83年生態研究第09號

黑面琵鷺之生態研究(一)

The Ecological study of Black-faced Spoonbills (Platalea minor) In Taiwan. I

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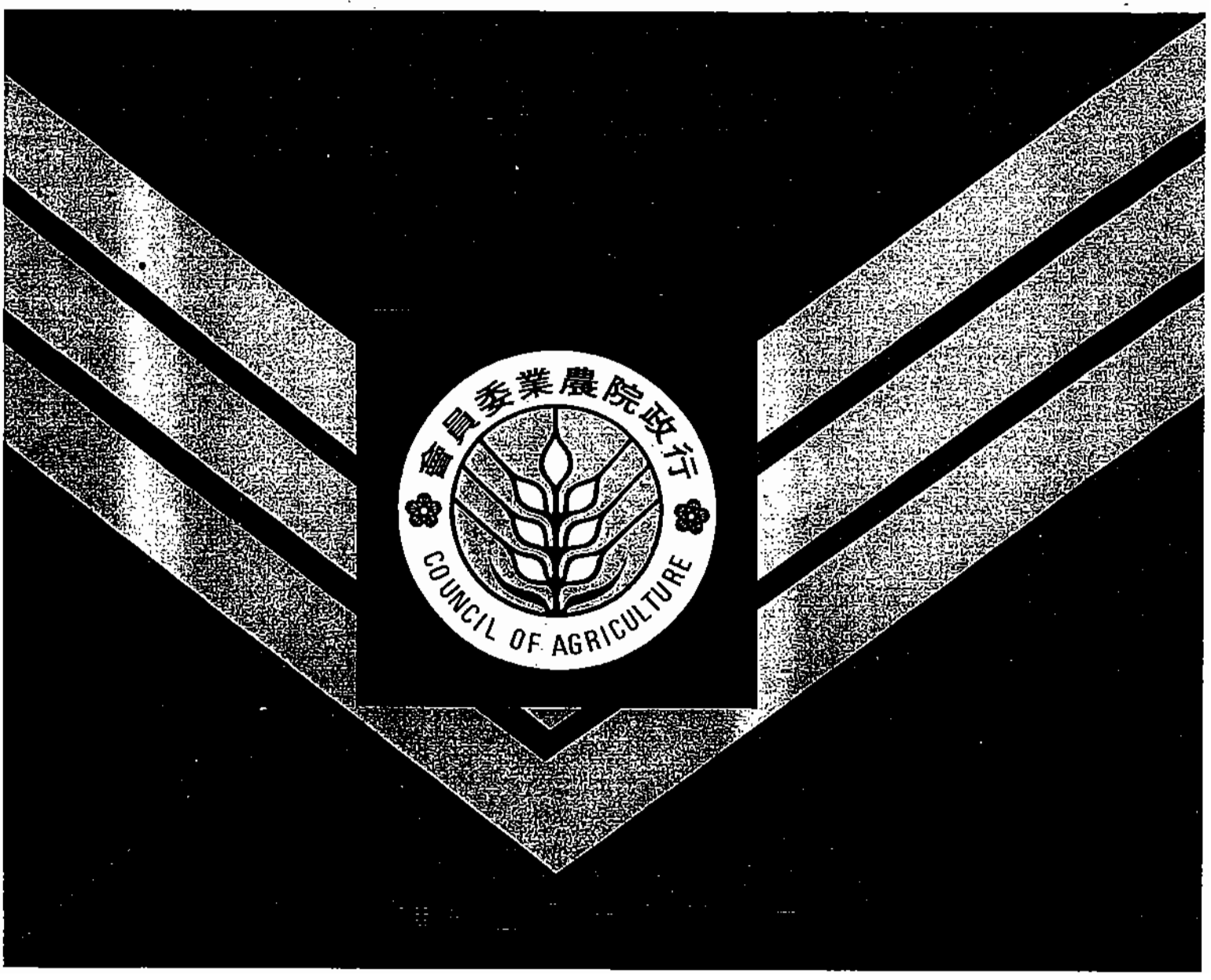

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中華民國八十三年八月

目　　錄

壹、曾文溪口棲地調查

台灣省特有生物研究保育中心

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曾文溪口棲地調查　目錄

摘　　要

本研究之目的在於了解黑面琵鷺渡冬區之狀況，調查方式分休息區、覓食區及新浮沙洲三區進行。經83年1月至6月調查結果休息區共發現魚類26種、昆蟲類8目18科31種、鳥類4目12科26種；蟹類5科19種；軟體動物8科10種；常見植物有土牛膝等6種。覓食區方面共發現魚類23種、哺乳類2種、兩棲類1種、昆蟲類5目6科15種、鳥類7目14科31種；蟹類4科15種；軟體動物8科10種；植物有土牛膝、五節芒等162種。新浮崙沙洲共發現魚類24種、哺乳類2種、昆蟲類7目11科16種、鳥類3目6科13種；蟹類3科15種；軟體動物7科8種；常見植物有白矛等5種。

比較黑面琵鷺棲息區、鄰近覓食區及可能替代棲地之結果，有關台南縣政府所擬保護區設置替代方案之新浮崙沙洲，與黑面琵鷺原棲地環境差異極大，底棲動物相雖類似，但族群數量則有顯著的差異，且新浮崙沙洲區之漲退潮差明顯的較堤內之浮覆洲爲大，又因其面積逐潮縮減，作爲替代區可能缺少足夠之安全距離。

一、前言

黑面琵鷺爲國際間重要之瀕臨絕種鳥類，目前所知最大族群每年都會到曾文溪口渡冬。三年前臺南縣政府提出將曾文溪口開發爲石化工業區的計畫，引起國內外保育界普遍的重視，及社會不同層面間相當尖銳的爭議。因此，如何在保育與開發之間尋求平衡點是一個相當重要且急迫的課題；而要解決這個問題，首要的工作在於對黑面琵鷺之生態進行研究；農委會有鑑於黑面琵鷺生態研究的重要性，及於八十二年九月邀請台灣省特有生物研究保育中心、中央研究院動物所劉小如博士、師大生物系王穎博士、台南市野鳥學會等單位及專家進行協商並確立研究之方向後，即由各有關單位分別進行黑面琵鷺之行爲研究、族群動態研究、誘食區整治、棲息替代區評估及七股地區之棲地調查等工作；同時爲隨時修正研究方向及控制研究進度，另成立「黑面琵鷺之生態研究諮詢及督導小組」定期開會指導各研究之進行。

本中心今年度執行之曾文溪口棲地調查工作其目的在於了解黑面琵鷺主要渡冬區－曾文溪口之棲地情形，其調查之重點包括曾文溪口之動物資源、底棲生物及植物種類，並分休息區、覓食區及新浮崙沙洲三區分別調查其生物相，並比較黑面琵鷺不同利用地區之環境因子，以供日後研究及制訂黑面琵鷺保育決策之參考。

二、調查區概述

本次調查之地點位於台南縣七股鄉之鹽文溪口北岸，調查之範圍包括曾文溪北岸、七股工業區預定地及該預定地北方之魚塭區，總面積約3340公頃（圖一）。而在這範圍內，爲期比較黑面琵鷺在此區域之利用情形，將之分爲休息區、覓食區及新浮崙沙洲三區來進行調查，有關各區之環境概況如下：

1.休息區：本區之面積約280公頃，爲黑面琵鷺之主要渡冬休息區，其環境主要分爲水域及浮覆沙洲二部分該二部份之大小受由3號閘門進出之潮水所控制，而黑面琵鷺在白天則會隨潮水之漲落移動其位置。

2.覓食區：本區之面積約2800餘公頃，土地利用以魚塭及農作物爲主；另在廢棄農田中大都被草本植物所覆蓋，而廢棄的魚塭中則已部份被草本侵入形成小水池，水池中的一些魚類，提供了黑面琵鷺食物的來源。

3.新浮崙沙洲：本區之面積約200公頃，爲一南北向狹長之沙洲，其內並無植物覆對，主要爲沙灘及水域，最深之水域達2公尺以上之深度。

三、調查方法：

1.魚類：

(1)選擇休息區二個樣點、覓食區四個樣點及新浮崙沙洲二個樣點共八個樣點。

(2)以手撒網方式採樣，每一樣點撒五次。

2.哺乳類：

(1)利用捕鼠籠及薛氏捕鼠器內放地瓜切塊加花生醬當誘餌，依地形置於鼠類可能出沒的地點，共放置了10個鐵製捕鼠籠及10個薛氏捕鼠器，進行一個捕捉夜（trop-night）的捕捉工作。

(2)利用車行及步行的方式尋找哺乳動物之跡相，如殘骸、洞穴等。

3.兩棲類：

(1)實地調查：

於83年4月及6月分赴研究現場調查，利用圍繞黑面琵鷺主要休息區之堤防與現有道路，作爲研究調查路線。每200m定點以探照燈尋找兩棲類，共藉聽蛙鳴輔助之。

⑵訪問調查：

對當地駐軍、漁民、與住戶進行訪問調查，了解當地兩棲類種類、數量與黑面琵鷺覓食習性。

4.昆蟲類：

⑴目視法：於每日上午09:00～11:00及下午13:00～15:00於調查區域觀察昆蟲，特別針對鱗翅目的昆蟲進行調查，記錄出現有的種類與數量。

⑵掃網法：在進行目視法中，對草生地點逢機掃網。每一區掃網兩次，每次來回掃網20回，距離約10公尺，網子的口徑爲30公分。

⑶在每一區的中心附近埋入直徑10公分，深20公分的透明壓克力瓶。瓶內倒入鳳梨加砂糖之混合液（比例爲4:1）10c.c.爲誘餌，隔日收回檢視所捕獲之昆蟲種類與數量。

5.鳥類：

⑴調查時間

曾文溪口之鳥類調查自八十三年一月廿五日起至八十三年六月三日止，分黑面琵鷺休息區，覓食區及新浮崙沙洲三區進行。

⑵調查方法

①黑面琵鷺之休息區因係一視野寬闊之沼澤區，因此對鳥類之調查係以定點調查爲主，即在此區擇三個定點並以kowa40倍單筒望遠鏡來進行觀察、記錄下所有出現在該區之鳥類。

②黑面琵鷺之覓食區因範圍較大，且視野易受魚塭之邊堤及部份植物阻隔，因此，此一區之調查係採穿越線來進行調查，即在曾文溪口北岸至堤防，工業區預訂地內之工業區北方堤防至魚溫區各設二條穿越線，以目視法並用kowa40倍單筒望遠鏡觀察並記錄下出現之鳥種。

③新浮崙沙洲係一視野廣闊之沼澤區，在本區以穿越線方式進行調查。

6.植物相調查：本調查技術採用穿越線法，利用既有之道路或步道進行調查，並記錄區內出現之植物種類、數量及代表性之植物組成。

7.底棲動物調查及標本採集鑑定：於調查區內設置若干樣區，採集、鑑定動物種類及調查其數量。

⑴大樣區：主要記錄較大型之底棲動物，如蟹、貝、螺及部分肉眼可見之底棲性動物，由調查者主觀在研究區內選擇數個具有代表性之樣區。每

樣區爲一平方公尺深十五公分，記錄樣區內可見之所有生物，分別稱重並測其物體大小。

⑵圓管樣區：以不銹鋼製採樣圓管（corer）－內徑10公分；長40公分，將採樣管垂直插入底土約30公分，密封管口後將採樣管抽出，管內泥沙依土壤分層，利用0.5mm之網目篩選土中生物，鑑定種類並記錄數量。

⑶生物種類記錄：於上述樣區外隨機記錄各處之蟹、螺等之種名、數量及大小。

8.環境因子調查：

⑴水質測定：測溫度、溶氧量、生物需氧量、化學需氧量、重金屬含量、凱氏氮、總磷、磷酸鹽、酚類、油脂、導電度、鹽度、濁度、pH值、懸浮固體及總鹼度。

⑵土壤測定：測溫度、導電度、鹽度、pH值及底土氧化還原電位，並以透明壓克力採樣圓管，內徑2.6公分；長40公分，插入土中約30公分採取土樣，陰乾後測有機質含量、陽離子交換量、土壤粒徑分析、顆粒間空隙大小、重金屬含量、主要元素含量等。

⑶蒐集氣象資料並實際測量潮位變化。

四、結果

1.休息區

⑴魚類：本次調查共發現沙鮻、曳絲鐵嘴、短鐵嘴、背斑叉舌鰕虎、污鐳鰨、高鼻水滑、黑星銀鉋、六帶鯵等八種魚類，惟經全年之調查記錄則共有26種魚類。

⑵哺乳類：未發現任何哺乳類動物。

⑶兩棲類：未發現任何兩棲類動物。

⑷昆蟲類：共發現8目18科31種昆蟲，包括鱗翅目之粉蝶科1種、蛺蝶科3種、小灰蝶科1種、螟蛾科1種、蜻蛉目之晏蜓科1種、蜻蜓科3種、雙翅目之雙翅科4科、膜翅目之粗腿小蜂科1種、姬蜂科1種、地蜂科1種、胡蜂科1種、緣椿科1種、長椿科1種、直翅目之蝗亞目3科、鞘翅目之金龜子科1種。

⑸鳥類：

①在休息區出現之鳥種共有4目12科26種，惟發現之隻次高達1387隻次，

其中以濱鷸最多共記錄到653隻次，其次爲東方環頸鴴共記錄244隻次，黑面琵鷺之隻次則排名第三，共記錄到138隻次，而在單一次調查之隻次上，仍以濱鷸爲最多，其數量高達550隻，東方環頸鴴居次有170隻，而黑面琵鷺則排名第三有138隻。其他如小白鷺、洋燕、淙沙燕等在本區皆有穩定之數量。

②在調查期間每次調查皆可發現之鳥種計有小白鷺、東方環頸鴴、褐頭鷦鶯及麻雀等四種。

③在五月份尚有發現記錄而在六月則未記錄到之候鳥有大杓鷸、金斑鴴、青足鷸、裏海燕鷗等四種。

④在四月份尚有發現記錄而在五月份以後則無記錄之候鳥有灰斑鴴、磯鷸等二種。

⑤大黑脊鷗、黑嘴鷗此二種鷗科鳥類僅在三月份有記錄，其他月份則無顯見，此等鳥類僅在本區做短暫之停留後即繼續往北遷移。

(6)底棲生物：

海堤內之浮覆洲：自魚溫區最後一道護堤起北沿九塊厝堤至七股海堤止，其內之浮覆洲。本區爲黑面琵鷺棲息之主要據點，區內潮水主由3號閘門（十孔閘門）進出，漲退潮差深度約差50公分，沿魚塭護堤旁之潮溝，漲潮可達之處，底棲生物極爲豐富。蟹種有白扇招潮蟹、北方呼喚招潮蟹、網紋招潮蟹、台灣招潮蟹、三角招潮蟹、日本大眼蟹、短指和尚蟹、側足厚蟹、伍氏厚蟹及雙齒近相手蟹，潮溝中主要魚種爲花身雞魚、小鰕虎、台灣鰕虎、大鱗鰕虎、鼬華鰕虎、高鼻水滑、夏威夷海鯉、狐頭塭、彈塗魚及大彈塗魚等，因潮水漲退，常有退潮後留存於潮池中之小魚，也是黑面琵鷺重要的食物來源。潮溝內及其周圍泥灘地，環節動物種類亦相當豐富，由取樣中所篩出之生物有引背蟲約10％，纓鰓蟲約50％，沙蠶約10％，小頭蟲約10％，端腳類數量亦豐約占20％。

浮覆洲內包括乾沙區、沙質灘地、泥質灘地及潮溝等，環境鑲嵌複雜。乾沙區內鹽定散生，底棲生物極少，其它潮水可達之處，動物種類岐異度高，因此另依微環境及甲殼動物組成再細述之；沿九塊厝堤下石縫中以雙齒近相手蟹最爲優勢，幼蟹數量極多，石堤下緣浸水處常附生大量綠色之藻類，內藏有數量極爲龐大之端腳類，最大個體約1公分，0.1公分以下

之個體約占80%，估計每100平方公分內即有數千隻以上之族群數，土堤下方之淤泥處，其附生之藻類中端腳類之數量稍減，而蟹類幼蟲（甲殼寬0.1公分以下者）之數量則增多，底棲性之魚類以鰕虎科之彈塗魚、青彈塗魚數量最多。

潮溝中有捕捉鋸緣青蟳、遠海梭子蟹及紅星梭子蟹之記錄，這三種蟹常隨潮水漲退移動。浮覆洲內潮水經常淹沒處，以日本大眼蟹占90%以上之優勢，且族群密度亦高，平均每一平方公尺棲息成蟹15隻～20隻，幼蟹密度則較不均勻，此泥灘地中軟體動物腹足類之澆酒海蜷極爲常見，高潮線以上之泥質灘地聚集大量之台灣招潮蟹。沙質灘地則以和尚蟹及白扇招潮蟹爲主要優勢；和尚蟹於一平方公尺之棲地內可達80隻以上之族群數，雙殼類在沙質灘地種類及數量均多，記錄有牡蠣、西施舌、文蛤、環紋蛤、公代、綠殼菜蛤等。

(7)植物：本區於冬春兩季潮溝中有藻類大量繁生，而維管束植物僅分布在堤岸上及兩側，常見有土牛膝、野塘蒿、毛西番蓮、濱刀豆、濱豇豆、葎草等。

2.覓食區：

(1)魚類：本次調查共發現吳郭魚、背斑叉舌鰕虎、污鰭鰨、高鼻水滑、虱目魚、印度牛尾魚等六種魚類；草蝦、五須蝦等二種蝦類；蟳等一種蟹類，惟經全年調查共有23種魚類。

(2)哺乳類：發現了三隻被車輾死之褐鼠殘骸、三個鬼鼠挖掘之洞穴、同時亦捕獲一隻褐鼠。

(3)兩棲類：未發現任何兩棲類動物、惟依當地居民描述曾於國聖橋附近發現黑眶蟾蜍一種。

(4)昆蟲類：在本區發現昆蟲共有5目6科15種昆蟲，其中包括鱗翅目之小灰蝶科1種、螟蛾科1種、蜻蛉目之蜻蜓科2種、雙翅目之雙翅科4種膜翅目之蟻形亞目4種及直翅目之蝗亞目3種。

(5)鳥類：

①在覓食區出現之鳥種共有31種795隻次，分屬7目14科；本區鳥種大都以單獨或小群出現，不若休息區中之鳥種呈現大群出現之情況。在調查期間，本區出現最多的鳥類爲小白鷺，高達220隻次，其次爲濱鷸，共記

錄115隻次，東方環頸鴴則排名第三，共記錄到88隻次。在單次調查上則以五月之小白鷺爲最多，共有86隻次；濱鷸居次，在元月份有85隻之記錄，而東方環頸鴴則居第三位，亦在元月份有64隻之記錄。

②在調查期間，每次調查皆可發現之鳥種計有小白鷺、東方環頸鴴、褐頭鷦鶯及麻雀等4種。

③青足鷸在本區僅在五月之前有記錄而在六月沒有出現，同時在休息區中亦有相同的情形，顯然青足鷸在七股地區僅停留到五月份即行北返。

(6)底棲生物：

海堤內之魚溫區及七股河堤與曾文溪口間；本區曾記錄黑面琵鷺於此覓食，區內東半部以種植旱作爲主（種植香瓜類），西半部則多經營魚塭養殖（以養殖虱目魚及文蛤爲主）。

本區因多爲魚塭，故蟹之數量及種類少，僅見土堤有少數蟹之孔穴，大部分之魚塭因曾施用飼料，底質有機污染嚴重，有惡臭，水域旁水鳥足印極多，螺及多毛類遺留之痕跡亦多，環節動物類小頭蟲約占99%，沙蠶1%；軟體動物主要爲燒酒海螺等。

另有少數非魚塭之深水塘，池內長滿蘆竹，水中有大量藻類，魚類以慈鯛科之種類爲主。魚塭間排水溝或荒廢淺水塘，以慈鯛科之福壽魚之鯔科的魚種最多，水塘旁常生有大量之禾草，草間之泥灘地以擬相手蟹及雙齒近相手蟹占絕大優勢，而其旁之開闊泥地則主要爲網紋招潮蟹及側足厚蟹與青彈塗魚分占三大優勢，環節動物以小頭蟲爲主。七股河堤與曾文溪間之潮溝旁有小區域之網紋招潮蟹純群，高潮線附近之泥灘區則聚集大量之台灣招潮蟹純群，草叢間常見擬相手蟹，沿七股海堤旁之排水溝記錄有網紋招潮蟹、白扇招潮蟹及相手蟹等。

(7)植物：

本區陸域面積較大，植物種類較多，依微環境可區分爲水塘、排水溝、乾涸養殖池內及土堤上等，其植生組成以鹽生植物爲主，依其生育地之含水量及鹽度高低有不同之優勢種。

荒廢養殖池或淺水塘因池水漸枯，池旁之海雀稗占滿池面，形成濕地演替的典型景觀，水塘中央較深處則以蘆葦等大型挺水植物爲優勢，其它伴生植物有濱水菜、水竹葉、狗牙根、龍爪茅、舖地黍、鹽地鼠尾粟等。

養殖池間之排水溝兩旁泥地多可見海茄冬成帶狀分布，伴生植物有蘆竹、濱水菜、濱雀稗、過江藤、岸邊較乾處常見土牛膝、銀合歡、野塘蒿、濱刀豆、濱豇豆、龍葵、牛筋草、毛西番蓮等。

人爲開挖之養殖池因廢棄或收成後即迅速乾涸，此類生育地土壤乾硬且含鹽份極高，不適合一般植物生存，因此常形成鹽定單一優勢，春季時大面積定植，紅色嫩芽蔚爲奇觀。伴生植物亦爲耐鹽之鹽生種，如鹽地鼠尾粟、濱水菜、台灣濱藜、雙葉藜、小葉灰藋、刺莧等。

在廢棄魚塭堤岸上及兩側，以土牛膝、野塘蒿、毛西番蓮、濱刀豆、濱豇豆、濱水菜、鹽地鼠尾粟、高麗芝爲主，偶而出現木麻黃、欖仁等小喬木。河堤及土堤上以苦藍盤或銀合歡爲優勢之植被，植株呈低矮匍匐狀，與之混生者爲馬鞍藤、假葉下珠、老虎心。

3.新浮崙洲區

⑴魚類：本次調查共發現污鰭鰕虎、高鼻水滑、雙邊魚、腹紋白點河魨等四種魚類，惟經全年調查共有24種。

⑵哺乳類：眼見一隻臭鼩及發現一隻褐鼠殘骸。

⑶兩棲類：未發現任何兩棲類。

⑷昆蟲類：在本區發現之昆蟲共有7目11科16種，其中包括鱗翅目之小灰蝶科1種、螟蛾科1科、蜻蛉目之晏蜓科1種蜻蜓科2種、雙翅目之雙翅科4種、膜翅目之粗腿小蜂科1種、姬蜂科1種、同翅目之稻飛科2種、半翅目之椿科1種及鞘翅目之步行蟲科1種。

⑸鳥類：

①在本區出現之鳥種共有13種194隻次，分屬3目6科。在本區出現之鳥類就數量而言，以小白鷺及東方環頸鴴48隻次爲最多，而濱鷸則有39隻次居第三位。在單次調查之數量上則以濱鷸之35隻爲多，其次爲小白鷺有24隻，東方環頸鴴之22隻則居第三位。

②在本區每次調查都可發現的鳥僅有小白鷺一種，東方環頸鴴則僅在三月份調查時沒有出現。

⑹底棲生物

爲曾文溪口北岸、七股海堤以西之沙洲；本區呈狹長帶狀，西側面臨台灣海峽，風及波浪皆較前述兩區爲大。沙洲與海堤間有一潟湖，附近居

民利用其養殖長牡蠣。沿海堤與潟湖間之泥灘地主要有短指和尚蟹、白扇招潮蟹、日本大眼蟹、北方呼喚招潮蟹、網紋招潮蟹，高潮線際有台灣招潮蟹小純群。新浮崙沙洲上角眼幽靈蟹占較大優勢，其它有痕掌幽靈蟹及長趾股窗蟹、圓球股窗蟹、雙扇股窗蟹等。本區由於經常受波浪沖刷，底質呈較粗之砂粒，棲息之環節動物較少，所取之樣區以篩網篩選結果皆無生物。軟體動物於潟湖旁沙地有公代、環紋蛤及竹蟶零星分布。

(7)植物：

新浮崙沙洲之乾沙地上有馬鞍藤小面積繁生，較濕潤處則混生有白茅、海雀稗、鹽地鼠尾粟、濱豇豆等。

四、討論

1.覓食區的撒網點大多爲廢棄魚塭及魚塭旁排水溝，主要存在的魚種爲吳郭魚及污鰭鱲，可能爲黑面琵鷺的主要食物來源。

2.新浮崙沙洲與覓食區的魚種，除污鰭鱲、高鼻水滑相同外，在魚種及數量兩者有相當差異。

3.黑面琵鷺僅在調查區內進行休憩及覓食行爲，未有繁殖行爲的發現，故通常對雛鳥及鳥蛋頗具威脅性的囓齒目動物對其應不具任何影響。同時黑面琵鷺的食性亦以水中生物爲主，因此和當地存在小型哺乳動物應無直接關係。

4.曾文溪口的昆蟲相與內地的昆蟲相比較起來是比較少，影響昆蟲相的可能因素爲海風與沙土：強烈的海風與貧瘠的沙洲均不利昆蟲的生存。基本上曾文溪口的昆蟲資源以鱗翅目及膜翅目的種類較多。從所劃分的休息區、覓食區及新浮崙沙洲區看來，以休息區中昆蟲的種類與數量最多。至於覓食區及新浮崙沙洲區，可能因爲受海風及沙土的影響，昆蟲的種類與數量比較少。

5.在鳥類調查方面是從83年1月25日開始進行調查所記錄之鳥種共有7目17科32種，惟依台南鳥會常年調查結果，本區之鳥種高達200餘種，兩者相差高達170種以上，其原因可能在於：

①候鳥之過境期大都集中在每年約9月至翌年的1月，而北返之候鳥經由本區較少。

②台南鳥會在當地之調查投入相當密集的人力及時間因此對一些僅做短暫停留之鳥種較不會遺漏，而本計畫之執行因遲至82年12月方經核准辦理，起步較晚漏掉了82年9月至83年1月份之間的調查，而造成記錄鳥種偏低的情

形。

6.根據1897－1988的觀測資料（表一）曾文溪口之年溫23.5℃，年降雨量爲1750.9mm，雨量集中於夏季，全年之蒸發量達1832.1mm，蒸發量的月變化幅度較小，由圖一可知本區冬季較爲乾旱。本研究並對上述三區進行水土採樣及檢驗工作，其分析項目及結果參見表二及表三，檢視分析數據，值得注意的是：

①新浮崙沙洲外側含銅量頗高（10.08ppm），可能受二仁溪之廢水污染（二仁溪口土壤含銅量10.18ppm）。

②魚塭內之泥灘底質因施用飼料，故有機污染嚴重（BOD及COD之值均高），底棲動物種數驟減，僅存耐污染種大量繁生。

由於現有記錄中黑面琵鷺最大族群數量在台灣曾文溪口，因此本棲地之保護無疑對該族群攸關重大；而棲地的破壞，如開墾農田使得黑面琵鷺的棲息地及覓食區減少，養殖及採集貝類的活動亦造成牠們極大的干擾，但該族群尚面臨一更大的威脅，即工業區的設立，工程的進行如疏浚泥沙造成底部的污染物攪動，對整個潮間帶生態系造成的衝擊，以及污染等問題將愈趨嚴重。

有關台南縣政府所擬保護區設置替代方案之新浮崙沙洲，經調查比較，與黑面琵鷺原棲地環境差異極大，底棲動物相雖類似，但族群數量則有顯著的差異，研究中並於三號閘門內外分別測量潮差，結果新浮崙沙洲區之漲退潮位變化明顯的較堤內之浮覆洲（休息區）爲大（圖二、圖三）。又據研究本區砂洲因受外海波浪侵蝕而有內移特性，內陸海岸則因河流漂砂、潮流漂砂、風砂堆積及人爲土地開發利用而向外伸長，因此潟湖不斷縮小，砂洲島與陸地逐漸相連。曾文溪河口以往由於堆積旺盛，形成河口間海岸凸出之廣大沖積平原。但自曾文水庫完工後，由於河川輸沙量減小，河口堆積現象減弱，反而受河水入海之沖刷而造成此處之海水深度逐漸增加，河口之新浮崙沙洲面積始逐漸縮減，作爲替代區可能缺少足夠之安全距離。

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表一：氣象資料表

月份	1	2	3	4	5	6	7	8	9	10	11	12	合計
氣溫	17	17.5	20.3	23.8	26.7	27.7	28.2	27.9	27.5	25.1	21.9	18.6	
降雨量	18.3	30.1	42.8	67.4	183.9	387.9	387.6	407.2	160.4	32	18.2	15.1	1750.9
降雨量百分比	1.00%	1.70%	2.40%	3.80%	10.50%	22.20%	22.10%	23.30%	9.20%	1.80%	1.00%	0.90%	
蒸發量	119.8	114.7	148.5	168	183.1	160.3	173.3	158.1	148.6	142.7	118.6	109.8	1832.1

表二：水樣分析結果

編號	地　　點	SS mg/l	COD mg/l	BOD mg/l	凱氏氮 mg/l	氨氮 mg/l	總磷 mg/l	磷酸鹽 mg/l	鹼度 mg/l
1	覓食區（廢棄魚塭）	44.00	157.00	30.02	5.46	3.27	0.83	0.23	379.00
2	覓食區（經營魚塭）	35.00	56.00	6.40	4.20	2.01	0.03	0.37	202.00
3	休息區（潮溝）	56.00	72.00	2.80	4.25	3.42	0.27	0.02	85.00
4	休息區（浮覆地）	123.00	98.00	4.80	3.30	2.80	0.19	0.05	122.00
5	新浮崙沙洲（外）	33.00	30.00	4.50	3.56	2.71	0.19	0.05	122.00
6	新浮崙沙洲（內）	27.00	98.00	1.70	3.36	2.52	0.17	0.06	121.00
7	曾文溪北岸	14.00	52.00	3.50	2.69	2.33	0.13	0.04	102.00
8	曾文溪口北岸	65.00	68.00	2.60	2.47	2.21	0.21	0.03	105.00

表二：水樣分析結果

編號	地　　點	Zn ppb	Pb ppb	Cu ppb	Cd ppb	油脂 mg/l	酚 ppb	硫化物 mg/l
1	覓食區（廢棄魚塭）	11.12	20.69	6.80	0.37	1.50	nd*	0.25
2	覓食區（經營魚塭）	9.19	84.65	5.90	0.59	0.60	nd	0.14
3	休息區（潮溝）	9.44	12.96	6.18	0.39	1.10	nd	0.47
4	休息區（浮覆地）	25.29	18.22	7.35	0.48	0.70	nd	0.94
5	新浮崙沙洲（外）	7.58	11.68	5.03	0.39	1.00	nd	0.17
6	新浮崙沙洲（內）	7.67	26.67	4.18	0.36	0.80	nd	0.19
7	曾文溪北岸	3.67	15.59	3.44	0.47	0.90	nd	0.22
8	曾文溪口北岸	8.94	24.26	8.98	0.34	0.90	nd	0.50
備註*nd表無法檢本出（本項目之偵測極限爲3ppb）								

表三：土壤樣本分析結果

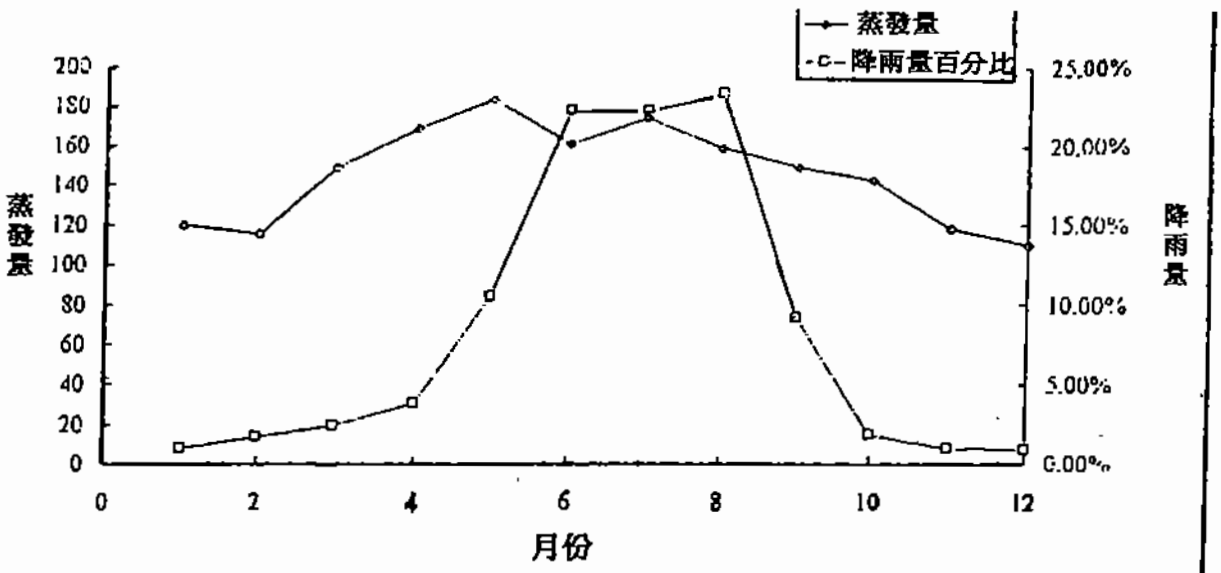
編號	地　　點	CEC	有機質 %	N %	P ppm	K ppm	Zn ppm	Pb ppm	Cu ppm	Cd ppm
1	覓食區（廢棄魚塭）	2.24	0.80	0.10	4.03	323.00	46.20	11.43	6.03	0.20
2	覓食區（經營魚溫）	1.95	0.52	0.05	5.97	327.00	39.70	8.73	4.83	0.82
3	休息區（潮溝）	2.46	0.49	0.04	3.26	176.00	41.80	9.08	4.30	0.83
4	休息區（浮覆地）	2.48	0.63	0.03	3.64	319.00	43.00	12.40	5.78	0.78
5	新浮崙沙洲（外）	0.96	0.23	0.02	3.26	147.00	54.40	37.38	10.08	1.09
6	新浮崙沙洲（內）	1.22	0.51	0.05	6.36	255.00	41.10	9.65	3.68	0.70
7	曾文溪北岸	9.12	0.72	0.08	2.09	212.00	39.20	10.70	6.88	0.65
8	曾文溪口北岸	1.67	0.27	0.03	2.87	303.00	36.50	8.38	3.33	0.38

表三：土壤樣本分析結果（續）

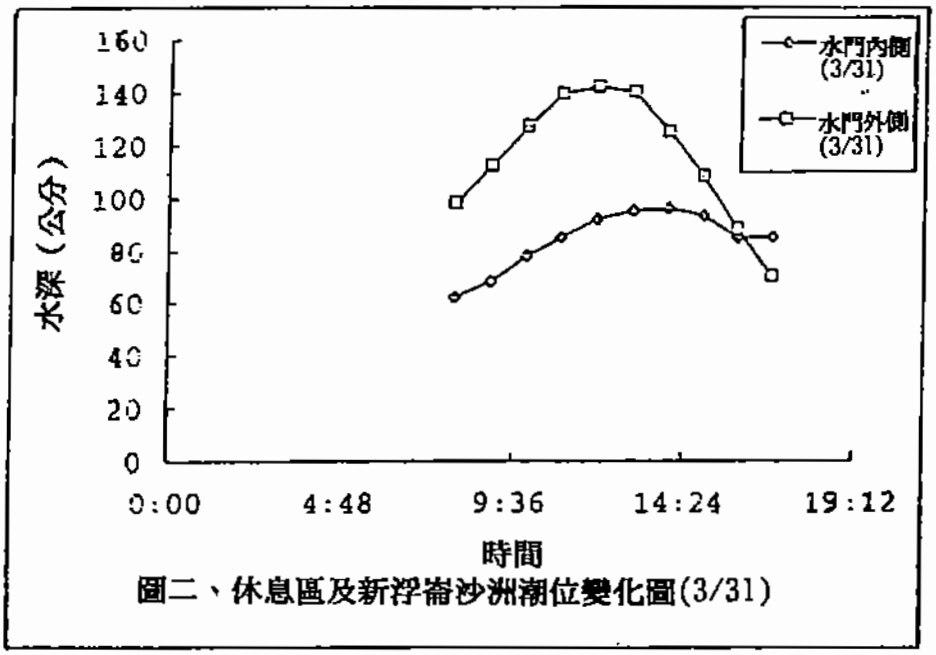
編號	地　　點	砂				粒	坋粒	黏粒	土垃密度
		2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.002	<0.002	g/ml
1	覓食區（廢棄魚塭）	0.00	0.06	0.85	44.32	14.73	34.13	5.91	2.65
2	覓食區（經營魚塭）	0.01	0.03	0.16	13.40	27.09	54.99	4.32	2.63
3	休息區（潮溝）	0.00	0.11	1.83	36.80	8.26	48.49	4.51	2.61
4	休息區（浮覆地）	0.00	0.00	0.17	16.67	15.93	61.27	5.96	2.58
5	新浮崙沙洲（外）	0.00	0.01	2.86	89.42	3.77	0.56	3.38	2.85
6	新浮崙沙洲（內）	0.00	0.15	8.75	76.85	2.42	8.61	3.22	2.63
7	曾文溪北岸	0.00	0.01	0.07	3.84	8.75	76.67	10.66	2.58
8	曾文溪口北岸	0.00	0.02	5.87	65.56	3.89	23.06	1.50	2.58

表四、曾文溪口脊椎動物種數

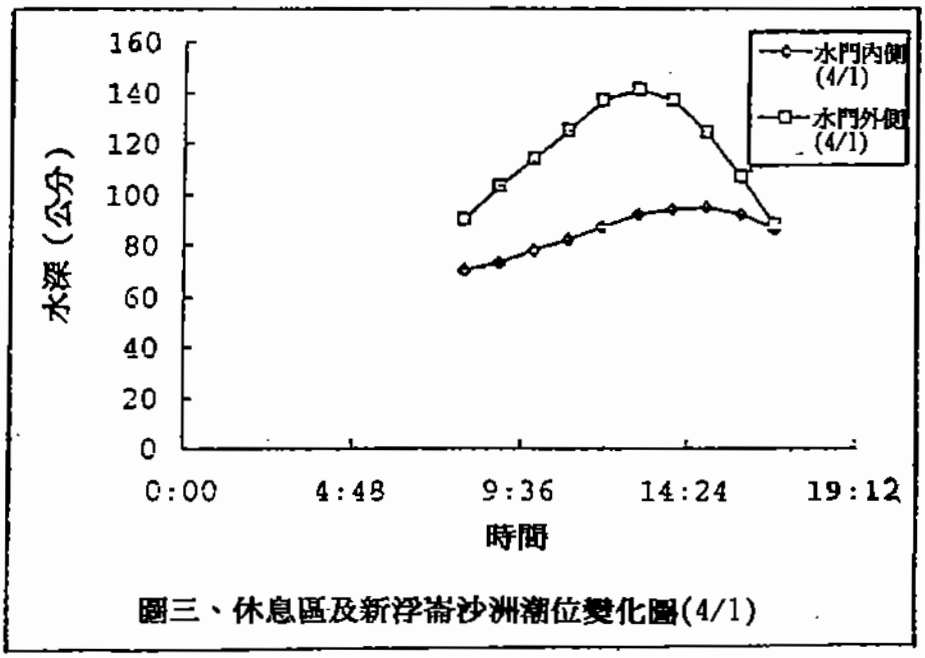
地點	動物別 魚類	哺乳類	兩棲類	昆蟲類	鳥類
休息區	8	0	0	31	26
覓食區	6	2	1	15	31
新浮崙沙洲	4	2	0	16	13



圖一、降雨、蒸發量比較圖



圖二、休息區及新浮崙沙洲潮位變化圖(3/31)



圖三、休息區及新浮崙沙洲潮位變化圖(4/1)

附錄一：曾文溪口脊椎動物名錄

魚類動物名錄

一、 休息區：

中　名	學　　名	數　量
沙鮻	Sillago sihama	16
曳絲鑽嘴	Gerres filamentosus	1
短鑽嘴	Gerres abbreviatus	1
背斑叉舌鰕虎	Glossogobius giuris brunneus	1
污鯖鯔	Liza melinopterus	20
高鼻水滑	Nematolosa nasus	6
黑星銀鉋	Scatophagus argus	5
六帶鯵	Caranx sesfasciatus	1

二、 覓食區：

中　名	學　　名	數　量
吳郭魚	Tilapia spp.	108
背斑叉舌鰕虎	Glossogobius giuris brunneus	1
污鯖鯔	Liza melinopterus	21
高鼻水滑	Nematolosa nasus	11
虱目魚	Chanos chanos	10
印度牛尾魚	Platycephalus indicus	1
草蝦	Penasus monodon	5
五鬚蝦	Palaemonus Exopalaemon orienpis	10
蟳	Scylla serrata	5

三、 新浮崙沙洲：

中　名	學　　名	數　量
污鯖鯔	Liza melinopterus	25
高鼻水滑	Nematolosa nasus	7
雙邊魚	Ambasis urotoenia	2
腹紋白點河魨	Tetraodon hispidus	7

哺乳動物名錄

目名	科名	中名	學名
食蟲目	尖鼠科	臭鼩	Srncus murinus
嚙齒目	鼠科	鬼鼠	Bandicota indica
		褐鼠	Rattus norvegicus

昆蟲動物名錄

		休息區		新浮崙沙洲區		覓食區	
		種數	隻數	種數	隻數	種數	隻數
鱗翅目	Lepidoptera						
	粉蝶科 Pieridae	1	5				
	蛺蝶科 Ntmphalidae	3	9				
	小灰蝶科 Ltcaenidae	1	3	1	1	1	3
	螟蛾科 Ptralididae	1	4	1	4	1	5
蜻蛉目	Odonata						
	晏蜓科 Aeshnidae	1	3	1	2		
	蜻蜓科 Libellulidae	3	10	2	5	2	2
双翅目	Diptera						
		4	16	4	15	4	10
膜翅目	Hymenoptera						
	粗腿小蜂科 Chalcididae	1	1	1	1	3	
	姬蜂科 Ichneumonidae	1	1	1	1		
	土蜂科 Scoliidae	1	1	1	1		
	胡蜂科 Vespidae	1	1				
	蟻科 Formicide	4	18			4	20
同翅目	Homoptera						
	稻蝨科 Delphacidae	2	2	2	2		
半翅目	Hemiptera						
	椿科 Pentatomidae	1	1	1	1		
	綠椿科 Coreidae	1	1				
	長椿科 Ltgaeidae	1	1				
直翅目	Orthoptera						
	蝗亞目 Acridodea	3	4			3	3
鞘翅目	Coleoptera						
	金龜子科 Scarabaeidae	1	5				
	步行蟲科 Carabidae				1	1	

鳥類名錄
覓食區

名	科 名	中 名	學 名
鸊鷉目	鸊鷉科	小鸊鷉	Podiceps ruficollis
鸛形目	鷺科	大白鷺	Egretta alba
		小白鷺	Egretta garzetta
		栗小鷺	Ixobrtchus cinnamomeus
鷹形目	隼科	紅隼	Falco tinnunculus
鶴形目	秧雞科	紅冠水雞	Gallinuls chloropus
鴴形目	鴴科	東方環頸鴴	Charadrius alexandrinus
		金斑鴴	Pluvialis dominica
		灰斑鴴	Pluvialis squatarola
	鷸科	濱鷸	Calidris alpina Dunli
		穉鷸	Calidris ruficollis
		田鷸	Gallinago gallinago
		大杓鷸	Numenius arquata
		磯鷸	Tringa hypoleucos
		青足鷸	Tringa nebularia
		小青足鷸	Tringa guttifer
鴿形目	鳩鴿科	珠頸斑鳩	Streptopelia chinensis
		紅鳩	Streptopelia tranquebarica
雨燕目	雨燕科	小雨燕	Apus affinis
雀形目	百靈科	小雲雀	Alauda gulgula
	燕科	家燕	Hirundo rustica
		洋燕	Hirundo tahitica
		棕沙燕	Riparia paludicola
	鶺科	白頭翁	Pycnonotus sinensis
	鶯科	棕扇尾鶯	Cisticola juncidis
		灰頭鷦鶯	Prinia flaviventris
		褐頭鷦鶯	Prinia subflava
	鶺鴒科	大花鷚	Anthus novaeseelandiae
	伯勞科	棕背伯勞	Lanius schach
	八哥科	八哥	Acricotheres cristatellus
	文鳥科	斑文鳥	Lonchura punctulata
		麻雀	Passer montanus

鳥類名錄
休息區

名	科	名	中	名	學	名
鸛形目	鷺科		大白鷺		Egretta alba	
			小白鷺		Egretta garzetta	
			中白鷺		Egretta intermedia	
	朱鷺科		黑面琵鷺		Platalea minor	
鴴形目	鴴科		東方環頸鴴		Charadrius alexandrinus	
			金斑鴴		Pluvialis dominica	
			灰斑鴴		Pluvialis squatarola	
	鷸科		濱鷸		Calidris alpina Dunli	
			大杓鷸		Numenius arquata	
			黃足鷸		Tringa brevipes	
			磯鷸		Tringa hypoleucos	
			青足鷸		Tringa nebularia	
	鷗科		黑尾鷗		Larus crassirostris	
			黑嘴鷗		Larus saundersi	
			大黑脊鷗		Larus schistisagus	
			裏海燕鷗		Sterna caspia	
鴿形目	鳩鴿科		珠頸斑鳩		Streptopelia chinensis	
雀形目	燕科		家燕		Hirundo rustica	
			洋燕		Hirundo tahitica	
			棕沙燕		Riparia paludicola	
	鶲科		白頭翁		Pycnonotus sinensis	
	鶯科		灰頭鶯鶯		Prinia flaviventris	
			褐頭鶯鶯		Prinia subflava	
	伯勞科		棕背伯勞		Lanius schach	
	八哥科		八哥		Acridotheres cristatellus	
	文鳥科		麻雀		Passer montanus	

名	科 名	中 名	學 名
鸛形目	鷺科	大白鷺	Egretta alba
		小白鷺	Egretta garzetta
		中白鷺	Egretta intermidia
鴴形目	鴴科	東方環頸鴴	Charadrius alexandrinus
		金斑鴴	Pluvialis dominica
		灰斑鴴	Plrvialis squatarola
	鷸科	濱鷸	Calidris alpina Dunli
		黃足鷸	Tringa brieipes
		磯鷸	Tringa hypoleucos
		青足鷸	Tringa nebularia
雀形目	燕科	洋燕	Hirundo tahitica
	鶺鴒科	白頭鶺	Pycnonotus sinensis
	文鳥科	麻雀	Passer montanus

附錄二：曾文溪口植物名錄

(P.5) Equisetaceae 木賊科

Equisetum ramosissimum Desf.	木賊

(A.15) Lauraceae 樟　科

Cassytha filiformis L.	無根藤

(A.27) Caesalpinaceae 蘇木科

Caecalpinia bonduc (L.) Roxb.	老虎心

(A.28) Mimosaceae 含羞草科

Leucaena glauca (L.) Benth	銀合歡
Mimosa pudica L.	含羞草

(A.29) Papilionaceae 蝶形花科

Alysicarpus vaginalis (L.) DC.	鏈莢豆
Clitoria mariana L.	蝶豆
Canavalia lineata (Thunb) DC.	肥豬豆（濱刀豆）
Cassia occidentalis L.	望江南
Crotalaria pallida Ait.	黃野百合
Galactia tenuiflora (Koein ex Willd) Wight&Arn	小花乳豆
Indigofera spicata Forsk	穗花木藍
Macroptilium lathyroides (L.) Rrb.	寬翼豆（紫花菜豆）
Pongamia pinnata Pierre	水黃皮
Rhynchosia minima (L.) DC.	小葉括根
Sesbania roxburghii Merr.	田菁
Tephrosia candida (Roxb.) DC.	白花鐵富豆
Vigna marina (Burm) Merr.	濱豇豆

(A.67) Casuarinaceae 木麻黃科

Casuarina equisetifolia L.	木賊葉木麻黃

(A.70) Moraceae 桑科

Broussonetia papyrifera (L.) L"Herit ex Vent	構樹
Humulus scandens (Lour.) Merr.	葎草

(A.107) Passifloraceae 西番蓮科

Passiflora foetida L.var. hispida (DC.) Killip.	毛西番蓮
Passiflora suberosa L.	三角葉西番蓮

(A.113) Cactaceae 仙人掌科

Hylocerens undatus Britt.&Rose.	三角仙人掌
Opuntia dillenii (Ker.) Haw.	仙人掌

(A.116) Tiliaceae 田麻科

Triumfetta bartramia L.	垂岸草

(A.120) Malvaceae 錦葵科

Abutilon indicum indicum	冬葵子
Hibiscus mutabilis L.	木芙蓉
Hibicscus tiliaceus L.	黃槿
Hibicscus rosa-sinensis L.	朱槿
Malvastrum coromandeliaum Garcke	賽散
Sida acuta Burm	細葉金午時花
Sida cordifolia L.	圓葉金午時花
Sida rhombifolia L.	菱葉金午時花
Urena lobata Linn.	野棉花

(A.133) Euphorbiaceae 大戟科

Breynia accrescens Hayata	小紅仔珠
Euphorbia atoto Forst.f.	濱大戟
Euphorbia makinoi Hayata	小葉大戟
Euphorbia vachellii Hook.& Arn.	華南大戟
Euphorbia heterophylla L.	猩猩草
Euphorbia hirta L.	飛揚草
Macaranga tanarius Muell.-Arg.	血桐
Mallotus japonicus (Thunb.)Muell.-Arg.	野桐
Phyllanthus urinaria L.	葉下珠
Ricinus communis L.	蓖麻
Synostemon bacciforme (L.) Webster	假葉下珠
Securinega virosa (Roxb.) Pax & Hoffm.	密花市

(A.159) Clusiaceae 藤黃科

Calophyllum inophyllum L.	瓊崖海棠樹

(A.162) Myrtaceae 桃金孃科

Melaleuca leucadendra Linn	白千層
Psidium guajava L.	番石榴

(A.163a) Lythraceae 千屈菜科

Cuphea cartagensis (Jacq.) Macbrids	克非亞草

(A.165) Combreraceae 使君子科

Lamnitzera racemosa Willd	欖李
Terminalia catappa L.	欖仁樹

(A.202) Vitaceae 葡萄科

Ampelospis brivipedunculata (Maxim.) Trautr. var.

hancei (Planch.) Rehder. 山葡萄

Cayrata japonica (thunb.) Gagnep. 虎葛

(A.215) Sapindaceae 無患子科

Cardeospermum halicacabum L. 倒地鈴

(A.233) Apocynaceae 夾竹桃科

Cerbera manghas L. 海檬果

(A.237) Rubiaceae 茜草科

Hedyoits diffusa Willd. 定經草

Paederia scandens (Lour.) Merr. 雞屎藤

Richardia scabra L. 擬鴨舌

(A.242) Ehretiaceae 厚殼樹科

Cordia dichotoma Forst.f. 破布子

(A.243) Verbenaceae 馬鞭草科

Avicennia marina (Forsk) Vierh 海茄苳

Clerodendrum inerme Gaertn. 苦籃盤

Lantana camara var. aculeata Moledнke 馬纓丹

Phyla nodiflora Greene 過江龍

Stachytaupheta jamaicensis Vahl 長穗木

Vitex negundo L. 黃荊

(A.269) Cruciferae 十字花科

Cardamine scutata THunb. var.

Capsella bursa-pastoris (L.)medic. 薺

Rorippa indica (L.) Hiern 印度焊菜

(A.273) Coryophyllaceae 石竹科

Drymaria cordata subsp. diandra 菁芳草

(A.274) Aizoaceae 番杏科

Sesuvium portulacastrum L. 濱水菜

Tetragonia tetragonides (Pall.) 番杏

(A.275) Portulacaceae 馬齒莧科

Portulaca oleracea L. 馬齒莧

(A.276) Polygonaceae 蓼科

Bumex joponicus Houtt. 羊蹄

Polygonum perfoliatum L. 杠板歸

Polygonum chinenss L.	火炭母草
(A.283) Chenopodiaecae 藜科	
Atriplex nummularia Lindl.	台灣濱藜
Chinopodium virgatum Thunb.	變葉藜
Chenopodium album L.	藜
Chenopodium ambrosioides L.	臭杏
Chenopodium sertinum L.	小葉灰藋
Suaeda nudiflora Moq.	鹽定
(A.284) Amaranthaceae 莧科	
Achyranthes aspera L.var. indica L.	土牛膝
Amaranthus spinosrs L.	刺莧
Amaranthus viridis L.	野莧
Celosia argentea L.	青箱
(A.287) Basellaceae 洛葵科	
Basella alba L.	洛散
(A.288) Onagraceae 柳葉菜科	
Ludwigia perennis L.	小花水丁香
(A.297) Plantaginaceae 車前草科	
Plantago asiatica L.	車前草
(A.311) Umbelliferae 繖形科	
Centella asiatica Urban	雷公根
(A.320) Compositae 菊科	
Ageratum houstonianum Mill.	紫花藿香薊
Artemisia capillaris Thunb.	茵蔯蒿
Bidens pilosa L.var. minor (Blume) Sherff	咸豐草
Bidens bipinnata L.	么針草
Blumea balsamifera (L.) CD. var. micorcephala Kiitamura	艾納香
Cichrocephala bicolor (Roth) Schlechtendal	茨苓菜
Eclipta prostrata L.	鱧腸
Emilia sonchifolia DC.	紫背草
Erechtites valerianaefolia (Wolf) DC.	昭和草
Erigeron linifolius Willd	野塘蒿
Erigeron canadensis L.	加拿大蓬
Erigeron bonariensis L.	野棉蒿

Gnaphalium affine D.Don	鼠麴草
Gnaphalium purpureum L.	鼠麴舅
Ixeris chinensis (Thunb.) Nakai	苦荬菜
Lactuca indica L.	山萵苣
Pluchea indica Less.	鼠魚膽
Soliva anthemifolia R.Br.	假吐金菊
Tridax procumbens L.	長柄菊
Vernonia cinerea Less.	一枝香
Wedelia biflora DC.	雙花蟛蜞菊
Wedelia chinensis Merr.	蟛蜞菊
Xanthium strumarium var. japonica Hara	蒼耳
Youngia japonica (L.) DC.	黃鵪菜
(A.321) Solanaceae 茄科	
Physalis angulata L.	苦
Solanum cerasiforme Dum.	野蕃茄
Solanum nigrum L.	龍葵
(A.322) Convolvulaceae 旋花科	
Ipomoea acuminata Roem.& Schult.	銳葉牽牛
Ipomoea aquatica Forsk.	蕹菜
Ipomoea cairica Sweet	槭葉牽牛
Ipomoea obscura Ker-Gawl.	野牽牛
Ipomoea sinensis (Desr.) Choisy	中華牽牛
Ipomoea pes-caprae subsp.brasiliensis Olstst.	馬鞍藤
Operculina turpethum (L.)S. Manso	燈籠牽牛
(A.324) Scrophulariaceae 玄參科	
Lindernia procumbens (Krock.) Philcox	過長沙
Scoparia dulcis L.	野甘草
(A.325) Acanthaceae 爵床科	
Thunbergia alata Boj. ex Sims	黑眼花
(A.332) Oxalidaceae 酢醬草科	
Oxalis violacea L.	紫花酢醬草
(A.342) Labiatae 唇形科	
Hyptis rhomboides Mart.&Emdl.	頭花香苦草
(A.358) Commelinaceae 鴨跖草科	
Murdannia keisak (Hassk.) hand.-Mazz.	水竹葉

Murdannia simplex (Vahl) Brenan 細葉鴨草

(A.372) Liliaceae 百合科

Asparagus officinalis L. var. altilis L. 蘆荀

(A.376) Smilacaceae 菝契科

Smilax china L. 菝契

(A.384) Typhaceae 香蒲科

Typha angrstifolia L. 香蒲

(A.385) Amaryllidaceae 石蒜科

Crinum asiaticum L. 文珠蘭

(A.392) Agavaceae 龍舌蘭科

Agave americana 龍舌蘭

(A.394) Pandanaceae 露兜樹科

Pandanus odoratissimus L.F. var.
Sinensis (Warb.) Kanehira 林投

(A.410) Cyperaceae 莎草科

Fimbristylis cymosa R. Brown 乾溝飄拂草

Pycrius polystachyos (Rottb.) P. 多柱扁莎

(A.411) Poaceae 禾本科

Phramites cwmmunis (L.) Trin. 蘆葦

Brachiaria mutica (Farsk.) Stapf 巴拉草

Brachiaria subquadripara (Trin) Hitche 四生臂形草

Cenchrus echinatus L. 蒺藜草

Cynodon dactylon (L.) Pers. 狗牙根

Chloris formosana (Honda) Keng 台灣虎耳草

Chloris barbata Sw. 孟仁草

Dactyloctenium aegyptium (L.) Beauv. 龍爪茅

Digitaria radicosa (Presl) Miq. var. radicosa 小馬唐

Eleusine indica (L.) Gaertn. 牛筋草

Imperata cylindrica (L.) P. Beauv. var. major
(Nees) C. E. Hubb. ex Hubb.& Vaughan 白茅

Miscanthus floridulus (Labill.) Warb.
ex Schum.& Laut. 五節芒

Panicum repens L. 舖地黍

Paspalum vaginatum Sw. 海雀稗

Paspalum conjugatum Berg. 兩耳草

Pennisetum purpurium schum.	象草
Rhynchelytrum repens (Willd.)	紅毛草
Saccharum spontaneum L.	甜根子草
Setaria viridia (L.) Beauv. var. pachystachys (Franch. & Sav.) makino	銹狗尾草
Spinifex littoreus (Burm. f.) Merr.	濱刺草
Sporobolus virginicus (L.) Kunth	鹽地鼠尾栗
Zea mays L.	玉蜀黍
Zoysia tenuifolia Willd. ex Trin.	高麗芝

附錄三、曾文溪口底棲動物名錄

DECAPODA 節肢動物門

Reptantia 爬蟲亞目		休息區	覓食區	新浮崙沙洲
Brachyura 短尾派				
Ocypodidae Rafinesque 沙蟹科				
Uca borealis Crane, 1815	北方呼喚招潮蟹	★	+	+
Uca formosensis ,Rathbun, 1921	台灣招潮蟹	★★	★	+
Uca arcuata (De Haan, 1835)	網紋招潮蟹	★★	★	★
Uca triangular (A. Milne Edwards, 1873)	三角招潮蟹	+	−	−
Uca lactea (De Haan, 1835)	白扇招潮蟹	★★	★	★★
Ocupode cordimana Latreillle, 1818	平掌沙蟹	−	−	+
Ocupode stimpaoni Ortmann, 1897	斯氏沙蟹	−	−	★
Ocupode ceratophthalma (Palllas, 1772)	角眼沙蟹	−	−	★★
Macrophthalmus (Mareotis) japonicus (De Haan, 1835)	日本大眼蟹	★★	★	★
Scopimera bitympna Shen, 1930	雙扇股窗蟹	★	+	+
Scopimera longidactyla Shen, 1932	長趾股窗蟹	★	+	★
Scopimera globosa De Haan, 1835	圓球股窗蟹	★	+	+
Grapsidae 方蟹科				
Parasesarma plicatum (Latreille, 1803)	摺痕擬相手蟹	+	★★	−
Paraasesarma pictum (De Haan, 1835)	神妙擬相手蟹	+	★★	−
Perisesarma bidens (De Haan, 1835)	雙齒近相手蟹	★★	★	−
Helice latimera Parisi, 1918	側足厚蟹	★	★★	−
Helice wuana Rathbun, 1931	伍氏厚蟹	★★	★	−
Mictyridae 和尚蟹科				
Mictyris brevidactylus	短指和尚蟹	★★	+	★
Portunidae 梭子蟹科				
Scylla serrata (Forskal, 1755)	鋸緣青蟹	★	−	+
Portunus pelagicus (Linnaeus)	遠海梭子蟹	★	−	+
Portunus sanguinollentus (Herbs)	紅星梭子蟹	★	−	+
Gecarcinidae 地蟹科				
Cardisoma carnifex (Herbst,1974)	兇狠圍軸蟹	★	+	−

附錄三、曾文溪口底棲動物名錄（續）

Vertebrate 脊椎動物亞門		休息區	覓食區	新浮崙沙洲
Clupeidae 鯡科				
Herklotsichthys quadrimaculata	斑青鱗魚	+	+	+
Nematalosa nasus	高鼻水滑	★	+	+
Elopidae 海鰱科				
Elops machnata	夏威夷海鰱	★	+	+
Mealopidae 大眼海鰱科				
Megalops cyprinoides	大眼海鰱	★	+	+
Albulidae 狐頭鰄科				
Albul vulpes	狐頭鰄	★	+	+
Chanidae 虱目魚科				
Chanos chanos	虱目魚	★★	★★	★
Poeciliidae 胎生鱂魚科				
Gambusia patuelis	食蚊魚	+	+	+
Poecilia velifera	帆鰭胎生鱂魚	★	+	★★
Syngnathidae 海龍科				
Microphis manadensis	瑪那海龍	+	−	+
Centropomidae 雙邊魚科				
Ambassia spp.	雙邊魚	★	★	+
Teraponidae 條紋雞魚科				
Therapon jarbua	花身雞魚	★★	★	★★
Sillaginidae 沙鮻科				
Sillago maculata	沙鮻	★	+	★★
Carangidae 鰺科				
Caranx spp.	鰺	+	+	+
Lutjanidae 笛鯛科				
Lutjanus spp.	笛鯛	★	+	★
Gerreidae 鑽嘴魚科				
Gerres spp.	鑽嘴魚	★	+	+
Monodactylidae 銀鱗鯧科				
Monodactylus argenteus	銀鱗鯧	★	−	★
Cichlidae 慈鯛科				
Tilapia zillii	吉和慈鯛	★★	★★	★
Mrgilidae 鰻科				

Mugil cephaous	鯔魚	★★	★	★★
Liza carinata	銹華鯔	★★	★	★
Liza parva	小鯔	★★	★	★
Liza macrolepis	大鱗鯔	★★	★	★
Liza formosae	台灣鯔	★★	★	★
Gobiidae 鰕虎科				
Scartelaos viridis	青彈塗魚	★	★	—
Periophthalmus cantonensis	彈塗魚	★★	★★	★
Bopeophthalmus pectinirostris	大彈塗魚	★★	+	+
Acentrogobius criniger	美尾細棘鰕虎	★	—	—

附錄三、曾文溪口底棲動物名錄（續）

Mollusca 軟體動物門		休息區	覓食區	新浮崙沙洲
Bivalvia 雙殼綱				
Mytiliae 貽貝科				
Perma viridis	綠殼菜蛤	★	+	★
Ostreidae 牡蠣科				
Crassostrea gigas	長牡蠣	★★	+	★★
Psammobiidae 紫雲蛤科				
Hiatla diphos	西施舌	★★	+	★★
Veneridae 簾蛤科				
Anomalocardia squàmosa	歪簾蛤	+	+	★
Mèretrix lusoria	文蛤	★	★★	
Cyclina sinesis	環文蛤	★	★	+
Lternulidae 薄殼蛤科				
Laternula (Exolaternula) limicola	公代	★	+	+
Solenidae 蟶蛤科				
Solen grandis	竹蟶	★	+	+
Gastropoda 腹足綱				
Potamididae 海蜷科				
Batillaria zonalis	燒酒海蜷	★★	★★	+
Littorinidae 玉黍螺科				
Littorina scabra	粗紋玉黍螺	+	★	—

※ 註：★★ 表族群數量極多
★ 表族群數量多
+ 表有記錄
— 表無記錄

貳：黑面琵鷺棲息替代區之評估及誘食區之整治執行報告

台南縣政府
吳武久、張宏明、蘇永銘

台南縣政府執行「黑面琵鷺之生態研究」報告

壹、前言：

黑面琵鷺屬於遷移性候鳥，主要分佈於東亞地區，每年十月至翌年四月飛抵中國大陸東南沿海、台灣、香港及越南等地渡冬，而其主要渡冬區則爲本縣七股鄉曾文溪口，即七股工業區預定地，本府爲秉持保育與開發並重之原則，乃於鄰近之新浮崙汕地區，提出黑面琵鷺棲息替代區之構想，並獲行政院農委會委託本府委請專家，期藉由科學上之調查研究，評估其可行性。

貳、執行目的：

一評估黑面琵鷺棲息替代區之可行性。

二藉由新浮崙汕之整治，期能引誘黑面琵鷺前往覓食及棲息。

參、執行情形及成果：

一新浮崙汕替代區之評估及規劃：

㈠於八十三年三月十五日委託財團法人台灣區域發展研究院環境科技研究所執行。

㈡執行期間：八十三年三月十五日至八十四年三月十四日止。

㈢調查項目：

1.研討及分析黑面琵鷺在台灣曾出現棲地之相似性與岐異度。

2.就現棲息之七股工業區現況資料與上述地區資料之相互比較分析。

3.研討替代棲地新浮崙區之現況與上述地區之相關性。

4.研擬改變棲地位置之可行性評估及進行步驟。

5.評估黑面琵鷺對上述棲息環境利用情形。

6.黑面琵鷺生態習性特色與各種棲地形態之關聯性分析。

㈣本計畫預定於八十三年七月提出期中報告。

二誘食區之整治：

本府於八十二年十月曾針對新浮崙汕無漁業設施之區域，僱用堆土機進行整地工作，並投放魚苗五〇〇〇尾，可能因整地區域小及無管制人員之進出，故並未發現黑面琵鷺前往棲息或覓食。

至於新浮崙汕整區域之整治，本府將配合新浮崙汕替代區之評估及規劃報告提出後，再依規劃內容之實際需要進行整治。

肆、檢討與建議：

本研究之新浮崙汕替代區之評估、規劃及誘食區之整治，原是連續性之工作，即利用黑面琵鷺抵曾文溪口的這段期間（八十二年十月至八十三年四月）進行替代區之評估規劃工作，再利用規劃報告於八十三年五、六二個月，執行誘食區之整治，但因本計畫核定及本府委請學術單位調查時間之延誤，使得評估、規劃無法在本（八十三）年度內完成，進而影響誘食區之全面整治工作。整個黑面琵鷺生態上之研究由於參與單位不一，各單位研究的課題又相關連，因此本府委託辦理之評估工作尚需其他參與研究單位之協助提供相關資料，以找出最適黑面琵鷺之生態習性，如此對於確定替代方案之可行性應大有幫助。

叁、黑面琵鷺之行爲研究期中報告

中華民國野鳥學會
陳擎霞、馮雙、王誠之
荷蘭專家
J.Jonker
E.P.R.Poorter

INTERIM REPORT ON BLACK-FACED SPOONBILLS JANUARY - FEBRUARY 1994

by **J.Jonker** (Foundation for Spoonbill Research Netherlands)

and **E.P.R.Poorter** (Dutch Ministry of Transport,
Public Works and Water Management
Directorate Flevoland)

Preface

The Black-faced Spoonbill Platalea minor,(Temminck and Schlegel,1849) is one of the six living species of Spoonbills in the world. Based on Peter Kennerley's recent review of the status of the species, the size of the population can be assessed at about 300 to 350 birds in the winter period. Considering the small population, the Black-faced Spoonbill must be regarded as one of the more seriously endangered bird species in the world (Hancock et a l.,1993). It breeds in W. North Korea and perhaps in N.E. China, and spinds the winter in S.E. China,N.E. Vietanm and in Taiwan.

The largest winterflock of platalea minor is that of about 150-200 birds on the estuary of the Tsen-Wen River in S.W. Taiwan. There are plans to convert the last remaining wetlands here into industrial parks, harbours, high roads and resident areas. It is this area with Black-faced Spoonbills and related land-use problems which is the subject of the study in this report.

Taipei, 14th February 1994

ITINERARY AND ACTIVITIES

January 1994

-3rd Departure from the Netherlands 19.30h, KL 878
-4th Flightstop at Bangkok; arrival at Taipei Airport at 17.45h We were welcomed by Mr. Roger C.J.Wang and Mr.Wen-Horn Lin of the Wild Bird Society of R.O.C.(Taiwan)

-5th Afternoon meeting with Mrs. Lucia Liu Severinghaus, Institute of Zoology, Academia Sinica; Video presentation of Black-faced Spoonbills by Mr. Jung-Feng C -hung.
Dinner with Mrs. Ching-Hsia Chen, president, Mis Shuang Feng, secreta-ry-general , and other staff members of the Wild Bird Society of R.O.C.

-6th Meeting at the office of the Council of Agriculture (C.O.A.) with Mr. San-Wei Lee, Mr. Tsung-Nan Wu and Mr. Chau-Jen Chen (C.O.A.) Mrs Lucia Liu Severinghaus, Mr. Ing Wang (Tainan Normal University); Mr. Philip T.H. Kuo (Tainan Wild Bird Society); representatives of the Taiwan Endemic Species Research Institute (T.E.S.R.I.) and other sympathizers.
During the morning session Mr. Poorter gave an introductory speech, illustrated with dia-positives. Mr. Ing Wang took charge of the translations during the speech and during the discussions.
During the afternoon session Mrs. Jung-Yu Liou (T.E.S.T.I.) presented the results of the research done on Fiddler Crabs in the frame work of the Environmental Impact Assessment Study Chiku Industrial Park, and Mr. Philip Kuo presented the results of the research on Black-faced Spoonbills carried out by the Tainan W.B. S.
The general discussion following, relating Spoonbill habitas and habits and issues concerning future research on the Spoonbills as well as well as the land-use problems were of interest to all parties. Mrs. Severinghaus took charge of the t -ranslations.

-7th Study on files dealing with the Black-faced Spoonbills in the office of the W.B.S. of R.O.C.
Arrangement of flights to Hong Kong and back to Amsterdam. Shopping for equipment to be used during the fieldstudy.

-8th Visit to Nanliao at the mouth of Touchien River, guided by Mr. Chen-Yue Kuo, president of the Wild Bird Society of Taipei.
Visit to Taichung for a meeting with Mr. Chung-Wei Yen of the National Museum of Naturel Science.
Arrival at Tainan.

-9th Afternoon meeting in the office of the Tainan Wild Bird Society with Mr. p -hilip Kuo, Mr. Ing Wang., Mr. Pei (Pingtung Agricultural Institute) and Mr. Yih-Tsong Ueng (Kung Shan Institrte of Technology) about the research to be done on the land-use problem of Chiku Industrial Park.
First meeting with Platalea minor in the Lagoon of Chiku.

-10th Our first early morning session (EMS) with the Spoonbills was broken up by fog, rapidly coming from the sea. Therefore we went up to the north to explore and saltpan areas up to Kunpa.

-11th and 12th EMS and late afternoon sessions (LAS) at the Lagoon of Chiku.

-13th Mr. Yih-Tsong Ueng guided us to explore the coastal area between Tainan a -nd the mouth of the Pachuan River.

14th EMS at the Lagoon of Chiku.

15th-16th Working out field notes, weekend birdtrips at and around a well-known" Spoonbill Fish Pond", north of Tainan City.

17th-20th EMS and LAS at the Lagoon of Chiku

-19th Nightmeeting at Tainan with Mr. Philip Kuo, Mr. Jung-Feng Chung and othe-rs about the research to be organized by the Tainan W.B.S. during the full-moon phase around January 25th.

-21th FMS and LAS at the Lagoon of Chiku.
Nightmeeting at Tainan with Mr. Guang Jeng-liaw, Mr. Chen Li-jen and three assi-stants of the T.E.S.R.I. about research to be done on the prey-items of the Bla-ck-faced Spoonbills and the ecology of these aquatic organisms.

-22th - 23rd Working out field notes,weekend bird trips in the area between Tai-nan-city and Chiku

-23rd-24th From 22.30h till 9.00h"moonlight session" at the Lagoon of Chiku.

-25th "Around noon" observations at the Lagoon of Chiku. Some catches of fish w-ith fisherman.

-26th EMS and "around noon" observations at the Lagoon of Chiku.
Mr. Chen Li-jen (T.E.S.R.I.) placed an order for a seine fishingnet at a fishing gear workshop at Chiku. Mr. Poorter designed this net.
Moonlight-session at and around the Lagoon of Chiku.

-27th EMS and around noon observations at the Chiku Lagoon.

-28th EMS at the Lagoon of Chiku; placing tide-gauges at sluice 1 of the Lagoon of Chiku; picking up the fishing net from the workshop at Chiku.
LAS at the Chiku Lagoon.
Visit with Mr. Harry Lee to photograpger Mr. Chen Chia-sheng.

-29th-30th Eighteen hours of tide-gauche readings and spoonbill-observations.

-31th "Around noon" observations at the Lagoon of Chiku.
Night meeting at the office of the Tinan WBS with Mr.Philip Kuo,Tseng Lung Yang, Yih-Tsong Ueng and Chung-Cheng Kuo to descuss the results of the moonlight sess-ion of January 26th.

February 1994

-1st Visit to the Institrte of Fishpond Chiku, Mr. Din determined some species of fish which"we had caught of January 25th.
"Around noon" observations at the Lagoon of Chiku.

-2nd We fished at the SE-ponds in the Chiku Lagoon with Mrs. Jung-Yu Liou, Mrs. An-Jing Ho, Mrs. Tsung-Ling Hwrang, Mr. Shi-Tsang Chang and Mr. Che-Hung Lin of the T.E.S.R.I.
Around noon observations at the Lagoon of Chiku.

-3rd EMS and some afternoon observations at the Lagoon of Chiku.
Night meeting with Mr. King-Fu Lin, a fisherman living already many years near C -hiku.

-4th LAS at the Lagoon of Chiku.
Meeting with Mr. Tang-Shan Chen, Chief of Tainan County.

-5th Exploration of the remaining small wetland-sites on the coast south of Tai-nan-city with Mr. Yih-Tsong Ueng.
Last short visit to the Chiku Lagoon.

-6th Bird trip to the mountains SE of Tainan.

-7th Air-flight to Taipei
Dinner with Mrs. Ching-Hsia Chen, president of the W.B.S. of R.O.C.

-8th-14th Working on the report and typewriting the interim report.

Introduction

The shallow seas and tidal marshlands of W.Taiwan once gave been of large extensions, like those of the Waddensea in the Netherlands, Germany or Denmark.
River deposits from the central mountain range, sorted out by the tidal currents of the sea into different kinds of sediments,created the Taiwanese shallows and wetlands duting many thousands of years.
Like everywhere in the world man did, the Taiwanese people converted the fertile higher parts of the river deposits of their country into farmland.
In addition to the crops from these reclaimed lands, the estuaries, lagoons and tidal pools easily supplied the Taiwanese people with an abundaned of animal pr-otein, consisting of fish of many kind, prawns and shrimps, oysters and clams.
Recently however, from some fifty years ago, the rapidly increasing population a-nd the desire for enlarging the standard of life,have changed the conditions of the Taiwanese lowlands and wetlands dramatically. What had been created during m-any thousands of years-many thousands of hectares of fertile tidal marshland a-nd shallow sandy lagoons and beaches, the spawning and nursery grounds of edible seafish and shellfish-has been converted into ponds for aquaculture and into sa-ltpans, within only a few decades, There is much improper in this way of land-u-se.
Tilapia fish species,imported from Africa, cultivated in ponds of saltish soils, have to be supplied with fresh water, of precsh water, of precious quality, pum-ped up from the underlying aquafers. Milk-fishes, vulnerable to cold weather-th-erefore refuging naturally to deeper parts of the sea in winter-have to be prot-ected in fishponds from the chilling of the winds by enormous screens of plastic sheet and from fish predatory birds by bird-nets.
This improperly way of land-use is underlined by people's careless behaviour wi-th respect to the country side and the remaining fragmints of nature.
Rubbish is thrown everywhere. Nylon fishing nets washed away can be found at ev-ery 100 meters of shore line, being deadly traps for birds and fishes for long t-imes ahead. Embankments of aquaculturel ponds are even constructed of industre-al waste products.
Adjacent to this desolate scenery of ravaged wetlands, near the rivermouth of t-he Tsen Wen Hsi, the last stronghold of the Black-faced Spoonbills, the Governm-ent of the County of Tainan planned to develop an industrial park.
International protests followed!

The Council of Agriculture replied to the petitioners that the importance of the wetlands in the Tsen-Wen estuary to the Black-faced Spoonbill was fully acknowl-edged by the Council an that it had taken the following measures for protecting the habitat of the birds:
1. The Black-faced Spoonbill was listed as an endangered species on July 1,1992, according to the Wildlife Conservation Law.
2. A public awareness program will soon be launched to stress the importance of protecting such species as the Black-faced Spoonbill.
3. Cooperating with Environmental Protection Administration to do a carefully r-eview on Environmental Impact Assessmint of a developing program in the area ad-jacent to the habitats of the Black-faced Spoonbill, and emphasize to protect t-he habitat of the spoonbill.

4. Dr.In Wang has been invited to inrestigate the the wintering needs of the Black-faced Spoonbill in the Tsen-Wen estuary.

Problematic

In this part of the report we will list the questions that have been adressed to us and the points that have been brought to our attention.

Preceding to our visit to Taiwan we were informed that the following questions c-ould be adressed to us:

1. What are the ecological requirements of the Black-faced Spoonbill ?
2. Does it exhibit site tenacity ?
3. What are the limiting critical factors for a suitable environment ?
4. What is its minimum habitat area ?
5. If the local government in Tainan goes ahead with its industrial development plan, is it possible for the birds to move to another site? If so, what steps are necessary for such a move?

(letter from the Institute of Zoology,Academia Sinica,d,d 05.10.93)

In the letter of invitation of the Council of Agriculture,d.d 06.12.93 we were r-equested

6. to assist in ecological field work on the Black-faced Spoonbill,and
7. to give expertise in the matter of the land-use problems.

At the meeting of 06.01.94 at Taipei Mr. Chan-Jen Chen of the Council of Agriculture, put forward the following questions relating to the well-being of the Spoonbills:

8. What will happen if the land-use of the recently endiked area and surroundings will not be changed ? May there any detrimental effects be expected in the future?
9. If the exploitation of the fishponds in the recently endiked area will be intensified,will this result in a loss of indispensable acreage?

During the workshop of 09.01.94 at Tainan-city with Mr. Ing Wang (Taiwan Normal University), Mr. Pei (Pingtun Agricultural Institute) and Mr. Yih-Tsong Ueng (Kung Shan Institute of Technology) it was formulated that in order to contribute in solving the land-use problem of Spoonbills versus industrial development the aims of our study should include the following issues:

10. to identify similar (suitable) roosting areas already existing in the surroundings of up to 25 km from the current roosting area by means of aerial surveys , topographical maps and field vistits;
11. to identify possible sites of creating new suitable roosting areas by these means;
12. to compare the characteristics of the current roosting area with regard to i-ts topographical, physical and ecological characteristics with well known similar roosting sites of the White Spoonbill (Platalea leucorodia)
13. to identify natural feeding habitats of the Black-faced Spoonbill in S.W.Taiwan.

14. Do the Spoonbills of the roosting site at the Chiku Lagoon fly to other places in the late afternoon, and where do they go to feed at night? (to be investigated in the week around the full moon phase of 26th January in cooperation with the Spoonbill Working Group of Tainan)

At the meeting of 21.01.94 with Mr. Guang Jeng-liaw and his colleagues of the Taiwan Endemic Species Research Institute we were requested
15. to suggest fieldwork to be done on the food ecology of the Black-faced Spoonbills.

As a representative of the Spoonbill Committee, Mrs. Ching-Hsia Cheng asked us on 07.02.94 to pay attention in our report to the following issues:
16. to study the land-use type of the habitats of the Black-faced Spoonbill,
17. to make the suggestion of the minimum area of the habitat,
18. to study the possibility of changing the site of habitat,
19. to suggest the detail items of the study of the Black-faced Spoonbill,
20. to be the consultants of the study.

Preliminary statements

When we deal with questions or issues listed in the foregoing pages, the reader has to take into consideration that we had no idea of the problematics relating to the ecology of the Spoonbills and the land-use problems before we arrived in Taiwan.

A. The experience we have taken with us with regard to Spoonbills are:
-one of long duration of ecological and behavioural studies on Platalea leuc. leucorodia, mainly of the migratory populations of W. Europe, in the breeding areas as well along the migratory flyways
-our experience with Platalea alba and Platalea leuc. balsaci in W. Africa
-our knowledge from literature of the behaviour and ecology of the subfamily Plataleinae which has led us to the conclusion that most species of Spoonbills are rery alike, Platibis flavipes and Platalea leuc. archeri being the main exceptions.
-our study from literature of the international migration pattern of Platalea minor and our recent study in Paris of museum specimen in the collection of the Museum of National History in Paris.

B. With respect to land-use problems we have an experience of long duration from
-our work in the rural areas of our own country, from
-our work in new land developmint and wetland management in the Netherlands and from
-related problems in wetland areas in Spain and W. Africa.

C. We adhere to the principles of
-international responsibility for the safeguarding of the natural world of our common planet, the
-wise use of wetlands, and of
-sustainable development, principles which are increasingdy accepted, acknowledged and endorsed by politicians and leaders all over the world.

D. With regard to our visit to Taiwan , we have stated before that
-our mission should be regarded as one of orientation, because we believe that t-he physical conditions and the needs of the birds, as well as the ecological c-onditions in their habitats in Taiwan may vary significantly between mid-october (when the birds arrive) and april then they leave, and
-that the land-use problems should be regarded cautiously in this respect.

E. Upon our arrival in Taiwan we have been briefly informed on the land-use problems and the Spoonbills by several people, including the County Chief of Tainan County, Dr. Tang-Shan Chen.

F. We were also briefly informed on some studies on the Black-faced Spoonbills, and some studies relating to land-use and Environment Impact Assessment.
We sincerely hope that our work may contribute to these studies.
Therefore we gratefully accept the Spoonbill Commitee's request to be consultants of these studies.

G. This report is only an interim report to C.O.A.
Any comments should be mailed before 1st March 1994 to the following adress:

Drs. E.P.R.Poorter
R.W.S.-Directorate Flevoland
P.O.Box 600
8200 Ap Lelystad
The Netherlands

FAX 3200.34300

RESPONSE

We now arrive at our first response to the questions put forward and the issues that have been raised from the land-use problems.

1. Ecological requirements of the Black-faced Spoonbills

All species of Spoonbills need shallow water to feed, occuring in tidal shallow seas, estuaries, tidal marshland, temporary or seasonal folldings, shallow shores of lakes, etc.
Because they are depending on touch to find their food, which mainly consists of a variety of mobile prey-organisms, they need high densities of prey-items, like schools of fish, congregations of prawns, shrimps or assemblies of different kinds of prey-organisms. They need trouble water or dark hours to catch their prey

As far as known from literature Black-faced Spoonbills prefer estuarine habitats , in their breeding area as well in their winterquarters,It is not known whether they need fresh water to drink, as in the White Spoonbills that feed in marine e-nvironments, It might be that they are adapted to live in marine environments b-y having sufficient capacity of excreting excess of salt from salt glands.
Like other species of Spoonbills the Black-faced Spoonbill behaves socially in e-xploring and exploiting its food resources, The possibility of living together is essential for their survival and condition, i.e. for less experienced youngsters, A suitable roosting area in close connection with their feeding grounds is an essential component of this ceological requirement.

2. Does the Black-faced Spoonbill exhibit site tenacity ?

The answer is yes !
We know from our ring studies on the White Spoonbill that they exhibit site tenacity throughout the years to their feeding areas, in the breeding area as well along the whole migratory flyway.

3. What are the limiting critical factors for a suitable environment of Black-faced Spoonbills in their winterquarters ?

Since the Black-faced Spoonbill is a predator and on top of the food pyramid, its feeding areas must be free of high levels of contaminants which affect survival or reproduction.
As Spoonbills need to rest for long times they need quiet areas and safety from predators on their roosting site.

4. What is the minimum habitat area ?

The minimum habitat area depends on the ecological system of the wintering site. The migration and wintering sites of the Black-faced Spoonbills seem all to be e-stuarine (Mai Po and the inner Deep Bay marshes near Hong Kong; Shanghai-Yangtze estuary; Tsen-Wen River estuary; Red estuary).
The physical component of the ecosystem of an estuary is one of a comples of the sea ecosystem, of the land ecosystem and of the river ecosystem. River deposits, fresh water,tidal curretns, seawater and wind shape and reshape the estuarine e-

cosystem. The biotic component of an estuarine ecosytem consists of organisms adapted to the dynamics of the tides. Their spatial distribution is linked up with a variety of sites they need for reproduction, growth and maturing. Spoonbills depend for their food on the tidal co mponent of the estuarine ecosystem. Their food organisms are aquatic and depend not only on the intertidal zone but also on the river and the sea.
The best professional assessment for a minimum acreage of intertidal feeding area we can make for a wintering flock of 150 to 500 Spoonbills is 5,000 to 10,000 hectares.

5. If the local government of Tainan goes ahead with its industrial development plan, is it possible for the birds to move to another site ?

We have not found another suitable site for a long stay of Spoonbills within 30 km from the present wintering site. To answer the question we need more information from maps, from aerial photograpgs, from aerial surveys, from own field visits, about the functioning of the ecological systems around rivermouths, about the development plans for the environment, about the willingness of the local governments to create nature reserves of a size of at least 50000 ha. of suitable habitat.
A feasibility study for a move of the birds is the first what should be done.

6. Assisting in ecological field work on the Black-faced Spoonbills was carried out during our field work between 10th January and 4th February.

7. Expertise in the matter of the land-use problems is given in this interim report. We will try to help more specifically if this is needed.

8. May there any detrimentel effects be expected if the land-use will not be changed ?

The difficulty in answering this question is that we have no good picture about the current land-use.
Within the recently endiked area, some fishponds are abandoned, other fishponds seem to be on the way of being abandoned. These two categories appeared to be the most attractive for the Spoonbills. On the other hand many fishponds are in full exploitation, many are in repairing and many are under construction.
We have been informed that the endiked area is state-owned and that the state ordered that the area should be abandoned by illegal occupiers of state-owned territory. At riverside along the endeked area, which is also state-owned territory, we got the similar picture: fishponds are partly abandoned, others are in exploitation or have recently been in repairing. This area has no proper land-use. Oil leakes from old pumping stations and the shore line is full of refuse, bamboo, polystyrene and other rubbish drifted ashore.
Within the endiked area as well as along the riverside there is much gardening. We do not know if pes ticides are used that may leak into the water or leach into the soil.
The fishponds north of the endiked area are in full exploitation. During our stay one fishpond 300 meters form the endiked area attracted Spoonbill sand many

other fish eating and small-prawn eating birds (300 Little Egret, 20 White Egret , 1 Chinese Pond Egret, 200 Greenshank).
The birds were regularlychased away by the fishpond owner. The Spoonbills didt't fly to this fishpond at nightfall when the Egrets had disappeared. However, they did frequently at break,, but appeared not to be verysuccessful.
This fishpond area seems to be of minor importance to the Spoonbills.
Once we have seen a group landing in a "natural" place amongst some bushes of Mangroves.
In the lagoon oysters are cultured and fishes are caught.
The culture of oysters is mainly along the dikes. As far as this culture is within its current limits they do not harm the birds or the ecological system.
Fishing is done by fish-traps along the dike. Most of the fishing nets are temporarily out of exploitation, during the winterseason. We do not know when the fishing is in full exploitation. If this is from September and from February it might affect the food stock of the Spoonbills feeding in the lagoon.
This should be studied.
There is much of rubbish drifted ashore in the lagoon, a.o. there is much nylon fishing gear washed away. These will be bird-killing devices for along time in the future. The leaded underlines might contaminate the area.
We have not understood why the gates of the northern sluice are only partly opened, why the southern sluice is blocked and why the eastern sluice has been removed. The amount of water flowing into the lagoon with the high tides is very limited, as it can only pour in through small gates. Higher water levels in the lagoon may recreate tidal pools in the area of partly abandoned fishponds which will create excellent feeding places for females and young Spoonbills.

9. If the exploitation of the fishponds in the recently endiked area will be intensified, will this result in a loss of indispensable acreage of the Spoonbills ?

Our field work has learned that the females and the young birds of the wintering flock of Black-faced Spoonbills are largely depending for their food on the abandoned fishponds within the endiked area. Our answer to the question is affirmative.

10. We have not found any similar (suitable) roosting area within 30 km of the roosting site in the Chiku Lagoon.

11. There are several possible sites of creating new suitable roosting habitat. None of these sites, however, is also an important feeding site like the one in the Chiku Lagoon.This feeding site forms an integral part of the Spoonbill habitat and of the estuarine ecosystem. The soil is muddy, which it is not or probably not around other possible sites in the surroundings where a suitable roosting site might be created. We missed soilmaps, which are indespensable for land-use studies.

12. Our first sight of the roosting flock of Spoonbills in the Chiku Lagoon was one of recognition. We have seen many similar sceneries in Spain and W.Africa :

roosting Spoonbills on sandbanks or in salt-marsh waiting for the right time for feeding. The roosting sites are often in the midst of vaste stretches of water. We will try to find the topographical maps of these areas to compare the sites w -ith the Lagoon of Chiku.

13. The only two natural feeding habitats of the Spoonbills we have identified a -re:
-the Lagoon of Chiku, which is the main feeding site of the males and which is a -n important feeding site for the females and the less experienced youngsters
-the riverbank south of the Lagoon of Chiku (Mr. Yih-Tsong Ueng, pers. comm.; Y-ih-Tsong Ueng & Chung-Cheng Kuo, 1991)
-the abandoned fishponds within the recently endiked area and a place amidst Ma-ngroves, where Spoonbills have been observed ane semi-natural.

14. Do the Spoonbills of the roosting site in the Chiku Lagoon fly to other pla-ces in the late afternoon? Where do they go to feed at night ?

What we have observed on the Spoonbills of the Lagoon of Chiku has yet to be wo-rked out and will be reported in the final report.
We found that the birds feed during the day as well during the night, in the la-goon as well as outside of the lagoon.
The lagoon appears to be the main feeding area:
-during low tide in the dark hours;
-during low tide in the day-time when there is a lasting strong wind blowing, w-hich troubles the water with silt (mud).
The food of the Spoonbills which feed in the lagoon appears to be mainly consis-ting of fish, which in most cases is caught after chasing (because it is of com-paritively proportions).
Less than 50% of the birds, usually some tens, leave the lagoon in the early ho-urs of the day. Their total consists mainly of young age and of females.
About 50% (or more) of the birds leave the lagoon at nightfall. They fly to the riverside, to abandoned fishponds near the lagoon and to remote places, which a-re fishponds for some part and may be natural feeding gabitats for the other pa-rt.
We believe that the birds staying in the lagoon during the night are mainly ma-les and experienced females and that the birds which leave the area at nightfall are mainly females and less experienced young birds.

15. We suggested to the Taiwan Endemic Species Resarch Institute to focus their food-ecology study on the Black-faced Spoonbills firstly to qualitative sampling of species fish, prawns and shrimps, mainly in natural places, and secondly to s -tudy the ecology of these species from literature.

16. The land-use type of the habitats of the Black-faced Spoonbill

A. In our view the land-use type of the habitats of the Black-faced Spoonbill s-hould be a well protected sanctuary for reasons of:
-the species is an endangered one. Collecters of specimen may try or let try to kill birds

-birds feeding outside a sanctuary have higher risks of mortality because of fl-ying against overhead wires (in the night) , because of nylon fishing gear wash-ed out and because of anti-fish-predator bird-killing nets in fishponds
-fishpond owners or tenant fish pond farmers disturb the birds by chasing them a-way.

B. The land-use type should also be a nature reserve where measures can be taken for the watermanagement, the fishery, the cleaning up, the environment, and the conducting of the public.

C. The land-use type should also be a natural area for the purpose of protecting , restorating and managing the estuarine ecosystem, which is not only the habit-at of the Spoonbills but also of other birds of intertidal litoral zones and of intertidal marshland and lagoons, of fish-species typical for the estuarine eco-systems and of all other organisms, animals and plants which form together the b-iotic component of the ecological system.

D. The land-use type should be also a nature reserve for studying the ecological system, particularily on behalf of restorating and recreating essential parts of the ecological system of the estuaries, the litoral of the sea, the sand dunes a-nd the lagoons at other sites along the west coast of Taiwan.

17. A Suggestion for the minimrm habitat area for the Black-faced Spoonbill is 5-000 ha ., provided this area forms part of a complete estuarine ecosystem and p-rovided it is well protected from all external impacts, i.e. those or air-poll-rtion and waterpollution from industrial sites and harbours and waterpollution f-rom resident areas.

18. We assess that it would be very difficult to change the site of the habitat of the birds, because the habitat should be one of an intergral part of the est-uarine ecosystem. The area west of the endiked area, near the litoral area is n-ot suited in any aspect of the habitat of the Spoonbills.

19. The suggestions for the detail items of the study of the Black-faced Spoonb-ill will be given in the recommendations.

RECOMMENDATIONS

A. Research

A-1 Research on Spoonbills and their food

We recommend the following ecological study :

1. Surveying all species of fish, prawn and shrimp (necton) in the estuarine tidal area by means of qualitative sampling.

2. Studying the literature on the species collected, bearing upon their ecology(seasonal and tidal movements, reproduction, numbers, food ecology, anti-predator behaviour).

3. Studying the literature on estuarine ecological ststems ,i.e. those of subtropical and tropical zones.

4. Quantitative sampling in the intertidal zones of the estuary and the litoral of necton species of sizes between 2 and 15 cm, occuring in high densitiesof conspecifics, widespread or locally.
If types of intertidal zones of the estuarine ecological system have disappeared we recommend sampling these components of the intertidal system still occuring e -lsewhere.

5. Studying the feeding behaviour of the Spoonbills with regard to the information collected under 1 up to including 5 . Complementary to this part of the study the structure of the winter population should be studied. Intensive training in recognizing sexes and ages well be indispensable.
We suggest for the fishery ecological work to appoint for a period of five years a fishery biologist holding a university degree and for the spoonbill ecology job an animal ecologist holding a university degree.
Each of the two scientist should be sufficiently master of the English language.

A 2 Research of physics and watermanagement

We recommend that concurrently with the research on Spoonbills and their food, p -hysics and watermanagement problems will be studied.

Routine measurements in the lagoon and near the rivermouth include :
- tidal movements of the water
- salinity
- temperature at 15 cm of depth
- translucidity
- windvelocity at 60 cm of height (in relation to the turbidity of the water and the shelter of dikes and other elevations)

Other parameters for the quality of the water, in relation to the emptying of waste water and to waterpollution must be determined regularly(C.O.D.;B.O.D.; biological monitoring of heavy metals in benthic organisns like Oysters)

Soil mapping is recommended for the intertidal zone (elevation and sediment)

A 3 Research in aim of the restoration of the estuarine and litoral ecosystems

-We recommend that concurrently with the research of Spoonbills, physics and watermanagement problems well be studied relating to restoration of the estuarine and litoral ecosystems.
-We recommend that prior to this study the following institutes will be consulted:
-the Asian Wetland Bureau at Kuala Lumpur, Malaysia, which aims to promote protection and sustainable utilization of wetland resources in Asia
-the Directorate Tidal Waters of the Directorate - General Traffics, public Works and Watermanagement in the Netherlands, which is most qualified in the world to deal with tidal problems (currents, transport of material by tidal movements , erosion material by tidal movements, depositing of material in tidal areas)

B. Measures

-We recommend to establish a nature reserve (or an ecologically coherent network of nature reserves) of at least 5.000 to 10.000 ha. of estuarine and litoral tidal ecosystems, including the Lagoon of Chiku.
-We recommend to establish this nature reserve (or a coherent network of nature reserves) for the purpose of re-establishing and safeguarding (from detrimentel impacts of the area outside) a complete ecological system of estuarine and litoral habitats for the Black-faced Spoonbills,as well as for all other animal and plantspecies belonging to

-We recommend that this nature reserve shall be one of educational and scientifical value

-We recommend a feasibility study for such a nature reserve in order to clearify the restrictions to be made with regard to the allocation of territories and waters around the reserve, a.o. for the purpose of E.I.A.-studies, industrial parks, resident areas and harbours.

Table 1

Observation periods at the Lagoon of Chiku

January

9	17.00-18.35h	
10	06.37-07.54h (fog)	
11	06.10-09.40h	17.00-18.19h
12	06.12-08.25h	16.00-18.40h
14	06.15-12.40h	
17	06.10-10.15h	16.40-18.40h
18	06.05-11.00h	16.40-18.20h
19	06.10-10.30h	16.40-19.00h
20	06.10-14.00h	16.10-17.00h
21	06.10-11.30h	
23	08.30-10.35h	22.30->->->->
24	->->->09.00h	
25	08.30-15.40h	
26	06.30-15.05h	20.30-23.00h
27	06.30-11.45h	
28	06.30-11.00h	17.45-19.00h
29	08.15 >>	>>>>>>>>>>>>>>>>>>>>
30->->01.30h		
31	10.00-17.45h	
February		
1	10.45-16.30h	
2	08.50-13.10h	
3	06.00-08.30h	14.30-17.35h
4	13.30-19.00h	
5	16.00-17.00h	

Table 2

Counts of Spoonbills in and near the Lagoon of Chiku in January/early February 1994

January		
9	17.00h	200(ca)
11	07.25h	192
	09.20h	190(ca)
	17.50h	189
12	08.35h	160-165
	16.00h	165-175
17	08.35h	135-140
	10.15h	164
	17.50h	190(ca)
18	07.40h	156
19	07.05h	178
20	10.25h	177
24	06.30h	158
25	12.50h	174
26	09.35h	187
	14.20h	185-190
27	15.55h	187-190
28	09.30h	183
29	09.45h	170-180
	12.40h	184-190
	13.30h	168
	17.15h	187-190
February		
1	14.35h	177
2	13.05h	166-170
3	08.00h	186
5	16.15h	179-182

Appendix I

Preliminary notes on fish species in the Lagoon of Chiku

The folowing species were caught with a fisherman on 25th January

* Family Clupeidae - Herrings
  Nematolosa nasus (Nematolosa japonica ?)

Some specimen were caught and preserved in alcohol. This species prefers muddy p-laces around rivermouths and to some extent upstreams in lowland rivers.

* Family Mugilidae - Mullets
  Liza melinopterus

Mr.King-Fu Lin told us that small sized fishes occur in shallow water,, but move to deeper water when it is cold.
This mullet species contributes probably significantly to the total fish biomass of the lagoon. We preserved in alcohol the smallest sized fishes we caught.

* Family Centropomidae - Snooks
  Ambassis urothaenia - Glassfish

A small sized species (up to 8 cm in length) usually occuring in schools in s-altish water along rivermouths. We caught only one, probably because the fishin-gnet we used had too wide meshes. The fish caught was preserved in alcohol.

* Leiognathidae
  Leiognathus splendens - Black - tipped ponyfish

This small carnivore fish species (up to 10 cm) lives on shores of sand and m-ud in rivermouths and lagoons.We caught one and preserved it in alcohol.

* Family Gerreidae
  Gerres filamenthosus - Threadfin pursemouth

Near the bottom living fish species, often in small ponds. We caught two specim-en and put them in alcohol.

Mr. King-Fu Lin told us about some fish species of the Chiku Lagoon, occuring t-here already before the endikement. Three kinds of fishes, all appearing to bel-onging to the Family of Gobiidae, seem to be typically for the Chiku Lagoon area , because this area has a much more muddy soil than other areas around.

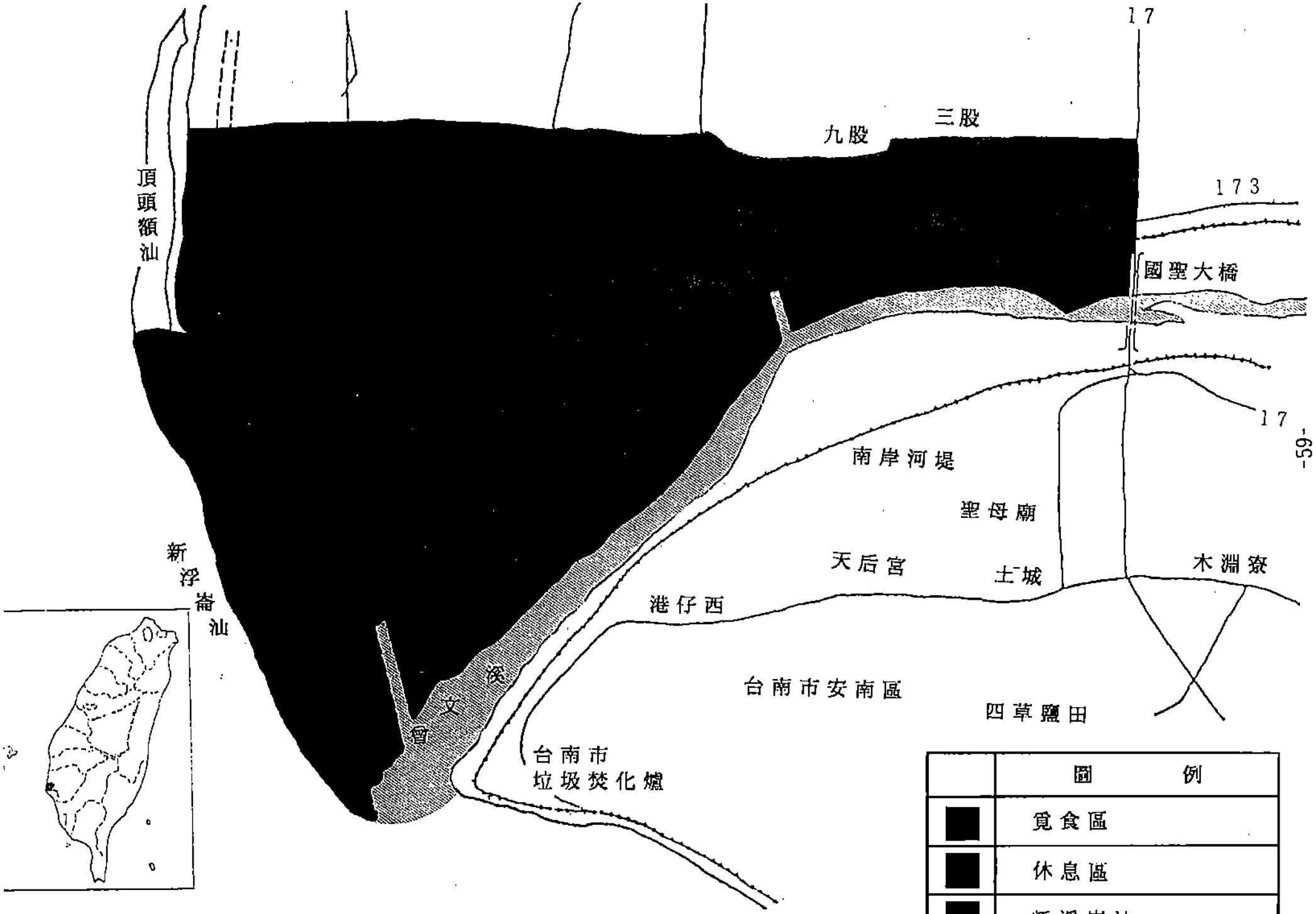
* Family Gobiidae - Gobies
  Glossobius olivaceus ? - Spottyband goby ?

Mr. King-Fu Lin caught some gobies in the Chiku Lagoon, which he freezed for us. We preserved them in alcohol of 95%. We are not sure that the specimen were det-ermined correctly.
The Spottyband Goby is small benthic fish up to 20 cm of length. It inhabits sh-allow seas, mud beaches, rivermouths or pure fresh water.
It eats small fishes, shrimps and other invertebrates.
The fishes that have been preserved in alcohol have a clear round black spot be-hind the eye.

Mr. King-Fu Lin indicated in a book with colour plates two kinds of Burrowing gobies (Trypauchenidae) which could be the Blind Gobie (Trypauchen microcephalus) which is reddish and a more purple or brown one.
The Blind Goby is red or light purple, up to 18 cm. It inhabits the bottom of the brackish tidal zone of rivermouths and coastline.
When there are typhoons, and the water becomes troubled by silt and sand they come out of the bottom and appear in the water.

We have caught two species of prawns in the Lagoon of Chiku, Palaemon orientis and Penaeus penicellatus. We preserved the two species in alcohol.

肆、圖　　片



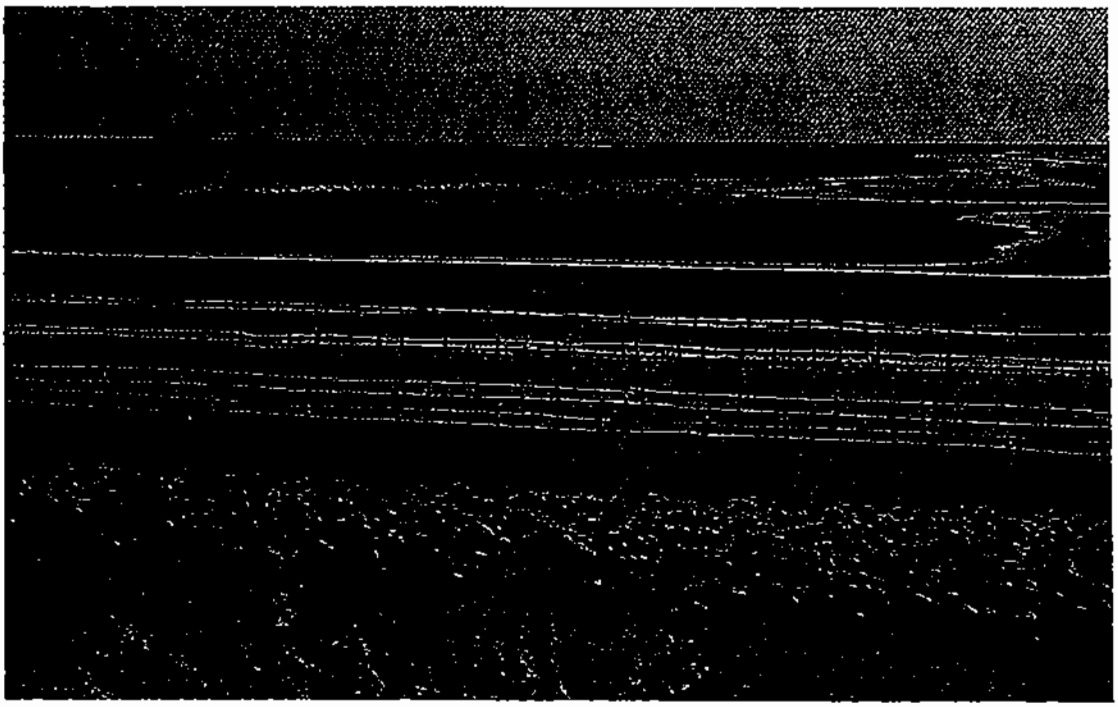
圖一：黑面琵鷺棲地調查區示意圖

郭東輝 攝

〔圖文〕會文溪口黑面琵鷺棲息地鳥瞰圖

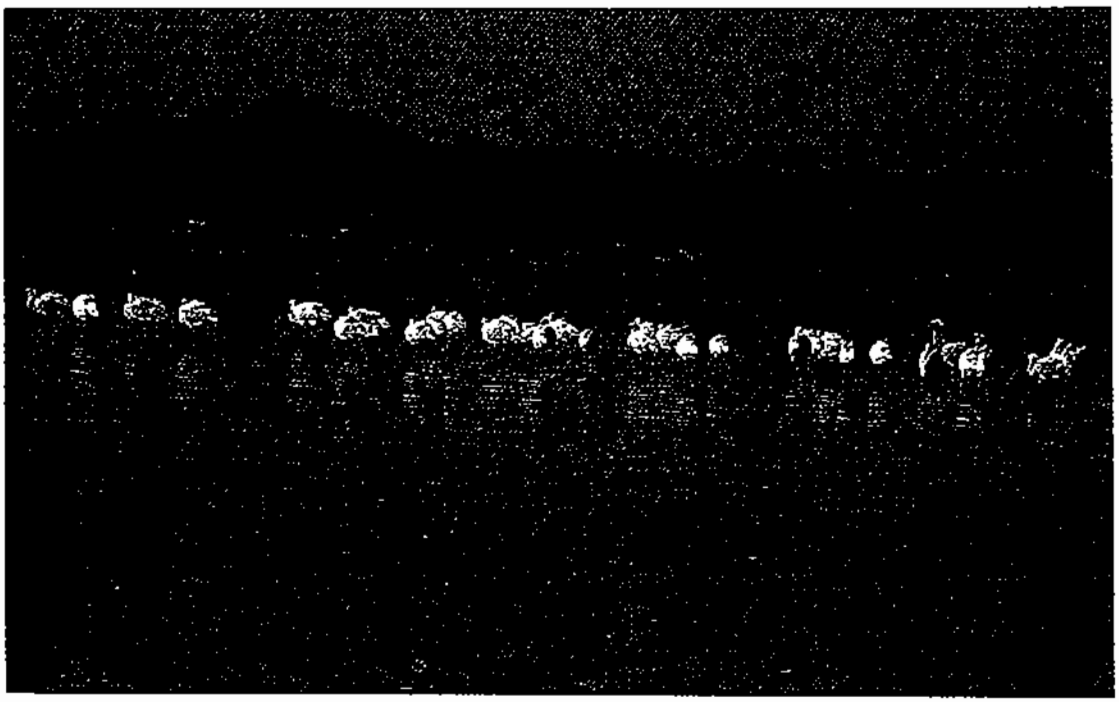
鍾榮峰 攝

〔圖文〕黑面琵鷺體長約74公分，其嘴黑色，冬羽全白，但亞成鳥初級飛羽外緣爲黑色，在繁殖時期（夏季）頭頂上會長出蓬鬆的黃羽冠及黃色的頸圈。



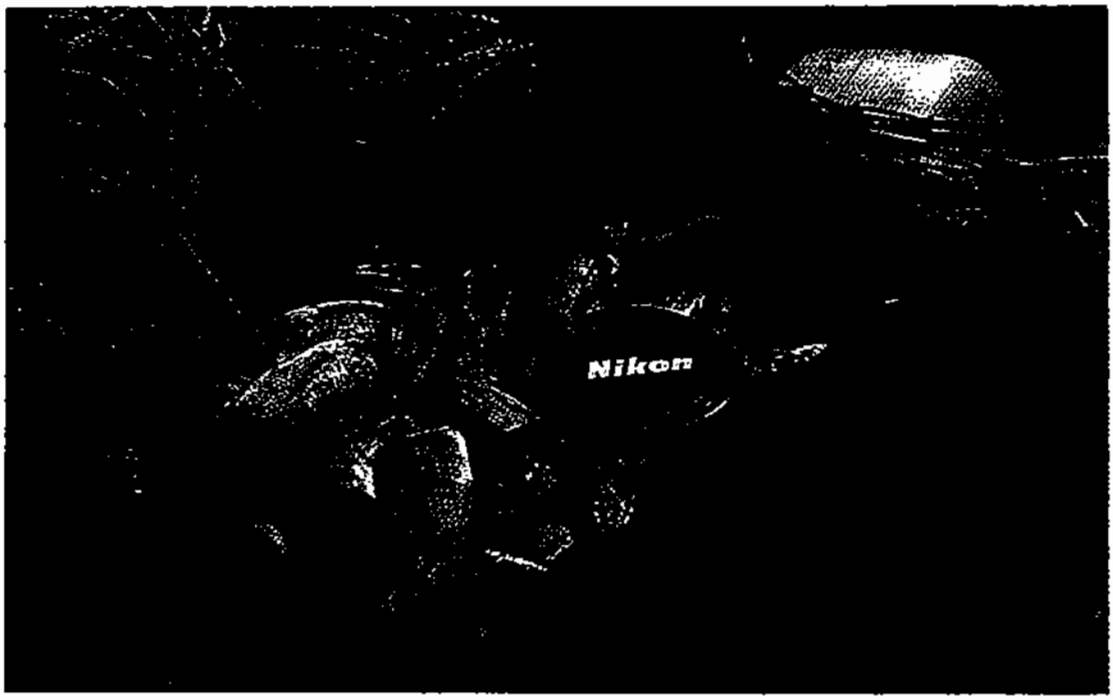
劉靜榆 攝

〔圖文〕黑面琵鷺所選擇之棲息地爲會文溪口北岸七股海堤內三號閘門以東及二號閘門以北間之浮覆地（約280公頃），由於河海堤所圈圍之面積寬廣（827公頃），且沿堤防內側有頗深的潮溝，具良好之隔離作用，適合膽怯之水鳥棲息。



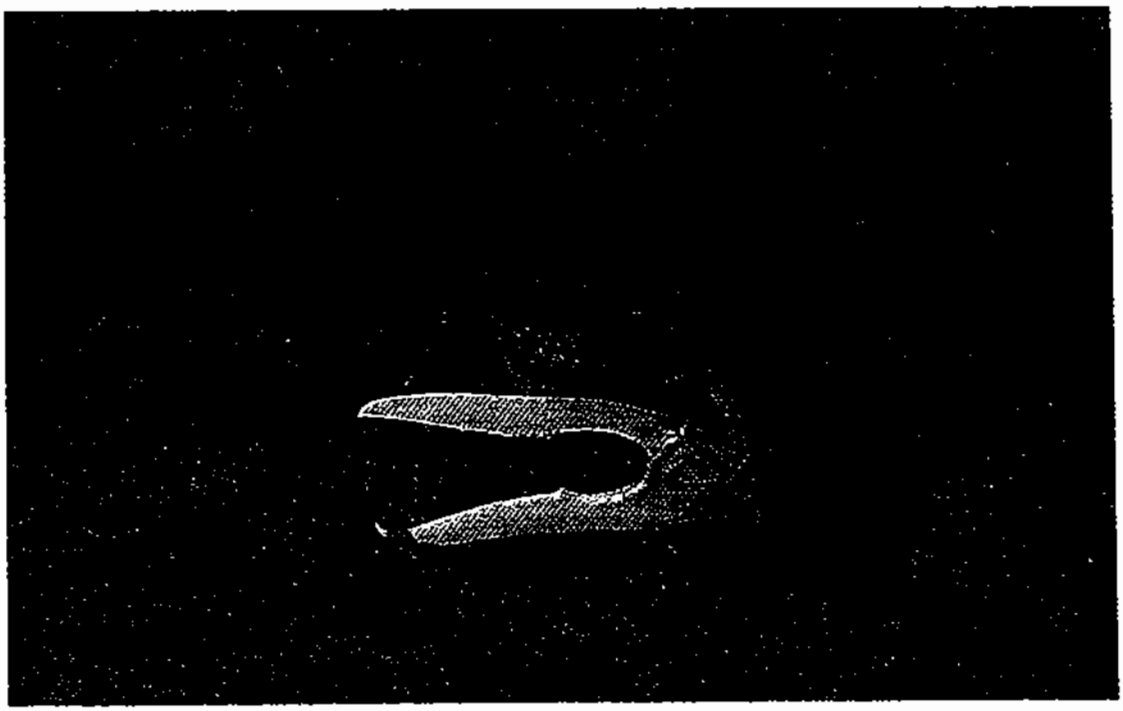
劉靜榆 攝

〔圖文〕黑面琵鷺除於附近的魚塭覓食外，偶亦於堤內之浮覆地內覓食。



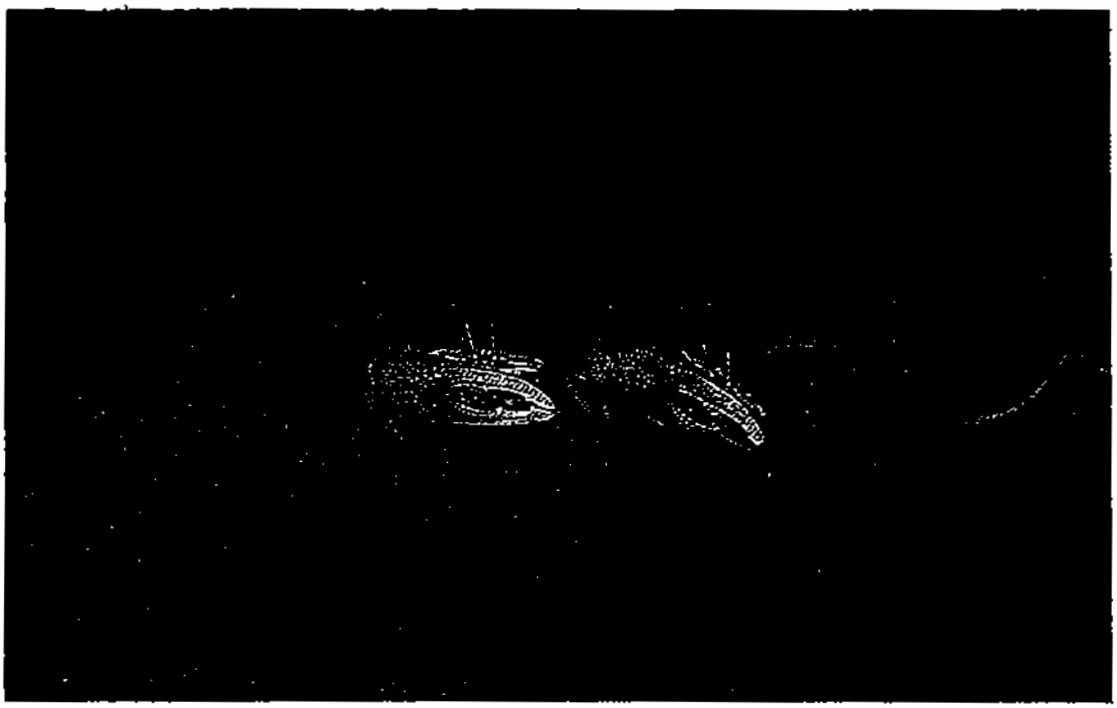
劉靜榆 攝

〔圖文〕慈鯛科之福壽魚爲黑面琵鷺主食之一，亦是廢棄魚塭之優勢魚種。



劉靜榆 攝

〔圖文〕台灣招潮蟹爲台灣特有種，於曾文溪口北岸的族群數量龐大，於特定時間有砌築高塔之特性，塔高10至20公分。

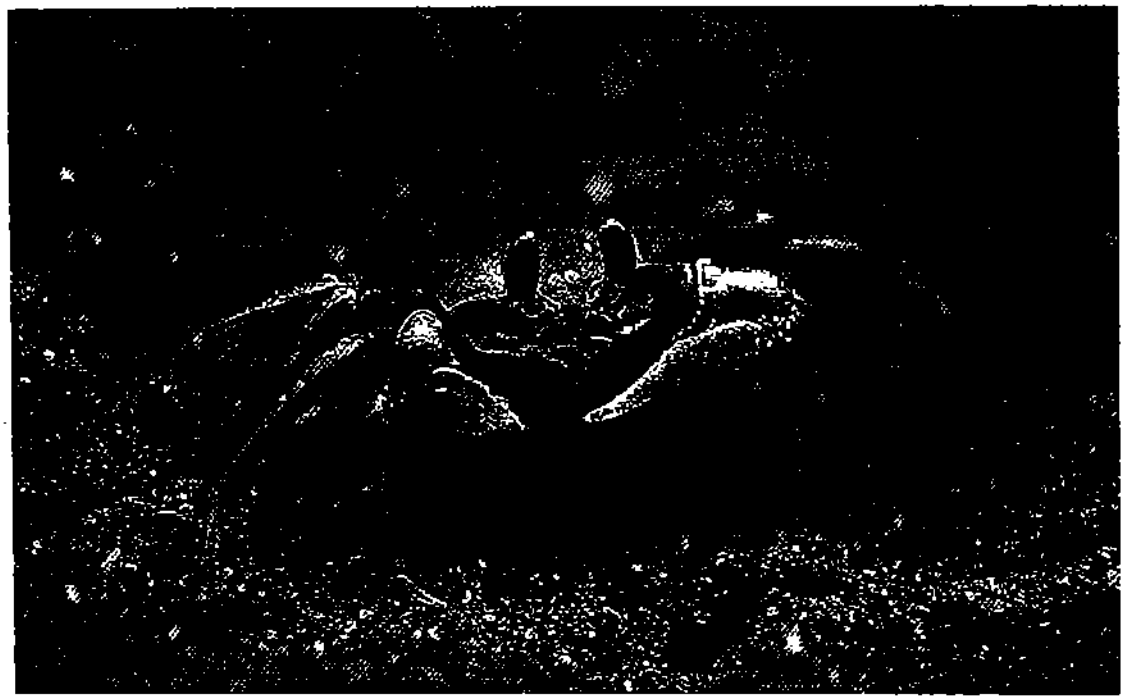


劉靜榆 攝

〔圖文〕網紋招潮蟹爲本省河口沼澤地之廣分佈種，亦常見於堤內浮覆地內，其背甲有網狀花紋而得名，洞口常築有似小火山口的塔狀物，塔高 1 公分至 8 公分不等。

劉靜榆 攝

〔圖文〕短指和尚蟹之頭胸甲呈特殊之球型，棲息於浮覆地內低潮線至高潮線間之砂質土或壤質砂土中。

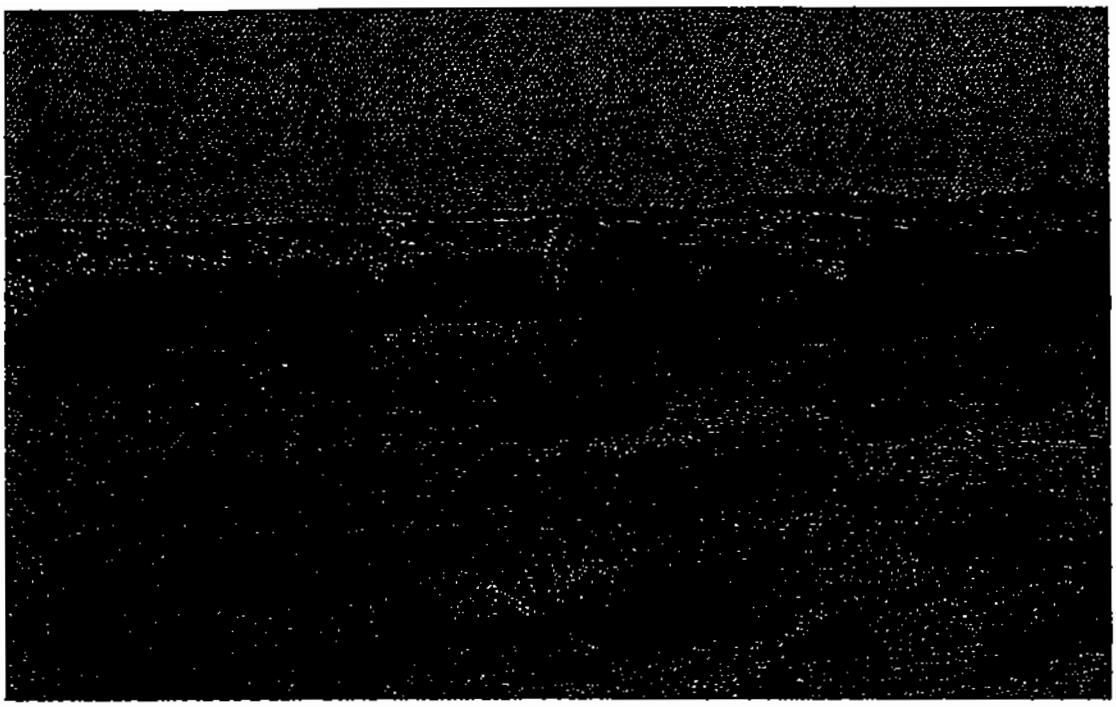


劉靜榆 攝

〔圖文〕痕掌幽靈蟹爲新浮崙沙洲區之優勢蟹種，其行動敏捷，主要棲息於高潮線以上的砂土。

劉靜榆 攝

〔圖文〕老虎心爲蘇木科之蔓性大藤本，全株被刺，族群數量甚少，目前僅於舊北堤發現一棵，其生育地爲大卵石所砌之堤防，生長情形尚佳且結實頗豐。



劉靜榆 攝

〔圖文〕人爲開挖之養殖池因廢棄或收成後即迅速乾涸，此類生育地土壤乾硬且含鹽份極高，不適合一般植物生存，因此常形成鹽定單一優勢，春季時大面積定植，紅色嫩芽蔚爲奇觀。

劉靜榆 攝

〔圖文〕欖李在台灣僅見台南及高雄海岸呈小面積殘存，在曾文溪口地區分布於七股海堤內木麻黃林旁排水溝兩岸。

劉靜榆 攝

〔圖文〕覓食區內養殖池間之排水溝兩旁泥地多可見海茄苳成帶狀分布。