special tools, in addition to a captain and technicians. Prof. Neilson provided the guidance she needed. On the scheduled day, the weather was not that nice. By the time the boat arrived at the sample collecting location, a heavy wind had come up and was blowing against the boat. It was impossible to stabilize the craft and collect the samples. Because the samples formed the very basis of the thesis, without them, there could be no research work.