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考察國外自然文化景觀報告與出席國際會議論文彙編(二)

A Collection of Reports on Nature Conservation Activities in Foreign Countries (2)

行政院農業委員會印行
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目　　錄

研究資源經營與環境評估報告

湯曉虞

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一、前　　言

台灣面積狹小，然在山多、雨多及人多之地理環境下，對於農牧之發展，房屋別墅之興建，雨水之儲存供應，水力之開發，工業資材之提供，觀光遊憩地區之興建，生態環境之保護等資源之保育利用；以及受到環境之衝擊，空氣、水、土壤、毒性物質等公害與汚染，均關係民生至鉅，故應加强資源經營以維持土地直接生產力，重視環境評估以避免環境遭受危害及衝突，促進自然生態體系之平衡，以提高國民生活品質爲最終目標。惟目前國內有關資源經營與環境評估理論及技術尙在起步階段，尤其是環境保育及生態規劃等方面，亟待加强改進。

報告人奉派於七十五年度農業科技人才培育計畫經費支助下赴英國研究資源經營與環境評估（計畫編號：七五農建一七。二一糧一二八(21)）爲期一年，藉以學習整體資源經營、環境影響評估等方面之調查、規劃及宣揚之技術與發展，實地考察觀摩文化資產保存、野生動物保育，以及資源規劃利用等工作，特提出心得報告，供我國自然生態保育及環境影響評估之參考。

本項研習計畫經報告人事先與英國各有關大學聯繫，最後決定以亞伯丁大學（University of Aberdeen）爲主，並分兩大階段進行。第一階段由七十五年十月至七十六年六月在該校地理學院（Department of Geography）之農村及區域資源規劃碩士班（Mc in Rural and Regional Resources Planning 簡稱 rrrp）選修相關課程。第二階段由七十六年七月至九月在該校之環境經營及規劃中心（Centre for Environmental Management and Planning 簡稱 CEMP）參加爲期三個月的環境影響評估密集訓練班。本報告之內容係依據實地學習研究，考察觀摩，與專家學者討論吸收新知及新觀念，及研讀收集之文獻資料等途徑獲得的訊息，加以整理分析撰寫而成。

本次研習及考察行程之安排承指導教授布萊恩先生（Mr. Brian D. Clark，亦爲 CEMP 之執行董事）熱心連繫，得以順利完成任務，謹申謝忱。

二、研究考察項目及內容

報告人於 rrrp 期間，選修規劃與開發理論（Theories of Planning and Development）、農村資源基礎（Rural Resource Base）、規劃及經營技術（Techniques for Planning and Management）、森林學（Forestry）、土地改革（Land Reform）、海岸資源規劃（Coastal Resource Planning）以及環境影響評估(Environmental

Impact Assessment ）等課程，對於資源的規劃與經營管理等方面，有更進一步的認識。同時，在研習過程中，撰寫完成一篇有關「台灣環境影響評估之研究（ A Study of Enuironmental Impact Assessment in Taiwan, Republic of China ）」之論文，主要設計出一套適用於台灣環境影響評估之系統，該論文共分六章計：

第一章介紹環境影響評估的源起，台灣環境的背景資料以及研究的動機和目的；

第二章依行政院核定的「加强推動環境影響評估方案，詳細敍明台灣目前執行環境影響評估的情況；

第三章介紹國外一系列的環境影響評估理論，包括開發中國家所採的環境影響評估，一些基本概念，篩選程序、評估範疇、計畫決定網、監測、環境影響評估及環境影響報告；

第四章介紹七種不同環境影響評估的方法以及如何選擇一適當的方法；

第五章爲台灣設計一套環境影響評估系統，包括程序（流程），需要做環境影響評估的類型，不同的例子使用不同的方法，以及設計爲方便審查之問題表格等；

最後，第六章提出十點建議事項及結論。詳細內容請參閱附件一。

報告人並參加CEMP 舉辦之「第二屆環境影響評估密集訓練課程 」，爲期三個月，共有來自科威特、卡達、中南美、巴西、索馬利亞、肯亞、馬來西亞、菲律賓及中華民國等國十四位學員，接受一系列有關環境影響評估的課程，研讀各種文獻資料，並實地做些環境影響評估及報告之實例。同時，也參加爲期二週之「第八屆國際環境影響評估研討會 」以及爲期一週之「開發案件影響健康環境的評估訓練課程 」。另外，也參加有關課程之野外實習及安排考察行程（詳如附件二），拜訪有關機關及學者專家，考察文化資產保存，動物園及保留區設置與經營等項目。

三、考察心得

茲將考察較重要之機構及値得報告之事項分述如下：

(一)蘇格蘭鄉村委員會（ Countryside Commission for Scotland ）

該委員會係一九六七年依據鄉村（蘇格蘭）法（ Countryside (Scotland) Act ）而設置，其委員由蘇格蘭州務卿（ Secvetary of State for Scotland)任命，包括規劃、建築、景觀設計、生態學、土地機構（ Land agency ）、教學、製圖（ Graphic Design ） 及相關技術等多達十四名，委員會係屬諮詢及推廣團體，主要發展的規模與速度從已發展的城鎮邁向鄉村。其主要的目標有五：

1. 保護（ Protection ）：保存及增進蘇格蘭鄉村的自然景觀。

2.遊憩供應（Recreational Prouision）：幫助提供、發展及改善設施，以供人民享受鄉村資源。

3.保育教育（Conservation Education）：增進大衆瞭解與認識，並促進合理的使用鄉村資源。

4.研究與發展（Research and Development）：提供事實基礎，以供決策參考；並施行野外調查工作，以建立基本資料。

5.評估（Review）：配合當前發展，以更新政策。

同時，在該委員會之庭院中，陳列各式各樣景觀設計樣品，如告示牌、垃圾箱、圍牆、棧道、遊憩設施、路標、烤肉設施等，均留供規劃設計之參考，以配合自然景觀。

(二)文化資產保存維護：

英國的歷史文化悠久，在保存維護文化資產方面不遺餘力，爲世界上的先進國家之一，且第一部有關文化資產保存的法令，迄今已有百年以上，有許多地方值得我們學習的。

在英國有關自然、人文的環境維護，歷史建築物及古紀念物等的中央主管機關爲設在倫敦的環境部（Department of the Environment），但其管轄權僅限於英格蘭而已，同樣的業務則分別由威爾斯辦事處，蘇格蘭辦事處的開發廳（Scottish Development Department）及北愛爾蘭辦事處的環境廳（Department of the Environment for Northern Ireland）所主管。至於地方主管機關則爲郡、區政委員會，且均設有規劃單位以負責是項業務。另外，值得一提的是在英國所有規劃單位，除了規劃整體資源利用外，同時也於規劃階段時，事前做好環境評估之工作，而使資源之開發利用破壞環境達到最小的程度。

報告人曾參觀許多古堡、博物館古物保存等地方，其共同的特點在①均有解說員負責回答遊客的問題；②對於每一古物都有詳細的敍述其歷史、來源等記載；③嚴禁遊客使用閃光燈拍攝；④每一管理單位都印製摺頁分送及簡介出售，以供遊客參考。又報告人亦參觀一些史前期巨石柱（Stonehenge）之遺址，亦有解說員在現場解說，並嚴禁遊客攀登於石柱上拍攝留念，而且環境部拍攝多組幻燈片現場出售，以加強宣導工作。

又報告人亦參觀一些自然文化景觀之保存維護，在英國係將具有特殊自然景觀如地質、地形等或珍貴稀有動植物及其棲息地劃爲自然保留區（Nature Reserves），並區分國家自然保留區（National Nature Reserves，簡稱NNRs），海洋自然保留區（Marine Nature Reserves，簡稱MNRs），地方性自然保留區（

Local Nature Reserves ，簡稱LNRs ）。另外，有一種類似自然保留區的爲特殊科學價值區（ Sites of Special Scientific Interest ，簡稱SSSIs ），且依其特性又區分爲特殊生態科學價值區（ Biological SSSIs ） 及特殊地質與地形科學價值區（ Geological and Physiographical SSSIs)兩類。除上述兩種外，尙有國家公園（ National Park ）、特殊優美自然景觀區（ Areas of Outstanding Natural Beauty ，簡稱AONBs ）、國家風景區（ National Scenic Areas ） 、鄉村公園（ Country Park ）、區域公園（ Regional Park ） 以及自然資產海岸（ Heritage Coast)等不同層次的保護措施，相當完備，惟很遺憾的是沒有足夠的時間可一一的參觀訪問。僅參觀幾處，但有許多地方値得我們學習，諸如：在每一個區域內均有資料中心（ Information Centre ） ，提供區域範圍、特色等資料，免費贈送簡介，但如需要詳細些則需購買，又區域內土地大都屬於人民，故大都由百姓組成管理委員會來經營管理，政府每年酌予補助，且該區野生動物若繁衍太多，則由委員會之土地所有人優先獵捕，以使該區之野生動物均保持在一生態體系上，政府每年僅補助少量的金額，以期能自力更生。

(三)倫敦動物園

倫敦動物園是世界收集野生動物最多的動物園之一，面積約一四・四公頃（三十六英畝），其內有超過八〇〇種的動物九〇〇種不同的品種，且每年均有超過一、〇〇〇隻小動物誕生；又企鵝、海獅、鷹、蛇和其他動物等每天都受到很好的照顧和飼養；經常有新的動物到達和繁殖的離去，使得動物園總是在改變及更新。

每年教育單位均安排超過六〇、〇〇〇人的學生去參觀，同時動物園的老師教導學生們一些有關動物的知識。而且倫敦動物園也從事保育工作以及人工繁殖瀕臨絕種的動物，並打上記號做一有系統的紀錄，以提供其他動物園之參考。

倫敦動物園的歷史悠久，在一九二六年史丹福先生（ Sir Stamford Raffles ）建立「倫敦動物社會」（ Zoological Society of Landon ） ，同時也在其殖民地一新加坡建立。當時，在一九二七年此「動物的花園」（ Zoological Gardens ）係位於累根公園（ Regent's Park ） 的北方，僅有二公頃（五英畝）大。直到一八六七年才改名「倫敦動物園」，並不斷地收集各種動物及經營才有今日之規模。

(四)大拉礦業有限公司（ Compang of Tara Mines Limited ）

報告人曾參加rrrp野外課程前往愛爾蘭（ Ireland ），其中最値得一提的是大拉礦業有限公司，該公司是在一九五三年以大拉探測和開發有限公司（ Tara Exploration and Development Co. Ltd. ）設立的，自一九六二年起開始在愛爾蘭搜尋礦產，至一九七〇年在那凡（ Navan ）鑽到含有金屬的岩石，預估超過六千九百

萬噸的金屬岩石中含有一〇・一%的鋅和二・六%的鉛，於是從一九七三年開始開發且至一九七七年六月開始生產。

礦區是採封閉性的，在礦坑口興建很大的廠房，將洗礦、分離等機器安置在內，所有運送過程均操輸送帶互相連接，廠房周圍均植生綠化，洗礦最後剩下的廢泥水，利用水管輸送到數十公里外的谷地中，慢慢的被泥砂填滿，然後再在上面植生而形成另一平坦可利用的新生高地，整個礦區一點塵埃都沒有，遠看還不知道是一礦場。

礦主對於環境的保護更是不遺餘力，分別在廠內、公路旁及住宅區附近建了三個環境監測系統，同時監視空氣、水、噪音、振動、人畜健康、農業及漁類環境以及附近生態環境等，收集並分析資料，這種高科技的採礦及環境監測工作，值得個人學習。

(五)環境綠化

在英國蘇格蘭，由於地廣人稀，不論在城堡、鄉村、城市等住宅區大都有院子，院子中植草皮，種各色各樣的花，並排列出各種不同的圖案，每當花開時，紅的、黃的、紫的……各種顏色十分好看，再加上每戶在院子裡都有一小鳥屋，懸掛一串核果等供留鳥來食，並做片刻休息，這幅美好的畫面眞令人感到心曠神怡。在城市的樓房窗台上，利用花盆栽植低矮灌木及草皮，使得整條街看起來很有生氣。在公園內更有專人負責整理草皮、花圃，隨季節不同而栽培不同的花，全年都可欣賞不同的景色。同時，蘇格蘭政府每年都舉辦環境綠化的比賽，而亞伯丁近年來都得到冠軍。

另外，值得一提的在瑞士興建高速公路，爲了不破壞景觀、水土保持、森林及野生動物棲息環境，利用高架方式橫越兩山腰，不但節省人車在兩山環繞的時間，而且形成另一種景觀，值得國內開闢高速公路之參考。雖然工程費較一般傳統式開路要昂貴些，但却省掉植生、水土保持等經費，相較下仍是可行的。

(六)土地政策

在蘇格蘭的土地政策與國內略不同，大部分屬於私有土地，小部分屬於國有。私有農地出售，如售與農人則可不須經當地政府之核准，反之。在私有土地上任何建築行爲，如加蓋車庫、小閣樓等，都均需當地政府核准始得爲之。首先，興建人必須提出申請，由當地政府所組成的委員會審查，委員們尙需到現場去勘察，是否合乎規定，是否破壞景觀等，確無影響後方准許建築。在市區老舊房舍改建，均以兩條街的範圍（ Black ）爲單位，整個拆除興建，並配合鄰近的景觀，因此，蓋起來都大致一樣，絕不會像國內有高低參差不齊的景觀。一般在住宅區如已有一家商

店，且夠附近居民購買，則就不同意另一家設立。

又一般農戶的土地面積很大，通常五、六戶聯合經營，組成一集團，聘請三、四人負責銷售農產品，與政府聯繫所分配各種作物生產面積；另聘請三位技術人員，指導農民種植、施肥、噴灑農藥等技術，其中還有一位負責監測土壤、水質等以防止污染。至於較小的農戶，如鄰近河流或近海岸，則附帶經營管理這地區，開闢海水浴場或釣魚場，百姓如需垂釣，除向當地政府申請垂釣證外，並可略收費用以增加收入，維護環境及增加魚群之用。

四、結論與建議

台灣地區幅員不大，但具有山明水秀得天獨厚之特殊地質地形景觀，有熱帶、亞熱帶、溫帶、寒帶四種不同的植物帶，並孕育著種類繁多的野生動植物。但目前正面臨環境保育與經濟發展相互競爭，孰重孰輕之困擾，往往爲了生存而需開發資源，而資源開發又破壞自然環境景觀，形成魚與熊掌不可兼得之情形，所幸近來經常看到民衆對環境保護的意識高漲，自力救濟活動迭送發生，可見國內自然生態與環境保育工作已漸受到各方重視，投資在是項工作的經費亦不斷地增加，是件可喜之事。

報告人除在「台灣環境影響評估之硏究」論文中，針對環境影響評估方面提出十點建議事項供有關同仁參閱外，謹於本文最後再提出五點建議事項如下：

㈠於各縣市建立資訊中心（ Information Centre ）：利用各縣市鐵、公路車站或文化中心設立資訊中心，提供轄區內名勝古蹟的資料，如地圖、摺頁等之贈送；提供或代替旅客訂旅館之服務，提供旅客一日遊、三日遊等好去處；出售精美各別歷史文化簡介（十幾頁，約一百元左右）；出售該名勝古蹟之幻燈片或紀念物；出售精美轄區內野生動植物圖鑑，俾便遊客在享受大自然之餘，亦可認識大自然。

㈡建立農業環境之底質標準：農業和環境事實上是不可分割且密切聯繫在一起的。因此，在農業發展中必須不斷地加强保護工作，反之，農業發展本身也要求有良好的環境。在一塊土地上，如果使用得當，荒蕪的土地亦會創造豐碩成果。如果使用不當，也可能會再次變成荒地，這也就是因過量砍伐或濫墾使土地在侵蝕面前毫無防禦能力；同樣的由於過量的使用肥料或農藥使原有土壤生物之生態體系遭受破壞，且影響地下水或河川之水質；相對的在農地附近的工廠，由於排出的廢氣、廢水、廢料等也將影響農業的生產；因此，應儘速調查全省農業環境建立基本資料庫，訂定底質標準，並做好監測工作，以確保農業資源。

㈢繪製農業環境質量評估圖：環境製圖是近年來發展的一項新型專題製圖，它是以地

圖形式來反映環境現象的特徵和規律，具有直觀形象，可以量測、對比等特點，是環境保護和環境科學研究的一種基本工具和手段，透過各種製圖，可一目了然的反映出一切與環境質量有關的自然和經濟條件（環境背景情形），污染源與污染物，環境污染與環境狀況以及多種環境現象的空間分布特徵和數量、質量指標等資訊，有助於查明環境質量在區域空間內的分異規律、原因、結果和趨勢，並對研究農業環境質量的形成和發展進行環境區劃和制定環境保護措施具有實質的意義。

(四)加強開發前的規劃及環境評估：任何一項工程於開發前就應做好詳盡的規劃和環境評估之工作，如城鎮之開發應依都市計畫分住宅區、商業區……等，嚴禁住宅區與商業區等混在一起，影響住宅之環境品質，又如於山坡地上開闢高速公路或省道等，避免在坡地上開挖破壞自然景觀及水土保持，而採高架方式橫跨兩地，雖然經費較高，但減少水土保持、植生撫育等經費，以長期觀點來看，可能所耗經費與傳統式差不多或甚至低些。

(五)改善目前探採礦之技術：於修改礦業法規中要求業者以封閉性方式經營，並利用輸送管道運送原料及廢土，以避免開闢道路而破壞自然生態、景觀及水土保持。同時，要做環境監測的工作，以維護周圍環境品質，如空氣、水、噪音、振動、人畜健康、農漁業生產及生態環境等，希望業者亦能為淨化環境而回饋周圍人畜及生態。

附件一

A STUDY OF ENVIRONMENTAL IMPACT ASSESSMENT IN TAIWAN, REPUBLIC OF CHINA

Hsiao-Yu Tang

June, 1987

A STUDY OF ENVIRONMENTAL IMPACT ASSESSMENT IN TAIWAN, REPUBLIC OF CHINA

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June, 1987

CONTENTS

PREFACE

This report has been produced by Mr Hsiao-Yu Tang over a period of one year's training at the Centre for Environmental Management and Planning, Aberdeen University, Scotland. It covers both broad issues relating to the development of environmental impact assessment (EIA) and specific ways that EIA might be adopted in Taiwan.

The report is indicative of the growing significance of EIA as an evaluative tool to assist decision makers in both developed and developing countries. Increasingly it is realised that environmental and economic issues must be jointly considered in the development process. There is now a clear need to look for cost effective measures to assess the likely consequences of proposed development projects. Mr Tang therefore suggests certain procedures and methods which he respectfully believes might be of relevance to his country of Taiwan.

It must be stressed that the views expressed in this report are those of the author and do not reflect a policy statement by the Centre at Aberdeen University. However as the Centre is committed not only to training in EIA but also to encourage participants to formulate their own ideas for the development of EIA, this report is to be welcomed with the hope it will provoke both reaction and positive action to help protect the environment.

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I wish to acknowledge my thanks to my service department, the Council of Agriculture, for giving me the opportunity for advanced study and for meeting all the expenses of the study, in the field of natural resources conservation and environmental impact assessment at the University of Aberdeen. At the same time, I wish to thank my superiors and colleagues for giving me encouragement. I also wish to thank my good friend, Lin Yaw-Yuan, for his great help and offers of information.

Finally thanks to my wife, Chu Yen-Ping, for taking care of my father and my daughter in Taiwan during my study.

SUMMARY

Environmental Impact assessment (EIA) is the systematic examination of the environmental consequences of projects, policies and programmes. It has a relatively short history of about 15 years, but it is growing very quickly in a number of countries.

In Taiwan, Republic of China, EIA is just beginning to grow. The governments and public attach great importance to protecting the conservation of natural resources before development. According to a "Program of Strengthening Environmental Impact Assessment" the following targets are expected to be achieved within the next five years.

(1) To determine the category and magnitude of developments which ought to require environmental impact assessment, so that major construction projects must be examined through the system of EIA to prevent occurrence of public nuisance and preserve the quality of environment.

(2) To proceed with research on EIA techniques to establish standard principles and guidelines, and also set up an environmental data bank.

(3) To establish the procedure of assessment and the flowing schedule of approving assessment reports. To consider and discuss the feasibilty of public participation to make suggestions, and the necessity of establishing a tracing and supervising system.

(4) To train specialists in assessment administration and management. Each relevant organization should have a special department with personnel responsible for EIA.

(5) To review every year the merits and defects of implementation of this programme and to review after 3 years of implementation the results of educational training and assessment technique research. Also to proceed with the study of relevant legislation, and to introduce the "Environmental Impact Assessment Law" after making an overall review of the subject.

This paper, which is based on a variety of foreign experiences, contains a proposed environmental impact assessment system. For convenience, the report is divided into a sequence of chapters, as follows:

- Chapter 1 introduces the evaluation of EIA and its background in Taiwan, and oultines the motive and aim of the study;
- Chapter 2 details EIA in Taiwan including the responsibility, legislation, current situation and problems, the procedure and financial aspects of EIA;

- Chapter 3 introduces a series of EIA theories from foreign countries, including the adoption of EIA in developing countries, some basic concepts, legislation, screening procedure, scoping the project decision network, monitoring, EIA and EIS;

- Chapter 4 introduces 7 different methods of EIA and suggests how a suitable methodology might be selected;

- Chapter 5 describes the design of an EIA system for Taiwan including the procedure, the types of projects requiring EIA, methodologies and a check list of questions for various cases;

- Finally, Chapter 6 gives ten suggestions and conclusions. It has become increasingly neccessary to develop further and refine the practice of EIA. Through case studies, the analytical tools for evaluation and for policy formulation can be identified and assessed. It is hoped that more people will develop an interest in EIA and study environmental/ natural resources conservation and environmental impact assessment.

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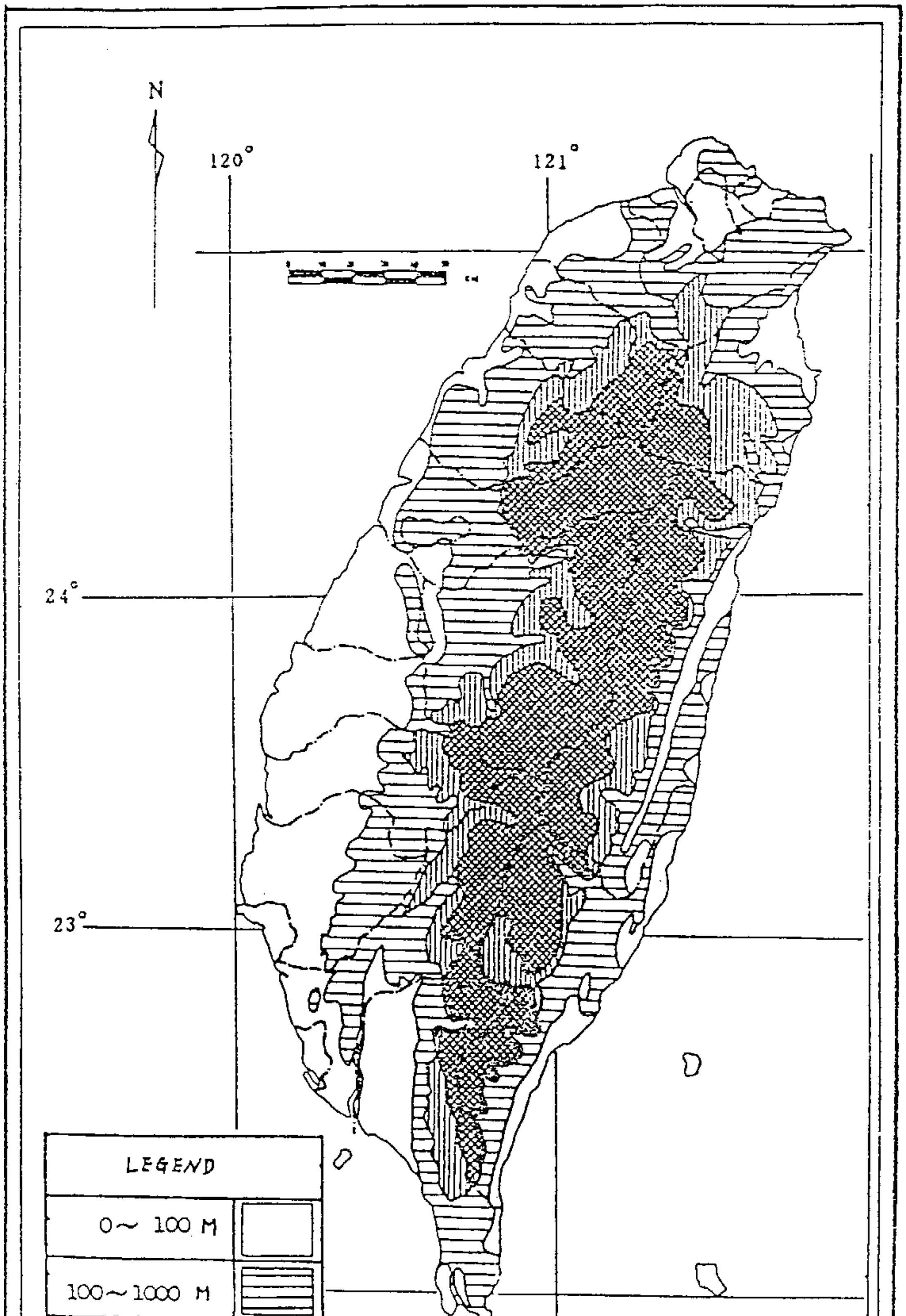
Fig 1.1 The Map of Taiwan



CHAPTER 1

INTRODUCTION

1. FOREWORD

After the Second World War, development occurred in many developing countries, as a result of rapid economic growth through a massive and accelerated modernisation of the productive structures, based on industrialization. The aim was to duplicate the economic and technological conditions already existing in developed countries mainly through investment in large-scale development projects. Since the 1950's growing environmental awareness has increasingly focused attention on the interrelation between development actions and their environmental consequences. In developed countries this has led to the public demanding that environmental factors be explicitly considered in the decision-making process.

Early attempts at project assessment were crude and often based upon Technical Feasibility Studies and Cost Benefit Analysis (CBA). CBA was developed as a means of expressing all potential impacts in terms of resource costs valued in monetary terms. Following the assessment of a number of major developments, such as the proposed third airport at London and the Aswan Dam, using CBA techniques, a new evaluation approach was developed which came to be known as Environmental Impact Assessment (EIA). The concept of EIA was also seen by the environment lobby as a potentially useful tool to assist their cause.

The basic legislation for environmental impact studies was first seen in the U.S.A. with the National Environmental Policy Act (NEPA) of 1969. It was the first law signed in the decade of the 1970's and it gave significance to environmental issues and considerations since the January 1, 1970 effective date by Richard Milhous Nixon the President of the USA. There are four purports:

> "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality."

An environmental assessment (EA) refers to a concise public document that serves to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact (FONSI). Pending this determination information from the EA can aid an agency's compliance with NEPA when no EIA is necessary or facilitate preparation of an EIA when one is deemed to be necessary. The components of an EAS should be similar to the components of an EIS. As originally listed in NEPA, the EIA was to address the following five points:

(1) the environmental impact of the proposed action;
(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;
(3) alternatives to the proposed action;
(4) the relationship between local short-term uses of man's environment and the maintenance and enchancement of long-term productivity; and
(5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The basic purpose of NEPA was to insure that the environment is considered in project planning and decision-making along with traditional technical factors and economic analyses. The environment must be considered in conjunction with these factors rather than separately after other decisions have been made based on technical and economic grounds. Accordingly, EIA has evolved as a comprehensive approach to evaluation, in which environmental, as well as economic and technical considerations, are given their proper weight in the decision-making process.

In 1979, President Jimmy Carter signed an executive order (a statement of the President with the force of law) relating to the implementation of NEPA for U.S.-funded projects abroad. The key sections of the order require that federal agencies preparing EISs for foreign projects take account of (i) the potential impact on the global commons, (ii) the possibility of trans-border effects, (iii) protection from any emmissions prohibited or regulated by U.S. law, and (iv) potential impacts on ecosystems designated to be of international importance.

NEPA is very much a reflection of the importance placed on "the legislative approach" under the American system of government. Under this system the general public, operating through the courts, act as the watchdog on government. With NEPA it was a series of costly court challenges to government decisions that eventually led to an improvement in agency performance. Such an approach requires the presence of well organized, well funded and influential environmental lobby groups since concerned individuals seldom have the resources to undertake legal proceedings against governments or large industries. Under the legislative option for EIA, as practised in the U.S., "enforcement" is achieved by public pressure operating through the judiciary who are the final interpreters of the statute.

EIA is the systematic examination of the environmental consequence of a project, policies and programmes. Its main objective is to provide the decision-maker with an account of the implications of alternative courses of action before a decision is made. The results of the assessment are assembled into a document referred to as an Environmental Impact Statement (EIS). Usually decision-makers are not involved throughout the planning and assessment process as this is normally considered to be a technical exercise. When an EIS has been prepared it is used by decision-makers as a contribution to the information base upon which a decision is made.

A growing number of countries around the world have adopted EIA as a tool for considering the potential environmental and socio-economic consequences in planning for human health and for the improvement of environment.

As a recognisable activity EIA has a relatively short history of about 15 years. Yet major changes have occurred over that period in the concept and practice of EIA. The United States and Canada were among the first countries to establish formal EIA procedures and the systems developed in each country have evolved over the years to a high degree of refinement. In this context, EIA has a very important role to play in ensuring human health and in the sensible utilization of environmental resources.

The object of this paper is to describe a number of possible methods of undertaking EIA. It is hoped that it will provide good reference information for the Government to decide about environmental policies. Furthermore, it is hoped that it will appeal to a wider audience and that concepts will be useful for decision-makers.

2. BACKGROUND IN TAIWAN

Taiwan is neither large in size nor rich in natural resources. It is an island situated in the sub-tropical northern hemisphere. It has a surface area of about 36,000 square kilometers of which most is hilly and mountainous, less than one-third being flatlands (Table 1).

Table 1

DISTRIBUTION OF THE LAND AT VARIOUS ELEVATIONS

Elevation (m)	Land area (ha)	Percentage (%)
Under 100	1,082,000	30
100 - 1,000	1,366,000	38
1,000 - 1,500	437,000	12
over 1,500	713,000	20
TOTAL	3,598,000	100

Rivers originating in the central mountain ranges are generally short and rapid, excepting the Kaoping, Tsengwen and Tamsui rivers, which flow across the plains. Topography tends to show sharp variation, partly as a result of long ages of flooding and erosion by rivers.

Over 90% of Taiwan Island is classified as non-registered agriculture and forestry (Table 2).

Table 2

THE CLASSIFICATION OF LAND USE

Land Use	Area (ha)	Percentage (%)
Agriculture and forestry	1,511,455	42.0
Building construction	126,777	3.5
Transportation and irrigation	64,592	1.8
Other	54,636	1.5
Non-registered land	1,840,550	51.2
TOTAL	3,598,000	100.0

The climate of Taiwan is characterized by warm temperature and abundant rainfall (Table 3).

Table 3

MEAN ANNUAL TEMPERATURE AND RAINFALL

Position	Temperature	Rainfall
The north of Taiwan	21.7°C (71.1°F)	2,340mm (92")
The middle of Taiwan	22.5°C (72.5°F)	1,594mm (62.7")
The south of Taiwan	23.8°C (74.8°F)	1,961mm (77")

Its mild weather and intensive rainfall are favourable for both animal and plant culture. Vegetation is categorized by changes in altitude which create tropical, sub-tropical, temperate and alpine climate zones. The most extended zone is the sub-tropical followed, in order, by temperate, tropical and alpine areas.

Across from the southeast mainland of China, Taiwan is situated at an area where continental and oceanic influences interact and is itself an area of special geographical and geological landscape heavily influenced by an oceanic climate and high average rainfall. The island's mountains and valleys exhibit special formations. Animal and plant life have developed within special ecological systems that are characteristic of Taiwan, called "Formosan".

The island's high percentage of mountainous terrain causes abruptly descending, rapid rivers and soil destruction. In such an environment, where erosion and sedimentation are significant, land reclamation and water conservation efforts are of great importance in the control and management of these environmental forces.

Consequently, apart from roles in the conservation of natural ecosystems, the function of environmental impact assessment is of value in the conservation of land resources and in forest protection. Within the island's singular topographical and climatic environment, the safety of people and property in downstream areas is associated with careful planning to assure that the upstream areas are managed in accordance with principles securing a balance between the laws of nature. These "invisible" effects must be taken into account along with competing economic considerations. The establishment of an environmental impact assessment system is, thus, more significant to Taiwan than to areas in many other countries.

3. MOTIVE AND AIM OF STUDY

In the past thirty years the rapid growth of industrial development, personal incomes and population has resulted in the fact that conflicting demands on land use are common.

Due to the steep terrain of the country, weak geological formations, erodable soil and intensive rainfall during the summer season, hillside farming, without proper soil conservation facilities, usually causes erosion problems in mountainous areas. Sediment and debris are carried by flood from mountainous areas to lower plain areas and are deposited in stream beds causing flood damage in that area. Also, due to an increase in population and of industrial development, land for residential dwellings and cemetries is urgently necessary. Correspondingly, population pressure and the use of pesticides and fertilizers as a result of the intensification of agriculture, often ill-suited to the agro-ecological systems of a region, are degrading and depleting the resource base. The equitable distribution and efficient use of land, water and other productive resources, in a manner that shows due regard for ecological balance and environmental protection is of priority if human health, the improvement of environment and increased production are to be ensured.

EIA is a relatively new concept that emerged in the 1970s as a direct consequence of world-wide environmental concerns. It has evolved into a highly-developed decision-making tool and has become wide-spread throughout the world. It is an important mechanism whereby developed and developing countries can obtain information on the environmental impacts of major developments and incorporate it into decision-making. EIA has the potential to benefit both the environment, people, as well as industry. By mitigating undesirable environmental impacts in advance, economic savings can be achieved.

This study of natural resources conservation and EIA, undertaken in the Department of Geography, University of Aberdeen, has collected detailed information on the development and utility of EIA with a view to designing a procedure for EIA in Taiwan. At the same time, it is hoped that this paper will be of use to the decision-maker, in addition to those concerned with the preparation and appraisal of EIA.

CHAPTER 2

THE CASE OF ENVIRONMENTAL IMPACT ASSESSMENT IN TAIWAN

1. RESPONSIBILITY

The Executive Yuan (Cabinet) is the highest administrative organization in the Republic of China. There are several ministries and councils, two special municipalities and a Taiwan Provincial Government under the direct jurisdiction of the Cabinet. Under the jurisdiction of the province are sixteen counties and four cities.

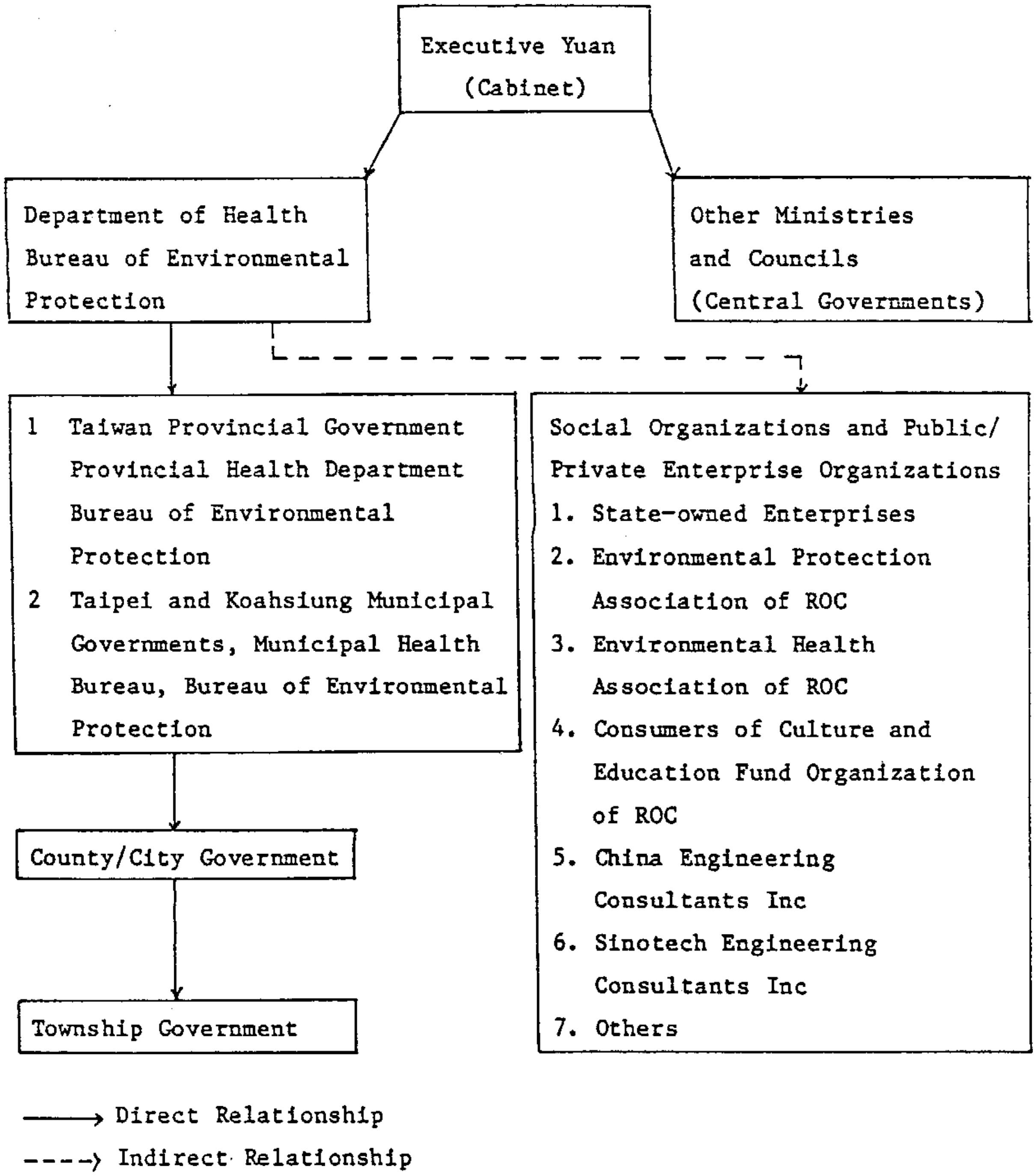
The Department of Health is one of the subordinate organizations of the Executive Yuan. The Department's major task is to handle the health affairs of the nation. It has the Bureau of Environmental Protection (BEP) which has the role of pollution prevention for the nation. The BEP has six divisions: Comprehensive Planning, Air Pollution Control, Water Pollution Control, Environmental Sanitation, Toxic Substances Control, and Laboratory.

The Taiwan Provincial Government has a Bureau of Environmental Protection under the Provincial Health Department. Taipei and Kao-hsiung Municipal Governments have a Bureau of Environmental Protection separate from the Municipal Health Bureau.

The central government plays a different role from the provincial or municipal governments in that it sets national policies and goals while the provincial or municipal governments retain control over most of the actual action and implementation of national policies. The agencies concerned with environmental protection are shown in Figure 1.

Figure 1

BEP RELATIONSHIP WITH GOVERNMENT AND ORGANIZATIONS



As EIA requires inputs from a variety of disciplines, there is a need for coordination between and within these. Technical inputs, administrative inputs and specialist inputs are handled by the Bureau of Environmental Protection. The Department of Health acts as the office responsible for promoting and conducting EIA. Due to the importance attached by the Government to the environment, the status of the responsible department was elevated by the establishment on 22nd August 1987 by a new Environmental Protection Administration, responsible for EIA and all matters relating to environmental planning and management.

2. LEGISLATION

In Taiwan, Republic of China, no legislation for the Environmental Impact Assessment System has yet been developed. This is currently being reviewed and two elements pertinent to this review can be identified.

(1) Enactment of public nuisance prevention statutes such as Water Contamination Prevention, Air Pollution Prevention, Noise Pollution Control, Garbage Disposal, which are designed to cope with problems of public nuisance which may arise after the implementation of development for which preventive measures are adopted. These are, however, merely an expression of prohibition and regulation. They cannot directly prevent the occurrence of environmental problems, even in areas declared under pollution control where disputes cannot be avoided because there is no definite assessment basis.

(2) Though the statute concerning regional planning such as the Regional Planning Act and others concerning Urban Planning, National Park, Water Conservation, Forestry, Cultural Property Preservation, Tourism Development, etc., contain text involving

the analysis of the present status of nature, society, economy and cultural property preservation, it only explains and emphasizes the present environmental situation, and does not prescribe the process of predictive assessment regarding the environmental capacity and its impact bearing on the area under planning, for reference to the decision making authority. Therefore considering regional planning as a whole and the way of selecting and exploiting the best natural resources, our present laws still lack a concrete and explicit set of rules and regulations.

Since 1986, however, a number of projects undertaken in hillside areas have been subject to EIA under legislation introduced by the Conservation and Use of Slopeland Resources Act.

The resolutions passed by the Executive Yuan 1854th session on 13th October 1983, stated that from now on all the Government's major economic construction plans, natural resources and tourism development plans, as well as large scale factory construction by the private sector which may cause environmental pollution, must be assessed and the impact on the environment taken into consideration before the application for planning permission. The Department of Health will then accept the application and file as part of the Programme.

The Department of Health has followed up on the resolution mentioned above, and formulated a "Programme of Strengthening Environmental Impact Assessment" which has gained approval for implementation from the Executive Yuan early in 1985. Within the next five years, all major economic development projects, development of tourism resources, and building of polluting factories, will be required to conduct EIA and to prepare EISs.

3. EXECUTIVE SITUATION AND PROBLEMS

From 1979 to 1982, academic institutions and private consultant companies within the country have submitted plans to the government planning department concerning environmental impact assessment of various construction works. Eight of these proposed assessment plans are significant. These include construction of highways, reservoirs, community development projects, industrial zone developments and thermo-electric plants. Most of the reports, however, were limited in their ability to actually achieve an optimal environmentally acceptable development proposal. Indeed, four areas where improvements are possible can be recognized as:

(1) The use of EIA is limited in that it does not consider and adequately respond to the result of the environmental impact assessment at the initial stage of planning and is therefore of limited value as a tool to ensure environmentally sound development.

(2) The assessment system is not fully established, and the technique of assessment is limited. In addition the present environmental data in this country cannot be effectively utilized because there is no systematic data collection and dissemination.

(3) The interests of different groups vary and, as a result, so do their perceptions as to the role and contribution of EIA to planning. In this way, the suggested procedures for implementing statutory EIA vary between government departments and agencies.

(4) In the absence of relevant legislation or regulations to support an environmental impact assessment system, EIA will not develop. This is exacerbated by a shortage of trained personnel with which to develop a procedure and implement EIA's.

4. THE PROCEDURE OF ENVIRONMENTAL IMPACT STATEMENT

Environmental impact assessment is a multidisciplinary process. It not only relies on specialist knowledge of nature, humanities, society, economy etc., to carry out the work of analyzing, examining and judging, but it also relies on opinions suggested by relevant parties in accordance with their different functions, to assist the decision making authority in making an overall consideration of the factor in relation to the environmental problem. Therefore, whether the environmental impact assessment possesses any substantial significance, and whether the consideration of the problems of environment can influence the process of plan decision, depends entirely upon the extent of the assessment procedures.

Apart from nuclear power plants, which are subject to different assessment regulations, those major construction and development projects which require assessment must submit environmental impact assessment reports along with the planning application according to the following procedures (Figure 2).

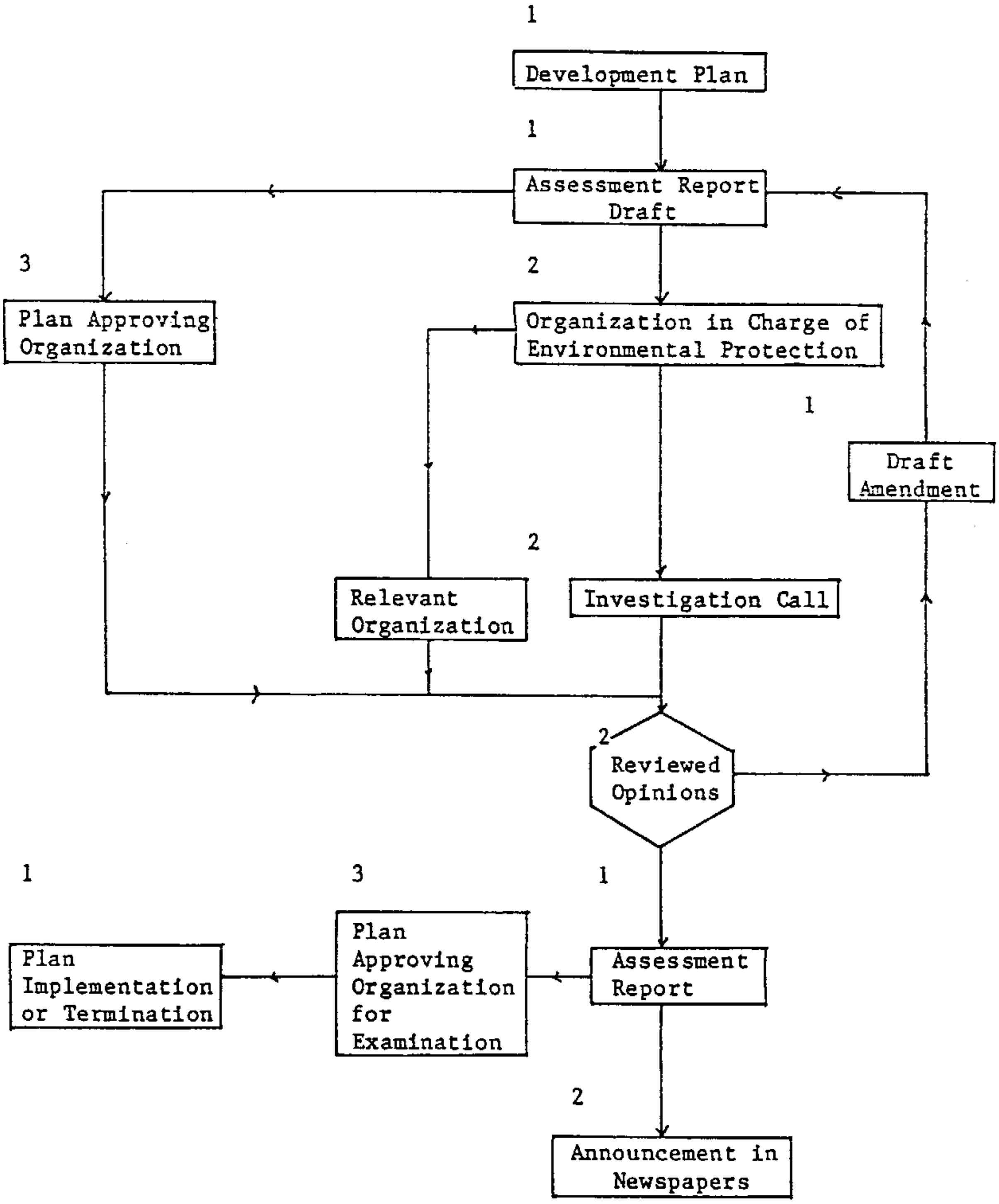
Figure 2 shows the examination and approval schedule of an environmental impact assessment report. Explanations of the procedures are given below.

A. To put forward a draft environmental impact assessment report

The developer should consult the prescribed items laid down as assessment technique standard principles or guidelines, while investigating, predicting, assessing and distinguishing the impacts on the environment according to the development plan and/or the alternative scheme, and also to put forward thirty copies of the initial draft of environment impact assessment report (referred to as

Figure 2

THE PROCEDURE OF AN ENVIRONMENTAL IMPACT ASSESSMENT REPORT



Note:

1. To take charge by development unit
2. To take charge by organization in charge of environmental protection
3. To take charge by plan approving organization

assessment report hereafter) to the development plan approving organization and the organization in charge of environmental protection.

The assessment report draft should include the following five items:

(1) The development plan's purposes and its contents.

(2) The present condition (land-use, environmental quality, precious or distinguished natural and human cultural resources) of the development project site.

(3) The assessment result (the unavoidable long and short term impact within five or ten years, the permanent or the unrecoverable mode of resources utilities) of the development plan and/or the alternative development scheme.

(4) Environmental preservation or public nuisance preventive measures.

(5) Appendix (assessing methods, types of prediction model, views from relevant organizations or opinions of the general public).

B. Examination of assessment report draft

The organization in charge of environmental protection should examine the assessment report draft together with the plan approving organization, and at the same time seek opinion from relevant organizations, then either decide whether amendment is necessary, or suggest rectifying measures that should be made to the development project.

The duration of examining the assessment report draft should not be longer than two months.

C. Amendment of assessment report draft, collection and classification of reviewed opinions

Regarding the assessment report draft or the development plan of which certain development items needed to be rectified, the developer should collect and classify all reviewed opinions and after necessary amendment of such items, prepare thirty copies of the assessment report and forward them to the organization in charge of environmental protection.

If the developer finds the reviewed and amended opinions not acceptable, he should produce supporting document explaining the reason why they are not acceptable.

D. Distribution of assessment reports and reviewed opinions

The organization in charge of environmental protection should distribute and forward the assessment reports and the concerned reviewed opinions to the relevant organizations and the development plan approving organization for the purpose of reference for planning, examining and approving.

E. Announcement of assessment report in the public newspapers

The organization in charge of environmental protection should announce the assessment report and the summary of relevant reviewed opinions in the government-owned newspapers.

F. Other coordinating items

(1) The review of the organization in charge of environmental protection should be carried out jointly by members from relevant organizations, scholars and specialists.

(2) If two or more developers undertake development activities at the

same locality simultaneously they should conduct an EIA jointly.

(3) Standards and principal guidelines for EIA's should be compiled by the organization in charge of environmental protection jointly with the development plan approving organization.

5. FINANCIAL ASPECTS OF ENVIRONMENTAL IMPACT ASSESSMENT

The operation of environmental impact assessment mainly includes (1) data collection, (2) analysis and prediction, (3) experimentation on model projects, (4) communication of all findings on assessment and analysis and to suggest preventive measures, (5) reporting, (6) reviewing, monitoring and auditing.

The proportion of expenditure represented by the first five items is comparatively higher as it includes data collection and analysis which must be undertaken at the time of planning whether an EIA is conducted or not. This must be considered therefore at the time of budgeting. Experience in this country suggests that EIA's have accounted for between 0.01% and 1.85% of total project cost depending on the nature of the project and of the EIA; some NT $800,000 to NT $20,000,000. Actual costs depend on the availability of data, and the time limit imposed, however.

CHAPTER 3

THE THEORIES OF ENVIRONMENTAL IMPACT ASSESSMENT

1. THE ADOPTION OF ENVIRONMENTAL IMPACT ASSESSMENT IN DEVELOPING COUNTRIES

Environmental impact assessment has been applied to the analysis of projects, such as large scale industrial plants and infrastructure projects (roads, dams, etc.) as well as agriculture and irrigation projects, housing and urban development, mining and energy (fossil fuel, nuclear power plants, oil and gas production, etc.). It has been much less frequently and less effectively applied at the planning, programme and policy levels.

Environmental impact assessment has been adopted in most of the industrialized countries, with either established formal procedures, such as U.S.A., Canada, France, and most recently the Netherlands and Japan; or incorporated environmental impact assessment into the existing planning systems, such as the United Kingdom and the Federal Republic of Germany. Some of the East European countries have also incorporated multi-purpose appraisal methods into their planning systems, such as Poland and Czechoslovakia.

Some sort of environmental impact assessment is also required by many national governments in developing countries. Among them could be mentioned Argentina, Brazil, Fiji, India, Indonesia, Korea, Malaysia, Mexico, Philippines and Thailand. Most of these countries are situated in Latin America or Asia, and belong to the group of "Newly Industrialized Countries".

Development assistance has been another field of application of environmental impact assessment related to developing countries. Both multilateral and bilateral lending institutions have given attention to the topic of environmental impact assessment. For example, the World Bank created the Environmental Affairs Division in 1974, and subsequently issued specific guidelines for environmental assessments. In 1980 the World Bank, along with the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP) and the regional development banks, signed a declaration which advocated the need to assess the environmental impacts of development projects. In 1982 they established, as a general policy, "not to help finance any project that seriously compromises public health or safety, causes severe or irreversible environmental deterioration or displaces people without adequate provision for resettlement" (World Bank, 1982). In 1984 this policy included aspects related to international environmental agreements, transboundary environmental problems and natural protected areas.

Among the bilateral lending institutions, the U.S. Agency for International Development (USAID) was the first to formally recognise the need to assess the environmental consequences of their initiatives. Since 1976 USAID requires an Initial Environmental Examination (IEE) to be carried out on all projects and an environmental impact assessment in cases where the impact is expected to be significant.

Although no other bilateral aid agency has yet established a policy and formalised procedure for EIA such as USAID, steps are being taken in this direction. For example, the aid agencies of Organization for Economic Cooperation and Development (OECD) countries have recently begun addressing this issue and passed several recommendations regarding the establishment of EIA policy and procedures for assessing proposed development activities in developing countries.

The United Nations (UN) and other international organizations, namely UNEP, UNDP, WHO (World Health Organization), FAO (Food and Agriculture Organization) and UNECE (United Nations Economic Commission for Europe), have also given attention to EIA, through scientific research, development of methodologies and guidelines and training.

2. BASIC CONCEPTS

The purpose of an EIA is to determine the potential environmental, social, and health effects of a proposed development. It attempts to assess the physical, biological and socio-economic effects in a form that permits a logical and rational decision to be made. Attempts can be made to reduce potential adverse impacts through the identification of possible alternative sites and/or processes. There is however no general and universally accepted definition of EIA and never can be. The following examples illustrate the great diversity of definitions:

(1) "... an activity designed to identify and predict the impact on man's health and well being, of legislative proposals, policies, programmes and operational procedures, and to interpret and communicate information about the impact" (Munn, 1975).

(2) "... to identify, predict and to describe in appropriate terms the pros and cons (penalties and benefits) of a proposed development. To be useful, the assessment needs to be communicated in terms understandable by the community and decision-makers and the pros and cons should be identified on the basis of criteria relevant to the countries affected" (UNEP, 1978).

(3) "... an assessment of all relevant environmental and resulting social effects which would result from a project" (Battelle, 1978)

(4) "... assessment consists in establishing quantitative values for selected parameters which indicate the quality of the environment before, during and after the action" (Heer and Hagerty, 1977).

(5) "... the systematic examination of the environmental consequences of projects, policies, plans and programmes. Its main aim is to provide decision-makers with an account of the implications of alternative courses of action before a decision is made" (PADC, 1981).

There exists at present no clear definition of EIA. Perhaps it is just as well that this is so. For environmental impact assessment is still a growing, changing concept, and the lack of a text-book definition facilitates its further development. Having said that, it must also be stated that EIA does not attempt to be "all things to all men". There is a consensus on several basic tenets of EIA, its aims and its objectives, and these will be presented in the following (Ahmed, Yusuf J., 1985).

First of all EIA is a study of the effects of a proposed action on the environment. In this context, "environment" is taken to include all aspects of the natural and human environment. Therefore, depending on the effects of scale of the proposed action, an EIA may include studies of the weather, flora and fauna, soil erosion, human health, urban migration or employment, etc., that is to say, of all physical, biological, geographical, social, economic and other impacts. Naturally, the number of studies will vary from action to action.

Secondly, EIA compares various alternatives by which a desired objective may be realized and seeks to identify the one which represents the best combination of economic and environmental costs and benefits. Naturally, there must be a trade-off between the pluses and the minuses. Adverse environmental impacts may be reduced at higher project cost. Conversely, economic benefits may be enhanced at some environmental cost.

Thirdly, EIA is based on a prediction of the changes in environmental quality which would result from the proposed action. For example, how will the proposed coal-burning electricity generator affect air quality in the adjacent villages? In the case of some impacts (e.g. those on water or air quality), prediction can be based on existing mathematical formulae. For others (such as social impacts) numerical analysis cannot be employed. Regardless of how predictions are derived, though, they are not facts and should not be presented as such.

Fourthly, EIA attempts to weigh environmental effects on a common basis with economic costs and benefits in the overall project evaluation. If this is done, the decision-maker is less likely inadvertently to overlook an environmental consequence in arriving at his decision. Also he is less susceptible to charges of "undue influence", which tend to arise when environmental effects are considered separately from economic effects.

Finally, EIA is a decision-making tool. Its ultimate objective is to aid judgemental decision-making by giving the decision-maker a clear picture of the alternatives which were considered, the environmental changes which were predicted, and the trade-offs of advantages and disadvantages for each alternative. The document produced, regardless of its format, should therefore include a set of recommendations.

3. LEGISLATION

At the political level there are two basic options to consider in establishing EIA procedures - the legislative option or the policy option. The choice depends on a number of factors such as the political system of the country, the current persuasion of the government towards environmental concerns, social and economic conditions, and the interest of the general public.

The legislative option is the more formal legal approach in which the EIA procedures become law and are enforced by the courts. The advantages are that such procedures are mandatory, regulations can be developed to direct and control various activities, and the requirements are enforceable. Disadvantages include the cost of the bureaucratic machinery required to administer the legislation, the time lost when the law is challenged in the courts, and the loss of flexibility in dealing with unique types of projects and/or environments.

The policy option as a basis for EIA procedures means that systems are developed and incorporated within the administrative machinery of government. Under this option the rules and regulations are not enforceable in a legal sense. The advantages include greater direct control over the process, more opportunity to alter procedures in light of experience, less administrative costs, and avoidance of long project delays due to legal arguments. The disadvantages are that the entire system is more vulnerable to political whims, it may be difficult to force agencies to take their responsibilities seriously, and the concerned public may not be able to directly challenge a final decision with which they disagree.

From literature on EIA has generally focused on the application of EIA procedures, methods and predictive techniques with little attention being paid to the subject of screening. This oversight perhaps results from the manner in which procedures for EIA are introduced in different countries. Four approaches can be identified.

(1) Specific EIA legislation - for example: Australia, Philippines, Canada and U.S.A.

(2) General legislation relating to EIA - for example: Malaysia, New Zealand and Thailand.

(3) Informal procedures - for example: India, Indonesia and Papua New Guinea.

(4) Ad hoc application - for example: United Kingdom, Nepal and Sri Lanka.

Whatever the legal basis for EIA, some criteria govern its application, whether by specific codes or by informal mechanisms such as the likely degree of public opposition or environmental setting. Given the different mechanisms by which EIA may be required, literature has generally described the various legal frameworks rather than evaluating screening procedures (Tomlinson, 1986).

4. SCREENING PROCEDURE

The concept of screening was to control the extent, and hence the cost, of an EIA. During the development of screening procedures the following two objectives require consideration:

(1) The procedure should be comprehensive, clearly identifying all projects that ought to be subject to EIA

(2) The procedure should be practical, quick and easy to use, thereby reducing delay to those projects not requiring an EIA

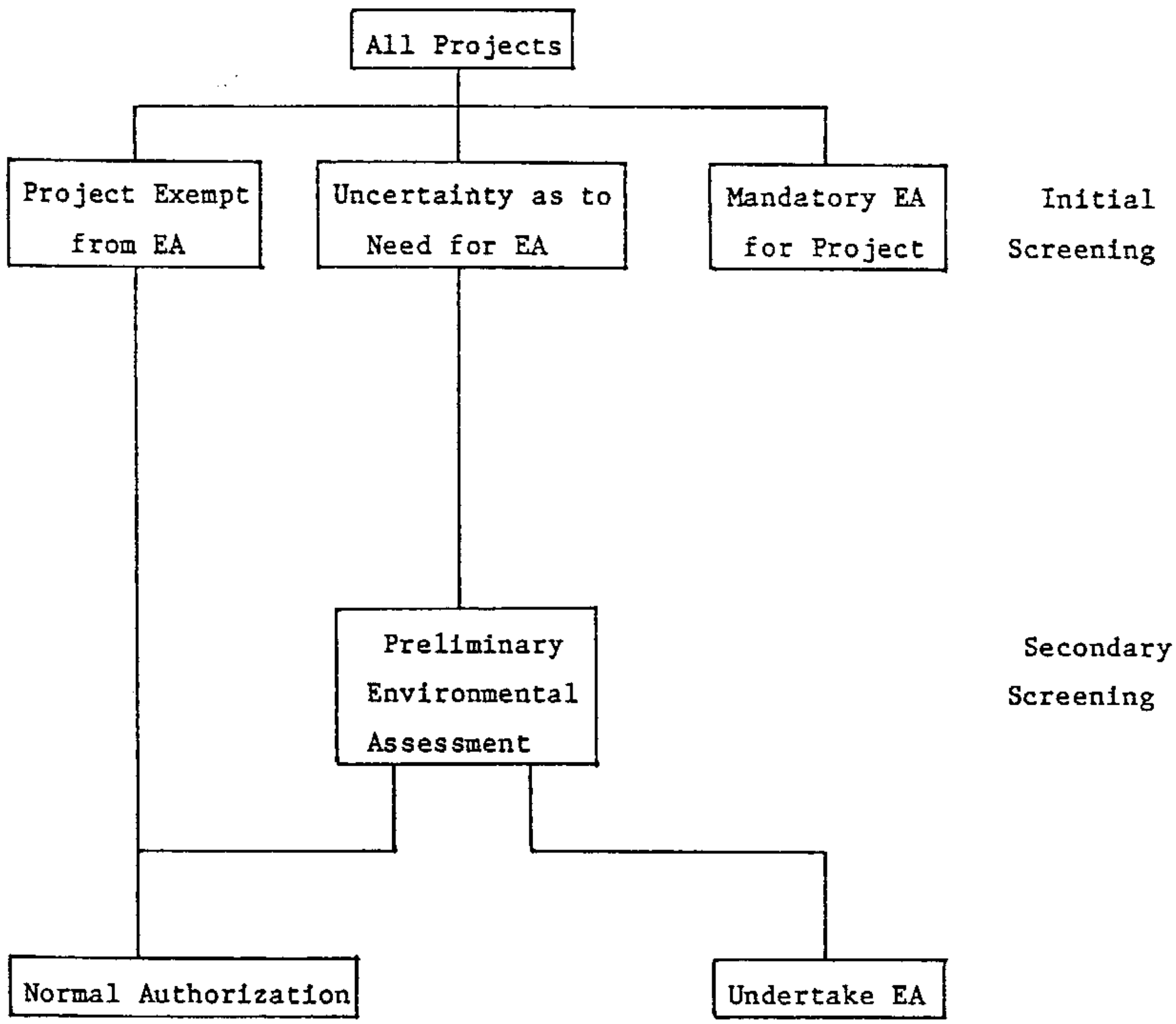
On examination of project types, it is possible to subjectively assign broad groups of projects into those of potential environmental significance and those for which their scale and nature can be adequately addressed by the normal permitting procedures. However the determination of screening is difficult. It may prove costly in terms of time and resources if projects with no significant environmental effects are screened. An alternative strategy is to use a two stage screening process as illustrated by Figure 1, in which an initial screening quickly removes those projects for which a decision on EIA is easy, while secondary screening addresses the more difficult projects.

Screening methods may be categorised according to whether they are applied in advance of project proposals, i.e. within a procedural framework, legislative or in a code of practice, or are applied on a case by case basis (see Appendix A). On the whole, procedures for EIA differ from country to country. For example, the EIA process applies to projects, programmes and activities which are initiated by federal departments or agencies in Canada. A two-step self-assessment of the likely impacts of the proposed project is the key aspect of the federal procedure. And these have the objective of ensuring that the proponent is aware of the information required by the panel, technical reviewers and the public. Finally, the public has the right of appeal to their parliamentary representative and/or the Cabinet should they disagree with a decision that has been made by the responsible ministers (Figure 2).

To be able to state in advance of a project proposal those criteria which will determine whether a project is likely to give rise to significant environmental consequences assumes more certainty about the effects, technical solutions and social judgement than is reasonable. Nevertheless, it is possible to expect the occurrence of certain types of environmental problem, although their magnitude will be dependent upon local ecological and socio-economic characteristics.

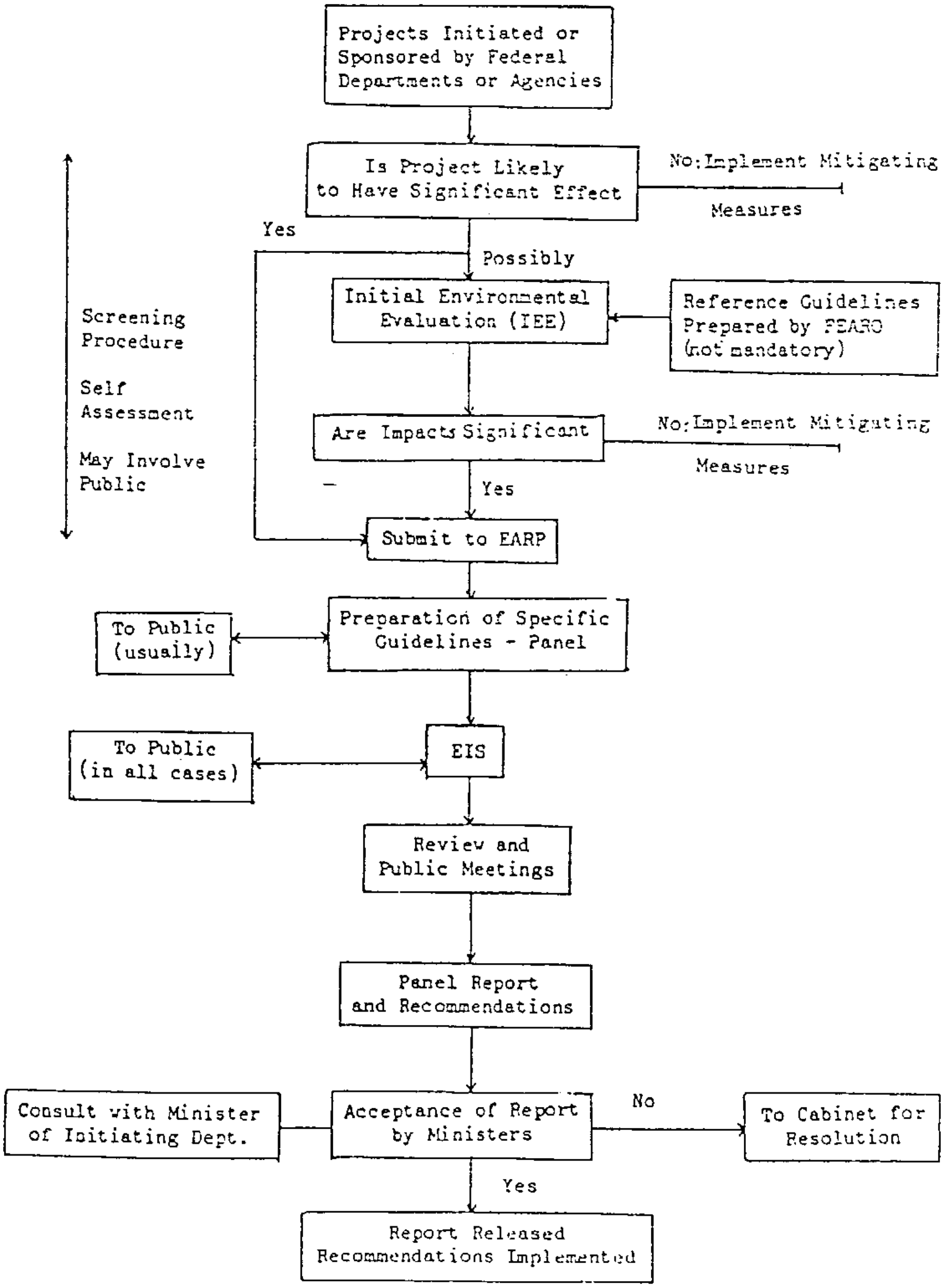
Figure 1

IDEALIZED SCREENING PROCEDURE



The United Nations Environment Programme (1980) has developed a set of guidelines for the assessment of industrial activities, in which guidelines are given on how to undertake an Initial Environmental Examination (IEE). Figure 3 indicates the various steps of a general assessment procedure within which IEE is incorporated.

Figure 2 Basic Steps in the Canadian Environmental Assessment and Review Process



LEGEND
FEARSO - Federal Environment Assessment Review Office
EARP - Environment Assessment Review Process
IEE - Initial Environment Examination

Figure 3 The UNEP Guide to Assessing Proposed Developments

PRELIMINARY ASSESSMENT PROCEDURE

Step 1 Identify Problems and Specify Alternatives
- State problems and requirements
- Nature and extent of each alternative

Step 2 Assemble Available Data
- Collect data relevant to each site and process/operation alternative
- Reference to national/international lists of priority chemicals

Step 3 Assess Staff Competence
- In-house sufficiency or external assistance required?

Step 4 Initial Impact Identification
- Review of site and construction/process alternatives in relation to the available data on the existing environment
- Identification of impacts via an "interaction" matrix

Step 5 Preliminary Assessment
- Application of Screening Tests—are there any potential adverse impacts generated by the proposed development?

NO ⇒ No Further Assessment Required

DETAILED ASSESSMENT PROCEDURE

Step 6 Preparation & Execution of Detailed Baseline & Process Studies
- Define terms of reference for further environmental assessment tasks; appoint appropriate specialists
- Execution of detailed studies—data collection & analysis

Step 7 Identification/confirmation of Potential Adverse Impacts
- On existing environment
- Initial consideration of appropriate constraints during construction and operational phases of the development

Step 8 Impact Assessment
- Assessment of impacts of the project activities in terms of their exposure, nature, reversibility, directness and cumulative and synergistic effects

Step 9 Summarize and Present Findings
- Summary sheet
- Provisions for follow-up surveillance and monitoring

As indicated earlier, a list of projects could be identified which are more likely to require an EIA. Such a list is often termed a positive list and may be compiled from a review of existing developments, identifying those projects giving rise to significant environmental concern. Alternatively, such lists adopted in other countries could be examined. Some indications of the environmental significance of projects also may be gained by an examination of the existing licensing/consent requirements. Projects which seldom give rise to adverse environmental consequences can be entered on to a negative list for which an EIA is not required. In the case where classification is difficult, an intermediate status can be created in which other screening techniques may be applied. Lists are one of the simplest approaches to screening, they are easy to use and are readily understood, although some research and extensive discussions are necessary to formulate an agreed list.

Difficulties with the list approach arise from the following factors:

(1) individual projects within a particular project type can have variations in plant design, layouts, etc. which can influence the size and form of environmental consequences;

(2) size variations of projects within the same project type will cause differences in impact magnitudes;

(3) knowledge of individual projects provides no guidance as to possible cumulative impacts;

(4) agreement on whether individual projects should be listed may be difficult.

In order to further define these intermediate status projects it is necessary to develop a series of attributes which are indicative of whether a particular project type is likely to give rise to environmental consequences. This may be achieved through the use of criteria and thresholds (Tomlinson, 1986).

As will have become apparent, each of the screening methods has different strengths and weaknesses, consequently the combined use of such methods can overcome individual weaknesses. Associated with the different screening methods are varying degrees of simplicity and ease of operation. The application of a rigorous screening method to all projects could lead to delays to the system, consequently a gradual increase in complexity in accordance with the difficulty in determining whether an EIA is needed for an individual project may prove a beneficial approach. However, as has been observed, the content and value of an IEE can vary enormously depending upon the procedures to be followed. There are some criteria, process and example of screening in some countries (see Appendix B).

5. SCOPING

Scoping is the term given to the process of developing and selecting alternatives to a proposed action and identifying the issues to be considered in an EIA. Essentially it is a procedure designed to establish the terms of reference for an EIA. Its aims are:

(1) to identify concerns and issues regarding consideration;

(2) to facilitate an efficient EIS preparation process;

(3) to enable those responsible for EIA to properly brief the study team on the alternatives and impacts to be considered at different depths of analysis;

(4) to provide an opportunity for public involvement;

(5) to save time (Tomlinson, 1984).

Scoping addresses itself to the identification of significant issues by the careful consideration of existing information relevant to the assessment as well as the organized involvement of other agencies and consultations with the public. Beanlands and Duinker (1983) have identified two categories of scoping. They are social scoping and ecological scoping. Through the application of these two scoping activities significant issues may be determined. It is important, however, to remember that the term impact attaches a value to change either positive or negative and thus related to social scoping. Change on the other hand has no intrinsic value and it is the role of social scoping to determine the issues of social importance, while it is the role of ecological scoping to determine which changes may be predicted or measured.

Scoping is not a discrete exercise as it may continue well into the planning and design phase depending on whether new issues arise for consideration. As suggested, there is no method for identifying significant issues, but rather an assemblage of interactions and discussion between the public, various agencies, and the project proponent.

Both screening and scoping activities are important stages in EIA's, although their exact boundaries are often blurred. A variety of approaches are available, each with various strengths and weaknesses. It is therefore important that appropriate methods, perhaps in combination, relevant to the needs of individual countries, are adopted.

While approaches to screening are reasonably well documented, scoping does not have any specific methods and hence only a few documents focusing upon this subject exist. Those which do tend to report the advantages which can be gained fromm scoping. In an efficient scoping procedure, the unnecessary expenditure of time and financial resources on irrelevant issues are minimized, essentially streamlining the EIA. With the aid of involvement of the public, acceptable terms of reference for the EIA can be developed, thereby reducing the likelihood of a major controversy once an EIS has been prepared. The scoping activities should also assist in the coordination of action from the various agencies involved, in theory, it is equally possible that early public involvement and inter-agency politics could cause delays to the EIA rather than minimize them. It is impossible to suggest which view may be correct, since little evidence exists for either at present. As scoping relies to a great extent upon the exchange of information and concern between the interested parties including the public, an appropriate organization is essential if difficulties are to be avoided.

While the detailed results of a scoping exercise will depend upon the specific nature of the project proposal under consideration, there are a number of themes which seem to be of common concern:

(1) The first concern of the public with respect to environmental matters is human health and safety. All other concerns are subordinate when Man's health is in jeopardy as a result of proposed development.

(2) The public will have a great concern for potential losses of important commercial species or commercially available production. The reverse would hold true regarding an increase in the numbers of undesirable species.

(3) Society can be expected to place a high priority on species of major recreational or aesthetic importance, whether or not they support commercial activities of any consequence.

(4) Specific interest groups will usually gain broad public support in their concern for rare or endangered species on the basis that mankind has special custodial responsibilities regarding their preservation.

(5) Next to the direct impacts on valued species, the public can normally be expected to be concerned over the loss of habitat as it represents a foreclosure on future production, whether or not the habitat is currently being utilized to capacity.

(6) In all of the above cases, public concern will be heightened in relation to perceived imbalances between supply and demand of species or habitats within a local, regional or national context.

The scoping of the project is best done after the engineering and economic feasibility studies have been completed, when a clear picture of the viable alternatives is available.

6. THE PROJECT DECISION NETWORK

In a very general sense, there are four critical stages in the sequence of project-related decisions, with different responsibilities assigned for each. The following is a summary:

Decision	Responsibilities
1. A primary decision on whether the project will be undertaken - an "approval in principal".	Ostensibly the decision is taken by the project proponent based on economic criteria; actually governments often decision indirectly through the provision of incentive grants, loan guarantees, licenses, permits, etc.
2. A decision on where the project will be built - sometimes within a national or regional context.	Normally the responsibility of the proponent, but often greatly influenced by government policies respecting political, economic and social development strategies.
3. A decision on how the project is to be built - a consideration of basic design options.	Proponent's responsibility, but influenced by standards and limits set by government agencies through legislation or policies.
4. A decision on how the project will be operated - to some extent this depends on the degree of flexibility inherent in the design.	

The nature and extent of baseline information required at each of these decision points is quite different, yet equally important from an environment perspective. Thus, in taking the initial project approval step, the proponent would need information on environmental legislation and policies which could seriously affect the economic viability of the project. If the decision is made to proceed with the project, the choice of a site may reflect concern over various environmental sensitivities, (e.g. endangered species) or resource use conflicts, some of which may be directly linked to the resource management responsibilities of government agencies. In considering the design and operation of a project, the proponent needs specific information on the resources potentially at risk in the selected site and on the relationship between projected effects and standards set by regulations or public acceptability.

In reality, these decisions likely would not be taken in the simplified sequence suggested above. Nevertheless, the point is that the information needs are quite different at various stages in the planning process. It should also be clear that limited information on the biological and physical characteristics of a development site will not ensure an adequate consideration of environmental concerns in the development planning process.

7. MONITORING

The purpose of monitoring is to consider the current status of and future progress in environmental monitoring, with special reference to EIA. In this context, a broad view of EIA is taken, including plans, development actions, projects, pollutants and products.

A useful general division of environmental monitoring programmes is into those that measure targets which may show changes in distribution or performance and those that measure factors which may cause changes in the environment (Somers, 1981). Factor monitoring is largely concerned with measuring levels, and may be carried out:

(1) at source (emission monitoring);
(2) at points in the environment (environmental monitoring);
(3) at the point of exposure (exposure monitoring);
(4) within the target (internal monitoring).

And target monitoring can occur at various levels of organization:

(1) within tissues of organism;
(2) at the level of the individual organism;
(3) level of species population;
(4) sample of ecosystem;
(5) total ecosystem.

Monitoring can be subdivided into three main types in terms of its importance for EIA. These are baseline monitoring, impact monitoring, and emission monitoring. For auditing to be successful, it is essential that baseline/impact monitoring be undertaken. Only by integrating both types of monitoring through impact identification and prediction can maximum benefit be achieved. Emission monitoring has an important part to play in project management, but is not so important for EIA. It is impact and baseline monitoring which are the basis for successful EIA.

Those implementing the EIA are faced with the problem of identifying likely environmental/social impacts. To try and narrow the focus of their inquiry they have conducted numerous meetings with various government departments, scientific institutions and representatives of nearby communities whose interests would be affected by the project. The aim of these meetings has been to determine which impacts are considered the most important. It has been decided to consider impacts over a period of thirty years and to concentrate on the section of the nearby coastal shelf, all agricultural land within a 30km radius of the proposed site, and on selected charcteristics of a village which is located next to the site, etc. All factors of environmental impacts must be considered.

Monitoring is an important tool in the process of EIA and in any follow up assessment and control programmes. It should be recognized that there is scarce experience in the application of monitoring in EIA. Somewhat wider experience exists in monitoring programmes for selected pollutants on the local or national scale, but even here monitoring has been predominantly used in support of regulation. "Descriptive" monitoring, which supports the identification and estimation of risks or impacts, is at a fairly early stage of development and substantial effects are required to ensure progress in this area.

8. ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL IMPACT STATEMENT

EIA is a mechanism which aids the efficient use of natural and human resources which has proved valuable to both those promoting developments and those responsible for their authorization. EIA may reduce costs and the time taken to reach a decision by ensuring that subjectivity and duplication of effort are minimized, as well as identifying and attempting to quantify the primary and secondary consequences which might necessitate the introduction of expensive pollution control equipment, compensation or other costs at a later date. And EIA therefore can be used not only to investigate and avoid harmful impacts but also to increase likely benefits.

EIA is not a universal panacea which will cure all environmental ills. It may have a restricted use in certain areas of decision-making where there are a number of difficulties regarding the application of EIA. So an EIA must consider the following subjects:

(1) impact identification;
(2) impact measurement;
(3) impact interpretation;
(4) impact communication to information users, including the public. Recently the importance of monitoring a project has been emphasized.

EIS refers to the document which details the results of the research and forwards recommendations to the decision-maker. An EIS is the substantial technical activity for which the EIS is a necessary reporting device. An EIS must cover the following topics:

(1) the environmental impact of the proposed action;
(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;
(3) alternatives to the proposed action;
(4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity;

(5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

From the aforesaid topics that an EIS should contain the following sections:

(1) brief description of the proposed development;
(2) brief description of the local area;
(3) potential impact;
(4) mitigating actions;
(5) projections of the effects of existing trends in the locality;
(6) consultants and objections.

In most of the rest of the world, the interpretation of EIA and EIS is very different. Generally, EIA is used to include the technical aspects of the environmental study, including data gathering, prediction of impacts, comparison of alternatives and the framing of recommendations. EIS (if the term is used at all) refers to the document which summarizes the results of the study, and forwards recommendations to the decision-maker. In marked contrast to the U.S. definitions, the EIA in this context is the substantial technical activity for which the EIS is a necessary reporting device.

CHAPTER 4

THE METHODS OF ENVIRONMENTAL IMPACT ASSESSMENT

The differences between methods and techniques must be stressed. Techniques are standardized means of describing and measuring specific attributes of the environment and for predicting changes which may occur. Methods aid the identification of impacts and the organization of results, while techniques provide the results. Methods and techniques are linked in impact analysis. First, impacts are identified using a method. Secondly, techniques are used to predict likely changes. Finally, data obtained using techniques can be organized, presented and, in some cases, evaluated according to the guidelines of a particular method. Techniques are not considered in this bibliography.

Most impact analysis methods can be divided into the following seven types:

(1) ad hoc methods
(2) checklists
(3) matrices
(4) overlays
(5) networks
(6) quantitative or index methods
(7) models

A brief description of the main characteristics of each type. However, several of the methods included in the bibliography cannot be classified into one of these groups.

1. AD HOC METHODS

This is the most common approach to impact assessment. Basically, ad hoc methods indicate broad areas of likely impacts by listing composite environmental parameters (for example flora and fauna) likely to be affected by a development. They are usually developed for a particular EIS by those conducting the assessment. Details of the methods are rarely published separately as they are described in the individual EIS to which they relate. Consequently, some of the descriptions are not readily available, particularly outside the country of origin. The categories of impact used in these methods are so broad that there is little utility in transferring the method to a separate assessment and therefore no ad hoc methods are included in this bibliography.

Ad hoc methods are needed to canvas opinions of committee members, but they tend to be subjective in nature. This major defect in the analysis process is short of consistency, because the different specialists have the different standard and sometimes they have have bias against the project.

2. CHECKLISTS

Checklists are an advance on ad hoc methods in that they list environmental, social and economic components in more detail. Also, some checklists identify impacts resulting from certain types of development. Both forms of checklists serve as a guide to the identification and consideration of a wide range of impacts. And this is used often by one of the approaches at present.

Checklist methodologies range from listings of environment factors to highly structural approaches involving importance weightings for factors and the application of scaling techniques for the impacts of each alternative on each factor. The term "checklist" covers a variety of methods having widely varying characteristics and degrees of complexity. There are five types which can be identified:

(1) Simple checklist
(2) Questionnaire checklist
(3) Descriptive checklist
(4) Scaling checklist or ranking checklist

(5) Weighting-scaling checklist

Checklist methodologies are frequently used in EISs. Checklists of environmental components are limited as they tend to be either checklists of development actions or environmental components. This was perceived to be a weakness by many involved in EIA. Consequently, these two types of lists have been brought together to form a two-dimensional matrix to aid impact identification. In Appendix C there are some various checklists.

3. MATRICES

Usually one dimension of a matrix is a list of environmental, social and economic factors likely to be affected by a proposal. The other dimension is a list of actions associated with development. These relate to both the construction and operational phases. Impacts are identified by making cells representing a likely impact resulting from the interaction of a facet of the development with an environmental feature. With some matrices quantitative representations of impact importance and magnitude are inserted in individual cells. This is very useful in deciding the environmental impacts.

This matrix can be used to measure and interpret impacts by describing impacts in terms of magnitude and importance on a common 1-10 scale, where 1 is least magnitude or importance and 10 is the greatest. In addition, it is possible to indicate whether impacts are positive or negative by incorporating a plus (+) or minus (-) sign respectively in the appropriate cell. Assigning scores for magnitude and importance to all identified aspects depends on the subjective views of those assessing a proposal. A completed matrix would consist of a number of cells, usually not more than 25-50 cells, containing two numerical scores and, in some case, a plus sign. The final matrix, therefore, contains a compact visual summary of all impacts identified and of some of their characteristics.

Despite this demonstration of its usefulness, this matrix and other variations exhibit a serious theoretical and practical limitation which deserves scrutiny. These matrices focus on direct impacts between two items - the impact-causing factor and a target enviromental component affected by the impact-causing factor. It is necessary to consider the next environmental component in the vertical list in a similar manner. Thus, impacts are identified by a series of discrete, two-way linkages between development activities and components. The result is the identification of initial direct impacts. Matrices have the same disadvantages as checklists - they compartmentalize the environment into separate items. Specific environmental features can be affected by a number of different impacts through different pathways. This cumulative aspect of impacts is not dealt with easily by using these types of methods. In Appendix D there are some various matrices.

Generally, checklists and matrices have the same strengths and weaknesses. They are useful for the identification of direct first-order impacts, which ensures that once identified they are not then overlooked in the analysis. It has been shown that checklists, with the aid of additional guidance, can be used to undertake most of the tasks required in EIA. This is achieved at the expense of simplicity and, one suspects, public comprehension. Matrices do not achieve generally the same complexity as checklists, and do relate project action to environmental features in an easily-understood format. Evidence from EISs shows that simple checklists and matrices are often used. The more complex scaling-weighting checklists are used, but much less frequently. This would seem to indicate the relative merits of the two methods, at least in terms of their actual use. Both methods have similar failings in that they cannot easily take account of indirect impacts. The division of the environment into discrete components which are examined in turn for project-induced change, inevitably compartmentalizes the environment. This creates a false impression of the nature of environmental systems protraying simplicity rather than the existing complexity. However, before identifying indirect impacts, it is necessary to identify all direct impacts; consequently, these methods fulfil a useful role. Perhaps the most useful of the two is the interaction matrix.

4. OVERLAYS

The use of overlay maps has generally been restricted to route or site selection and few examples of their use in environmental impact analysis have been reported. A series of maps, each containing data on environmental, social and economic variables, is prepared. By overlaying these maps, areas possessing a preferred combination of these variables can be identified. Computers can be used not only to store comprehensive data on a local area, but also to provide composite maps incorporating a large number of characteristics of the proposed developments and the surrounding area. This enables those carrying out assessments or route selection to introduce impact weightings into assessment. The computer can perform the complex mathematical operation required when a large number of variables are weighted.

A representation of the aggregate impact of a project (impacts on all selected environmental features) can be obtained by overlaying each colour-coded transparency on the base map. The aggregate impact on different areas is shown by the relative intensity of the shading. This simple method of visually representing individual impacts and combinations of impacts has a number of advantages. The results from application of the overlay method are easily understood. Most important, it is an excellent method of showing the spatial distribution of impacts. With this information, it is relatively easy to relate individual impacts and the total aggregate impact of a project to human population who might inhibit the localities affected. This allows the distributiion of beneficial and adverse impacts to be determined.

Few methods exist to assist the identification of alternatives, those which do, principally relate to the identification of alternative sites or routes. The overlay method, originally developed for a planning study of the town of Billerica, Massachusetts (Manning, 1913), has become established as a method for transportation alternative route selection, and has also been used to identify alternative sites. At the simplest level the key restraining factors of a development, such as engineering factors, the existence of areas of ecological or landscape value are mapped on a transparent overlay sheet. Alternative sites or routes are then identified by placing one map on top of another. Clear areas then represent potential alternatives (see Figure 1).

At this simple level, difficulties are encountered in dealing with more than about a dozen overlays. In addition, it is difficult to accommodate the concept of varying degrees of restraint, although to some degree, colour or tone intensity may be used. It is with the application of computerized systems that the greatest opportunities lie in relation to the identification of alternative sites or routes.

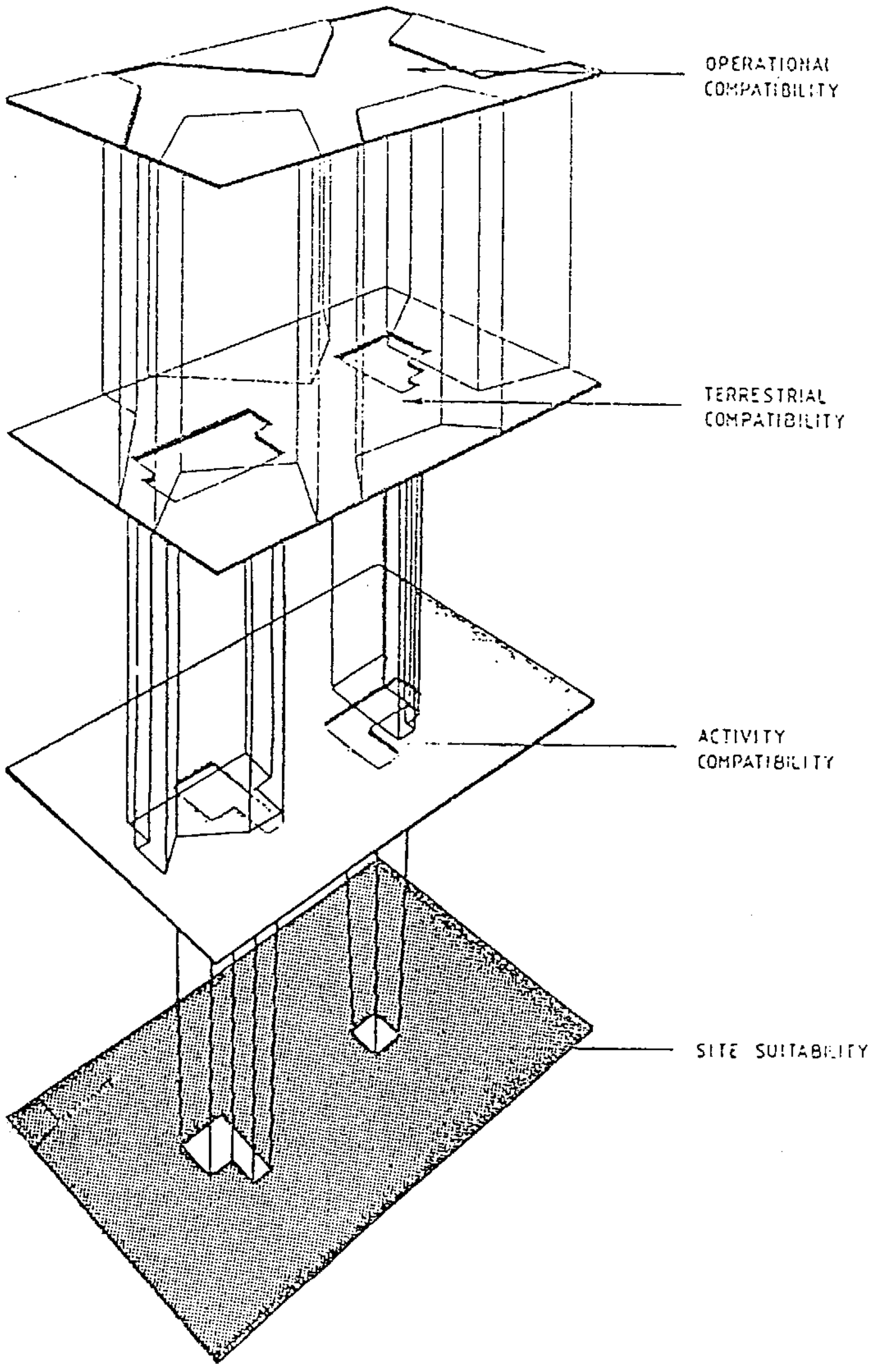
Two main problems arise with this approach. First, access to data and a computer, although increasing availability of micro-computers will reduce the latter constraint. The second problem relates to the quality of the data in terms of boundary definition and heterogenity within the grid units used to coordinate the data. But the experience with the overlay method indicates that it is most useful in assessing alternative routes for linear developments, such as pipelines, highways, transmission lines and new towns, etc. Composite displays enable the impacts of routes to be assessed and also can show routes which will have least environmental impact. Therefore, overlays are a very useful search mechanism.

5. NETWORKS

Networks are based on known linkages within systems. Thus, actions associated with a project can be related to both direct and indirect impacts. For example, impacts on one environmental factor may affect another environmental or socio-economic factor and such interactions are identified and listed on a network diagram. This diagram, subsequently, acts as a guide to impact identification and the presentation of results.

Networks refer to those methodologies which attempt to integrate impact causes and consequences through identifying interrelationships between causal actions and the impacted environmental factors

Figure 1 Overlay Mapping (From: Leonard and Partners, 1971)



Courtesy of Leonard and Partners.

including those representing secondary and tertiary effects. Network analyses are particularly useful for identifying anticipated impacts associated with potential projects. Networks can also aid in organizing the discussion of anticipated project impacts. Network displays are useful in communicating information about an environmental impact study to an interested public. The primary limitation of the network approach is the minimal information provided on the technical aspects of impact prediction, and the means for comparatively evaluating the impacts of alternatives.

A linear network display for an impoundment project is shown in Figure 2 (U.S. Conservation Services, 1977); Figure 3 shows a network for a dredging project (Sorensen, 1971). In both networks, the initiating action is shown on the left with various other causal actions and impacted factors shown in the phases of the network.

6. QUANTITATIVE OR INDEX METHODS

These methods are based on a list of factors thought to be relevant to a particular proposal and which are differentially weighted for importance. Likely impacts are identified and assessed. Impact results are transformed into a common measurement unit, for example, a score on a scale of "environmental quality". The scores and the factor weightings are multiplied and the resulting scores added to provide an aggregate impact score. By this means beneficial and harmful impacts can be summed and total scores compared. Alternatively, all impact scores for two alternative sites can be aggregated and compared. The alternative giving the "best" score is the preferred option.

The most important technical activity in an environmental impact study is the scientific prediction of the effects of project construction and operation. Prediction of the impacts of water resources projects can be based on (1) a qualitative approach which relies on general knowledge of the impacts of similar projects or specific results of comprehensive studies of similar projects; (2) a qualitative approach based on the use of simple mass balance and environmental dilution calculations; and (3) a qualitative approach based on the use of mathematical or conceptual models for multiple environmental factors. A given environmental impact study will probably involve all three approaches to some degree.

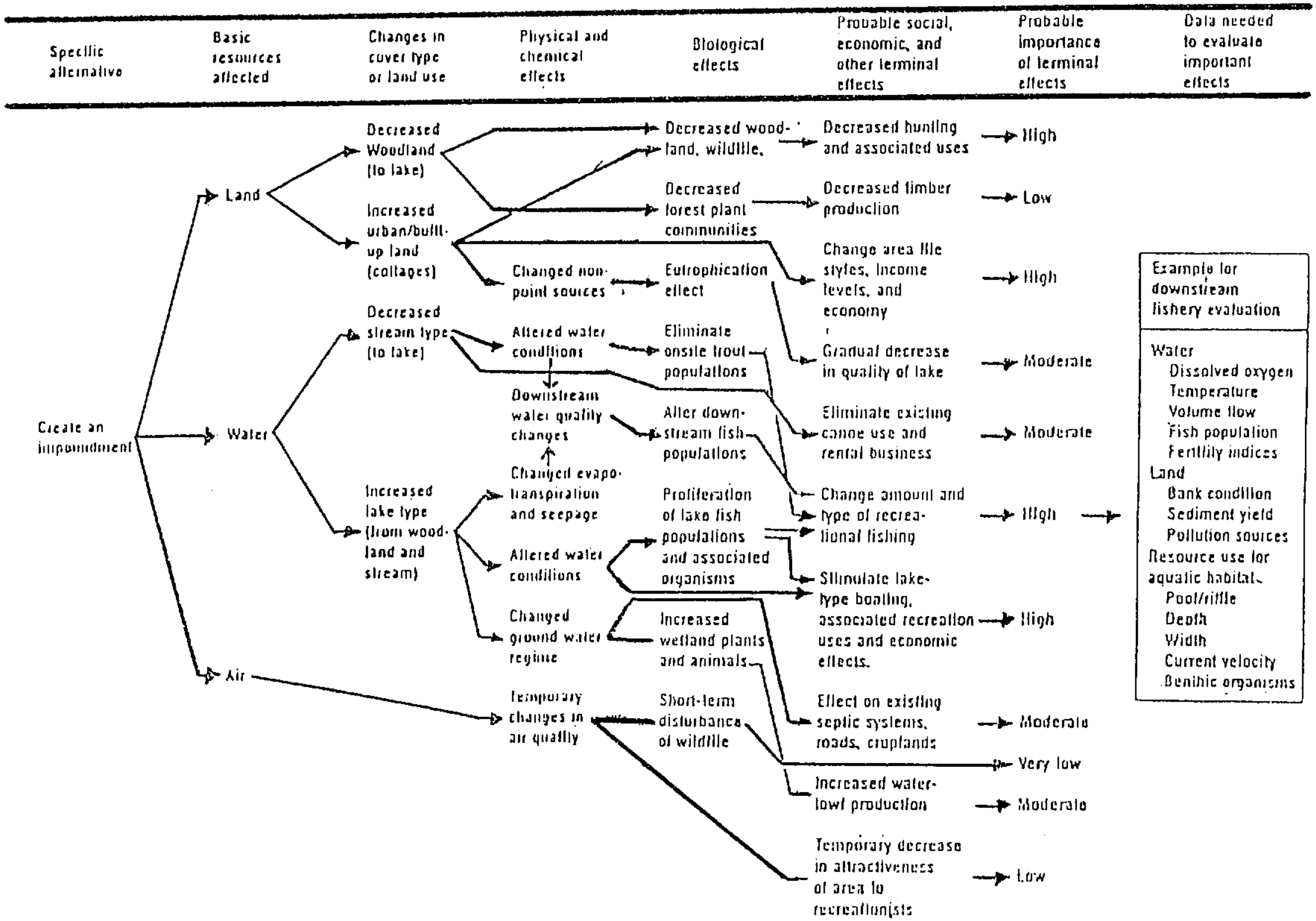
7. MODELS

Recently, considerable attention has focused on the use of systems modelling in impact analysis. However, the development of models for assessing particular projects is at an early stage. There are few examples of models utilized in the assessment of the wide variety of impacts resulting from most major projects. Usually, only a particular impact of great significance of a nuclear power station on a salmon population. It may be some time before a modelling approach can cope with a wide diversity of impacts. Modelling is being used in the development and assessment of alternative strategies for resource management, but again only a few key issues are dealt with. However, in the future the use of models in large-scale resource management problems may be the most fruitful application of this method.

8. SELECTION OF METHODOLOGY

As indicated earlier, there is no "universal" methodology for meeting the environmental impact assessment needs for all project types in all environmental settings. Accordingly, selection of an existing methodology or portions thereof, or the development of a new methodology, is required in the conducting of an environmetnal impact study. A reasonable early selection should focus on methodologies developed for project types similar to the potential project being evaluated. In other words, if the enviromental impact study is to be conducted for a highway project, methodologies which have been developed for usage on highway projects should be reviewed. The selection process can be aided by consideration of the following desirable characteristics of an impact assessment methodology or portions thereof.

An environmental impact methodology should be comprehensive in that it igure 2 An Example of a Network Diagram for Analysing Probable Environmental Impacts. (U.S. Soil Conservation Service, 1977)



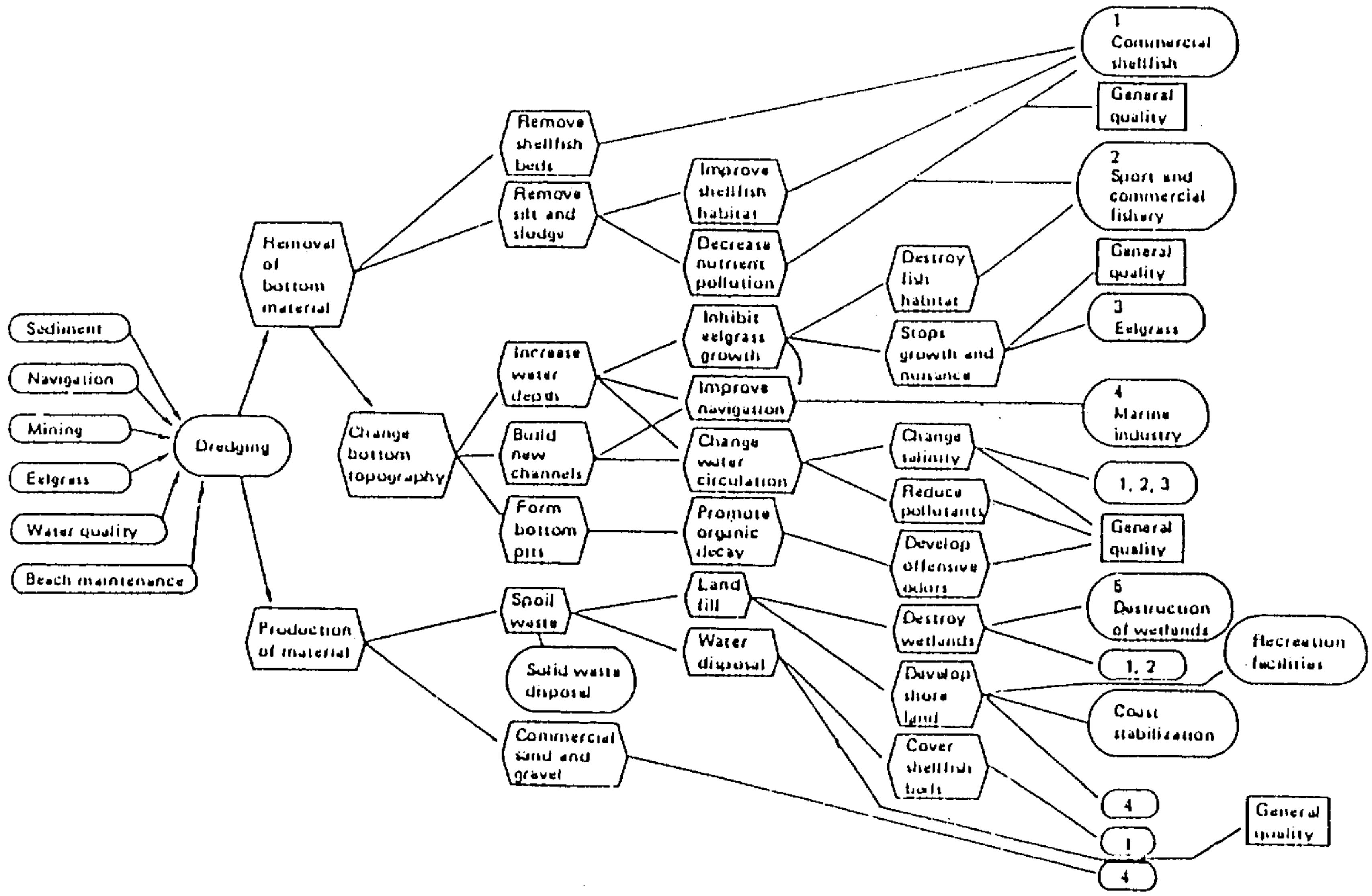


Figure 3 Network Diagram for Dredging Project (Sorenson, 1971)

addresses appropriate environmental factors and impacts related to the project type being evaluated. Attention should be given to both beneficial as well as detrimental impacts. In addition, methodologies should encourage the highlighting of key environmental factors and impacts, with this concept being analogous to "red flagging" of significant issues. Methodologies should also be responsive to the legal and policy requirements of the governmental entity related to the impact sutdy. For example, an EIS for an airport development project must address all land use, noise, and air pollution regulatory issues related to airport construction and operation.

Enviromental impact methodologies should be dynamic in terms of included environmental factors and technologies used for impact identification, prediction and assessment. Since the environmental impact assessment field is less than two decades old, rapid changes are occurring in study technology; accordingly, adaptation of methodologies for inclusion of new information is appropriate. Methodologies should also be adaptable to the unique environmental characteristics of the study area. The importance of environmental factors from one geographic location to another should be considered, and the flexibility provided to adapt the methodology to specific environmental settings.

Another desirable characteristic is that the methodology should stress objective, quantitative analyses rather than purely subjective, qualitative approaches. It is recognized that it may be impossible to make quantitative calculations for many environmental impacts; however, the orientation of the methodology should be toward the quantitative approach. It is also recognized that even with quantitative approaches there is the necessity for subjective evaluation of objective information. The methodology should provide guidance on the value judgments and subjective evaluations associated with impact interpretation.

Finally, the selected environmental impact methodology should be implementable in terms of manpower, funding and data and time requirements. Over-sophisticated approaches may be scientifically valid, but not particularly usable within the constraints of a

Characteristics of the Existing Situation	Climate	Land uses	Water quality	Landscape quality	Ecological characteristics	Population density	Tourism	Employment structure	Unemployment	Local economy	Traffic	Water supply	Sewerage	Finance	Education	Health service facilities	Housing	Emergency Services	Community structure	Culture
OPERATIONAL PHASE																				
Hazard		×																×		
Solid waste disposal			×	×	×															
Aqueous discharges			×	×									×							
Dust and particulates																				
Odours										×										
Gaseous emissions		×		×													×			
Vibration																	×			
Noise																×	×			
Transport of products											×									
Transport of employees											×									
Transport of raw materials											×									
Employment								×	×											
Local expenditure										×										
Water demand												×								
Severance		×																		
Structures				×																
Immigration						×								×	×	×	×	×	×	×
CONSTRUCTION PHASE																				
Hazard																		×		
Solid waste disposal				×																
Aqueous discharges			×	×																
Odours																				
Gaseous emissions																				
Noise															×		×			
Vibration																	×			
Water demand												×								
Local expenditure										×										
Employment								×	×											
Dust and particulates			×																	
Site preparation			×	×																
Transport of employees											×									
Transport of raw materials											×									
Severance		×																		
Immigration														×	×	×	×	×	×	×

Figure 4 Example of an Impact Assessment Matrix

specific environmental impact study. Trade-offs will be required in the process of selecting between simpler methodologies which are implementable and more complex approaches which require extensive time and effort yielding significantly improved information for impact assessment.

However, numerous environmental impact assessment methodologies have been developed within the last decade. Methodologies can be useful in identifying anticipated impacts, determining appropriate environmental factors for inclusion in a description of the affected environment, providing information on prediction and assessment of specific impacts, and allowing for systematic evaluation of alternatives and the selection of a proposed action. Methodologies can be categorized into interaction matrices, networks and checklists. Interaction matrices are of greatest value in impact identification and display of comparative information on alternatives. Checklist approaches range from simple listings of environmental factors to complex methods involving assignment of relative importance weights to environmental factors and impact scaling for each of a series of alternatives on the environmental factors. Checklist approaches are useful for identifying environmental factors and providing information on impact prediction and assessment. Weighting-scaling checklists are particularly valuable for displaying trade-offs between alternatives and their associated environmental impacts, thus they are useful in the selection of a proposed action. Network methodologies provide useful information for impact identification as well as valuable approaches for communicating information on interrelationship between environmental factors and anticipated project impacts. There is no single and optimal approach to evaluate environmental impacts in general. Therefore it may be a complex task to decide which method is the most suitable for any given situation.

CHAPTER 5

THE DESIGN OF AN ENVIIRONMENTAL IMPACT ASSESSMENT SYSTEM FOR TAIWAN

1. PRELIMINARY PHASE

Environmental Impact Assessment (EIA) is a new and dynamic subject in Taiwan and few people are familiar with its procedure. The executive situation of EIA was introduced in Chapter 2, in relation to Taiwan. Only certain major economic development and construction projects are used for the demonstration of environmental impact assessment. This enables personnel from every organization in charge of the programme, to consider the process from planning through to approval, the question of simultaneous protection and development, the prevention of public nuisance and environmental degradation and the maintenance of the environment for the people.

The procedure of environmental impact assessment is insufficiently detailed and the organization in charge of environmental protection should only distribute the assessment report to the relevant organizations and the development plan approving organization. The organization in charge of environmental protection is not empowered to control the development. At the same time, the relevant organizations and the development plan approving organization are both lacking expertise in environmental impact assessment. For this reason, it is necessary to establish a series of systems for the developers, assessors and decision-makers. A standard approach is clearly advantageous. This chapter presents such an approach, adapted from those of a variety of foreign countries (see Figure 1).

There are many different types of development administered by different governments. National developmments are administered by central governments whereas local developments are overseen by provincial/municipal governments. In each case, different departments are responsible for different developments (see Figure 2).

For each development project a draft detailed description of the development methods (engineering, building structure, etc.) and the information of natural and cultural resources (land-use, geology, climate, economic, social, etc.) are proposed by the developer. The developer must send a copy to the organization in charge of the development plan (for example, the developer of a motorway project should send a copy to the Ministry of Communications investigation). If the method and information relevant to the project is not detailed enough or is inaccurate, it will be rejected. Otherwise, it will proceed to the next phase.

2. SCREENING PROCEDURE PHASE

Each development project will fall into one of three different categories which may be identified as a result of screening. There are:

(1) a project clearly requiring an EIA (that is mandatory EIA for the project);

(2) a project exempt from EIA;

(3) a project for which the need for an EIA is unclear.

The procedure applies to all development projects initiated within public sectors that should be studied briefly in order to determine whether an environmental assessment is required. According to the particular values, capital cost or special site, etc. the decision to undertake an EIA will be taken. But all the major economical construction plan, natural resources development plan, large scale factory or environmental pollution industry etc. must be submit an EIA. Figure 3 illustrates some mandatory projects.

If the project wdoes not require an EIA, the developer would apply for planning permission. But if an accident occurs during the development, for example, collapse, pollution, etc. the developer must stop the project until the development plan approving organization examines with the relevant organizations and agrees to the continuation of the development.

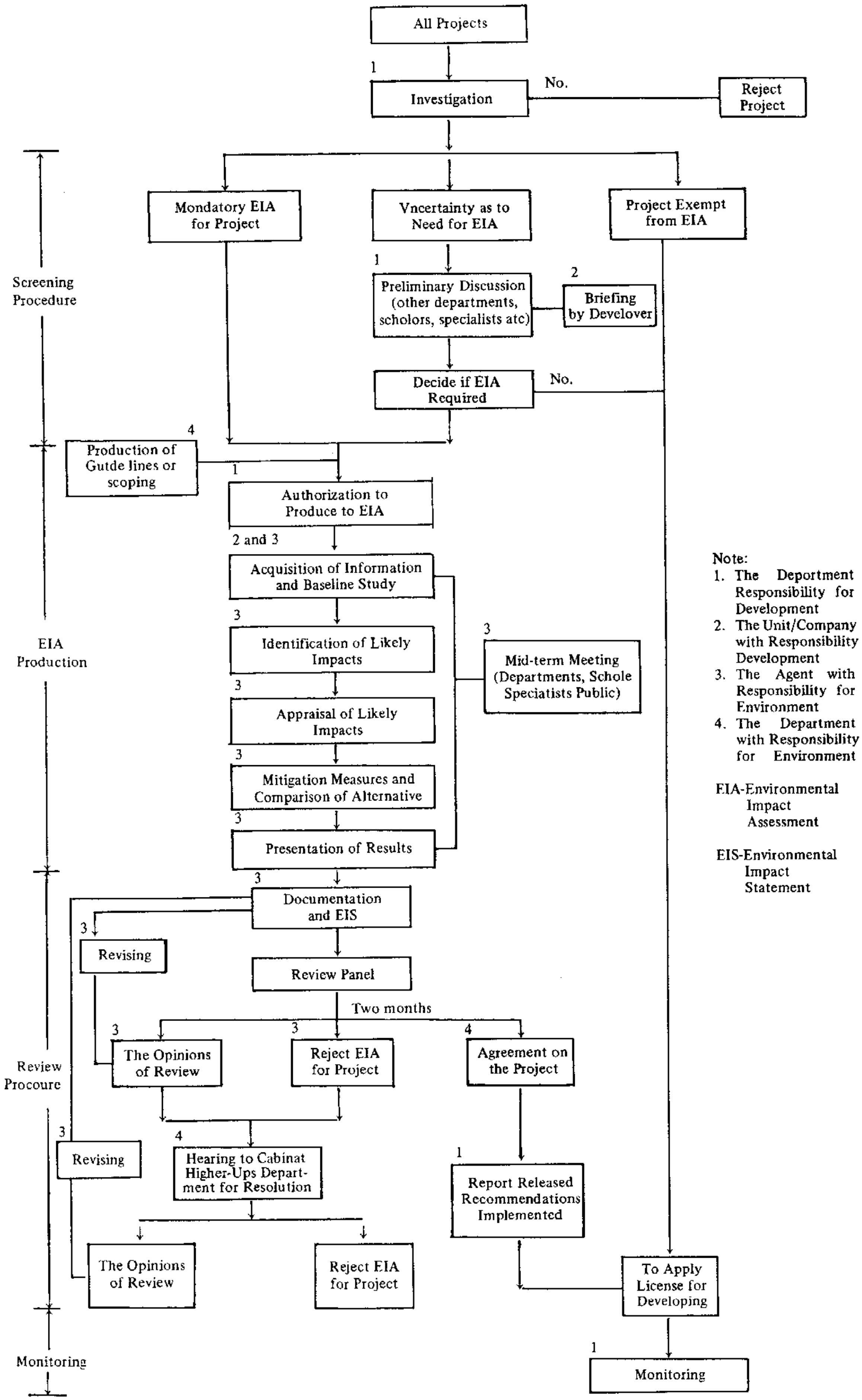

All Projects
1
Investigation
No.
Reject Project
Mondatory EIA for Project
Vncertainty as to Need for EIA
Project Exempt from EIA
Screening Procedure
1
Preliminary Discussion (other departments, scholors, specialists atc)
2
Briefing by Develover
Decide if EIA Required
No.
4
Production of Gutde lines or scoping
1
Authorization to Produce to EIA
2 and 3
Acquisition of Information and Baseline Study
3
Identification of Likely Impacts
3
Appraisal of Likely Impacts
3
Mitigation Measures and Comparison of Alternative
3
Presentation of Results
3
Mid-term Meeting (Departments, Schole Speciatists Public)
EIA Production
3
Documentation and EIS
3
Revising
Review Panel
Two months
3
The Opinions of Review
3
Reject EIA for Project
4
Agreement on the Project
Review Procoure
3
Revising
4
Hearing to Cabinat Higher-Ups Depart-ment for Resolution
1
Report Released Recommendations Implemented
The Opinions of Review
Reject EIA for Project
To Apply License for Developing
1
Monitoring
Monitoring
Note:
1. The Deportment Responsibility for Development
2. The Unit/Company with Responsibility Development
3. The Agent with Responsibility for Environment
4. The Department with Responsibility for Environment
EIA-Environmental Impact Assessment
EIS-Environmental Impact Statement

Figure 2

THE RELATIONS BETWEEN THE GOVERNMENTS AND THE TYPES OF DEVELOPMENT

Departments / Items	Central Government	Provincial Government	Special Municipality Government (Taipei and Kaohsiung)
New town development; building; urban planning development; population and manpower, etc.	Ministry of Interior	Department of Reconstruction	Bureau of Reconstruction
Cemeteries	Ministry of Interior	Department of Civil Affairs	Bureau of Social Affairs
Industrial estate development; prospect mineral deposits; mining; take soil & stone; hydraulic engineering; water resources development; etc.	Ministry of Interior	Department of Reconstruction	Bureau of Reconstruction
Road development; tourism and recreation development; etc.	Ministry of Communications	Office of Communications	Bureau of Reconstruction
Air pollution; water pollution; solid waste; garbage treatment; noise; radiation; hazardous substances; etc.	Environmental Protection Administration	Environmental Protection	Environmental Protection
Breakwater and levees; fish and wildlife; water and soil conservation; forestry; agriculture and land-use; etc.	Council of Agriculture	Department of Reconstruction and Department of Agriculture and Forestry	Bureau of Reconstruction
Etc.			

Figure 3

NOTIFICATION OF TYPE AND SIZE OF PROJECT OR ACTIVITY
REQUIRING EIA REPORTS
AND THE DEPARTMENT WITH RESPONSIBILITY FOR DEVELOPMENT

Type of Project or Activity	Size	Central Government	Provincial/ Special Municipality Government
1. Motorway	any	√	
2. Airport	any	√	
3. Mass transit system and expressway	any	√	
4. Nuclear power plant	any	√	
5. Thermal power plant	any	√	
6. Hydraulic power plant	any	√	
7. Mining	any	√	
8. Industrial estate development	any	√	
9. Oil refinery	any	√	
10. Natural gas separation or processing	any	√	
11. Heavy industry	any	√	
12. Cement industry	any	√	
13. Chemical industry	any	√	
14. Petrochemical industry	any	√	

15.	Pulp industry	1. Production capacity greater than 50 tons/day	√	
		2. Others		√
16.	Chlor-alkaline industry	1. Production capacity of each or combined product greater than 50 tons/day	√	
		2. Others		√
17.	Commercial port, harbour, or fishing harbour	1. With capacity for vessels of greater than 1000 ton-gross	√	
		2. Others		√
18.	Irrigation	1. Irrigation area greater than 5,000 hectares	√	
		2. Others (between 5,000 & 1,000 hectares		√
19.	Dam or Reservoir	1. Storage volume greater than 1000,000,000 m^3 or storage surface area greater than 15 km^2	√	
		2. Others (between 15 & 10 km^2)		√
20.	Town or countryside	1. Area greater than 10 hectares or greater than 1,000 houses	√	
		2. Others (between 10 & 5 hectares or 1,000-500 houses)		√
21.	New town development	1. Area greater than 20 hectares	√	
		2. Others (between 20 & 10 hectares)		√
22.	Fell the forest	1. Area greater than 10 hectares or fell greater than 1,000 trees	√	
		2. Others (between 10 & 5 hectares or 1,000-500 trees)		√
23.	Highway or road	1. Length greater than 100km or investment over NT$1,000,000,000	√	

		2. Others (between 100 & 50 km or NT$1,000,000,000 - 5,000,000		√
24.	Breakwaters or levees	1. Length greater than 100 km	√	
		2. Others (between 100 & 50 km)		√
25.	Significant land reform	1. Area greater than 10 hectares	√	
		2. Others (between 10 & 5 hectares)		√
26.	Garbage treatment	1. Area greater than 10 hectares	√	
		2. Others (between 10 & 5 hectares)		√
27.	Cemeteries	1. Area greater than 10 hectares	√	
		2. Others (between 10 & 5 hectares)		√
28.	Any type of project in the following location:			
(1)	National park	any	√	
(2)	National protected area	any	√	
(3)	Environmentally sensitive area	any	√	
(4)	Slopeland	According to the Statute on the Conservation & Use of Slopeland Resoures	√	(or √)
(5)	Others in the laws		√	
29.	Policy option			
(1)	Change the land use	(1) Area greater than 20 hectares	√	
		(2) Others (between 20 & 10 hectares)		√
(2)	Import new chemical drugs; use pesticides, fertilizers; flora and fauna species, etc.	any	√	
(3)	Others		√	(or √)
30.	Others		√	(or √)

If the project is not very clear as to the necessity for an EIA, the development plan approving organization would invite a preliminary discussion with the relevant organizations, academics and specialists, then they would go to the development site to review the requirement. The developer would prepare briefing information about the development. The development plan approving organization will then decide whether or not to undertake an EIA. If the project does not require an EIA, the developer would apply for a planning license. Otherwise, it will proceed to the next phase.

But before the next phase, there are four criteria which should be applied:

(1) Magnitude: Magnitude refers to the level of change that will be experienced. A change of great magnitude would be, for example, the doubling of a town's population. In other words, the measured level of the environmental parameter will be twice what it was before.

(2) Extent: The extent of an impact refers to the area which will be affected. The pollution of a whole bay would be considered extensive, whereas the pollution of a localized area of the bay would not be as great.

(3) Significance: The significance of an impact looks beyond the magnitude to the actual effects. Consider a species of fish which requires a minimum of ten parts per million (ppm) of oxygen in the water to survive. If that fish is an endangered species, or if it has economic or recreational value, then a change from 12ppm to 9ppm of oxygen, though not great in magnitude, is certainly of significance.

(4) Special sensitivity: The final criterion is specific to regional and national scales. Different regions of the globe have various levels of environmental sensitivity. In urban areas, it is air pollution. In the Sudano-Sahelian region, it is soil erosion. In South-East Asia, it is river basin management. This criterion

simply asks whether any impact of a proposed action will affect an area of special sensitivity.

The guidelines or scoping of the assessment is a function of the technical expertise available to help the agency from concrete case studies, for example, the risk evaluation in the short-term and long-term, the costs or the benefits etc. Different development actions have different guidelines or scoping. The guidelines refer to a process of deciding on a number of priority issues to be addressed by an EIA from a much broader range of potential problems. In other words, it is an attempt to focus the assessment on a manageable number of important questions. However, the importance attached to both guidelines and scoping arises from the fact that environmental assessments are almost always conducted under serious limitations of time and resources and, therefore, any priority-setting activity should improve efficiency and provide a more focused product for decision-makers. So each project clearly requires the guidelines or scoping from the organization in charge of environmental protection.

3. ENVIRONMENTAL IMPACT ASSESSMENT PRODUCTION PHASE

Usually, the EIA authorized agency must have many consultants and specialists, and have had enough experience for this work. The developer must offer the initial discussion and/or submission of planning application and project specification report to the agency before they undertake to do the EIA. The study finances are paid by the developere and the responsibility of the impact assessment for monitoring, for a period of thirty years, rests with the agency.

In this phase, there are five procedures consisting of a series of linked activities from structural approach to appraisal. These activities are described in this section. They are:

(I) The acquisition of information and baseline study

Assessment of development can best be undertaken when a wide range of information on the proposal is available. If a prospective developer is able to supply detailed information prior to submission an impact assessment can begin immediately. On the other hand only preliminary details may be available and neither party will be in a position to commit themselves at this stage. The scope of any analysis, at this stage, will be limited by the information available, but it may still be possible to make a preliminary assessment of the proposal in relation to existing plans and policies. In fundamental a sample brief information, has been devised to be relevant to a wide variety of developments and provides the following details baseline studies.

(a) PHYSICAL CHARACTERISTICS OF APPLICATION SITE

- Existing geographical environment, for example, climate, geology, ecological, landscape and land use etc.
- Land requirements
- Development plan (detailed plans at varying scales)
- Other characteristics (where appropriate)

(b) EMPLOYMENT CHARACTERISTICS

- During construction phase
- When development is operational

(c) FINANCIAL DATA

- Wage and salary levels
- Expenditure on locally produced inputs

(d) INFRASTRUCTURE REQUIREMENTS

- Raw material demand
- Transport requirement
- Water demand
- Electricity demand
- Gas demand
- Housing demand
- Other demand

(e) FACTORS OF ENVIRONMENTAL SIGNIFICANCE (quantification)

- Noise levels
- Vibration levels
- Gaseous emissions
- Particulate emissions

- Odours
- Dust
- Solid and liquid waste
- Change of aqueous effluents
- Others

(f) EMERGENCY SERVICES
- Fire and medical services
- Control of pollution

(g) HAZARD
- Explosion
- Chemical drug
- Radioactivity
- Others

This baseline study and information ais simply a record of what existed in an area prior to an action by developer. This information can offer terms of reference to the decision-maker in order to decide if the EIA is required. At the same time, this information can help the agency to consider existing policies, similar proposals and public inquiries elsewhere. If it is possible, the developer could offer alternative plans to the decision-maker or agency.

(II) The identification of likely impacts

It is necessary to establish the nature of existing environmental, social and economic conditions in the area surrounding a proposed development so that likely impacts can be identified and their effects assessed. It will be possible to obtain some of this information from existing structure plans, regional reports, local plans and other sources, such as policy programmes. Such plans will have considered many of the topics listed below and will have defined a clear context within which individual applications can be judged. A large amount of detailed information may need some form of evaluation by the gency involved. This may include:

(a) PHYSICAL CHARACTERISTICS OF THE SITE AND ITS SURROUNDINGS
- Land

- Water
- Climate
- Land use and landscape character
- Others

(b) ECOLOGICAL CHARACTERISTICS OF THE SITE AND ITS SURROUNDINGS
- Habitats
- Communities
- Species
- Ecosystem

(c) HUMAN ACTIVITY PATTERNS IN THE AREA
- Demographic aspects
- Employment structure
- Transport
- Business
- Agricultural
- Others

(d) INFRASTRUCTURE SERVICES
- Electricity
- Gas
- Water
- Gasoline
- Sewerage
- Solid and liquid waste disposal
- Finance
- Education
- Housing
- Telecommunications
- Others

(e) SOCIAL AND COMMUNITY SERVICES
- Health service facilities
- Entertainment establishments
- Emergency service such as fire and ambulance
- Others

(f) EXISTING LEVELS OF ENVIRONMENTAL POLLUTION

- Air pollution
- Water pollution
- Noise and vibration
- Radioactivity
- Secondary cumulative pollution

According to this information derived from the site and its environs it is possible to identify likely impacts. One of the most simple and effective ways to determine these impacts is by designing a generalised Impact Matrix. An example of such a matrix, devised for industrial development, is shown in Figure 4. In this matrix, characteristics of a development proposal are listed horizontally and characteristics of the site and the surrounding area are listed verticaly. When it is thought that the interaction of components on the vertical and horizontal axes is likely to result in an impact, the appropriate intersection is marked. It is impracticable to produce a comprehensive generalised matrix which can be used in every situation, but the example shown in Figure 4 may be used as a guide for the construction of other matrices which take account of the nature of a proposed development, the site and its surroundings. An expanded matrix is based on the same principles as the generalised matrix in Figure 4. It consists of a particular characteristic or limited set of characteristics of a proposal and specific items of the local area considered relevant for identifying likely impacts.

(III) <u>Appraisal of likely impacts</u>

Although there is no method of systematically identifying and describing every potential impact of a proposed development, the approach outlined below goes a considerable way towards providing a comprehensive assessment of those which are significant. No single method dominates, but checklists, overlays, matrices and networks are used often. Various forms may be used, e.g. two or more methods put together to represent the degree of impacts. Obviously various methods have various characteristics.

Usually methodologies can be useful throughout the impact assessment process with certain ones being of greater value for specific activities. Table 1 identifies four activities and useful methodologies for achieving the requirements of the activities. Matrices and networks are particularly useful for impact identification, while weighting-scaling checklists find greatest application in the final evaluation of alternatives and the selection of a proposed action. It is not necessary to use a methodology in entirety in an environmental impact study; it may be instructive to use portions of methodologies for certain activities. But the overlaps are very useful in many cases of choosing the site and its surroundings.

Whilst numerous methodologies exist, additional methodologies are still being tested. There is no "universal" which can be applied to all project types in all environmental settings. It is unlikely that an all-purpose methodology will be developed due to lack of technical information as well as the need for exercising subjective judgment about predicted impacts in the environmental setting wherein the potential project may occur. Methodologies must be selected based on appropriate evaluation and professional judgement, and they must be used with the continuous application of judgement relative to data inputs as well as analysis and interpretation of results. Figure 5 is a suggestion of methodologies for impact assessment in types of projects by author.

At the same time, in analysing probable impacts of a development it will be useful to determine whether a potential impact is:

(1) Beneficial or adverse: Certain impacts which are beneficial to some social groups may have detrimental effects on others.
(2) Short-term and/or long-term: Some impacts resulting from construction activities are short-lived, whereas others may last beyond the operating life of an installation.
(3) Reversible or irreversible: Some impacts may be reversible in the sense that naturally occurring ecological processes may repair damage caused by adverse impacts. In other cases, this cannot occur and the impacts are irreversible.
(4) Direct and/or indirect: Impacts such as noise nuisance can arise directly from the characteristics of a development. Others are the result of combinations of impacts: loss of tourist-based

Table 1

APPLICATIONS OF METHODOLOGIES IN IMPACT ASSESSMENT PROCESS

Process Activity	Useful Methodologies
Impact identification	Matrices - simple stepped Networks
Describing affected environment	Matrices - simple stepped Networks Checklists - simple descriptive
Impact prediction and assessment	Checklists - descriptive scaling
Selection of proposed action	Matrices - simple stepped Checklists - descriptive scaling - weighting-scaling

(Canter, 1986)

Figure 4

SUGGESTION OF METHODOLOGIES FOR IMPACT ASSESSMENT
IN TYPES OF PROJECT

Methodologies	Types of Projects
Overlay	Geography Information System (GIS) to choose the environment of development site and its surroundings. For example, motorway; highway; roads; pipelines; transmission lines; agriculture and forest land; irrigation system; urban development; industrial estate development; power plants.
Checklists	Environmental Evaluation System (EES) to evaluate the environment of development. For example, water resources; land development and use; housing and urban development; and the quantitative analysis of pollution; population growth; economic, employment, fauna and flora species etc. of quantitative analysis.
Matrix	Actions and Environmental Items System (AEIS) to evaluate the relationship between the action and the environment. For example, industry; fell the forest; power plants; health risks; ecosystem; water resources development; dam or reservoir; breakwaters and levees; mining.
Network	Action items System (AIS) to plan the details of every action. For example, diagram projects; mining projects; power plant projects; industry development projects; land use projects.

employment may be caused by the depletion of fish stocks in a river resulting from a discharge of aqueous pollutants.

(5) Local and/or strategic: Some impacts may be of only local significance, however, the hazard implications of developments such as natural gas liquids pipelines may be of strategic importance for a local area.

Statements of likely impacts are most convincing when supported by quantified information and reasoned argument. For example, when a particular development action is likely to result in an increase in public expenditure, it is helpful if relevant estimates can be included.

(IV) Mitigation measures and comparison of alternatives

From the aforesaid, a mitigation measure is seldom possible to eliminate an adverse environmental impact altogether, it is often feasible to reduce its intensity. Such measures may be engineering works (such as dust collectors, sludge ponds, noise mufflers, etc.) or management projects (such as crop rotation, phased plant shut-downs, etc.). All mitigation measures have associated costs. In some respects mitigation planning is a part of impact evaluation. Once applicable measures have been identified, it is necessary to compute their cost, and to requantify the level of impact, acknowledging the beneficial effect of mitigation measures. Depending on circumstances, mitigation measures might give rise to two or more project alternatives where only one existed before.

From the environmental losses and gains will be combined with the economic costs and benefits to produce a full picture for each project alternative. Usually, in order to proceed to compare alternatives, two pieces of information on each project alternative are required. These are:

(1) a summary of positive and negative environmental impacts; and

(2) a summary of economic costs and benefits.

So the simplest approach to comparing alternatives across both the economic and the environmental fronts is cost-benefit analysis. The agency must choose the suitable site very objectively.

(V) Presentation of results

Conclusions reached on likely impacts considered in depth during analysis may be drawn together in an impact statement. In this statement, each potential impact investigated, including the opinions of public involvement, may be considered in turn, and its implications stated as succinctly as possible. It is suggested that an impact statement should cover the following items:

(1) A brief description of the proposed development;

(2) A brief description of the local area;

(3) Potential impacts;

(4) Mitigating actions for adverse impacts;

(5) Examination of effects on the area if existing trend were to continue;

(6) Consultations and objections.

When considering the "no change" alternative, listed at (5) above, relevant factors might include:

(1) Employment prospects in the area, if the development were not to take place;

(2) Changes occurring from implementation of planning policies, for example shift in the industrial base of an area or population changes;

(3) Dynamic environmental factors, for example advancing sand dunes and other successional changes which may affect the conservation value of site.

It is suggested that technical reports, summaries of consultations and "no change" projections, should be appended to the impact statement. This document could be available for public consultation and could be presented to a planning committee as part of the background material.

In this step, the agency must have meetings with the relevant organizations, academics, specialists and public during the mid-term of the impact assessment study. A considerable amount of public interest will inevitably be generated by a major development proposal. This interest will be shown by wide ranging sections of the community including: individuals residing in the vicinity of the proposed site; local and national amenity ogranizations concerned with the environment; and trades organizations anxious to improve job opportunities etc. Public involvement has an important dual role in assessment, because the development has influence upon local benefits and environment. Public opinions may be considered by the decision-maker. The agency can now draft the impact statement formally.

4. REVIEW PROCEDURE PHASE

When the agency has finished the EIS it is sent to the organization in charge of environmental protection, with all the relevant documents. The documents which will arise out of an EIA will fall into two categories: reference documents, and working documents. The former will contain a detailed record of work done in the EIA and are necessary for future reference. It will help the decision-makers understand the statement and save time.

Usually, reference documents are intended for use by technicians who will examine the EIS or work on future EIAs etc. So the reference documents may be a series of reports, each addressing one impact, or may be one long report containing all the information. Whichever format is used, the contents should be written by the technical specialists.

Working documents are the formal means of communication from the technologists on the one hand to the decision-maker on the other. It is to convey clearly information from the former to the latter, so that informed and timely decisions can be taken. It should be concise and unambiguous. Figure 6 describes the recommended contents of an EIS which meets the above mentioned requirements.

Figure 6

THE CONTENTS OF AN ENVIRONMENTAL IMPACT STATEMENT AND THE LIST OF QUESTIONS

To assess the likely implications of a proposed development, before or after the submission of an application for planning permission, the assessment agency will require technical information from the developer. The type of information required will vary with particular development proposals but the agency may change, delete or add questions accordingly. And it could be supplied to consultants employed by the agency and other interested parties thus sparing the developer repeated requests for similar information in part I.

In part II, a list of questions has been compiled to assist in the consideration of the range of likely impacts that might occur if a proposed development proceeds. The answers to the questions should help the agency, academics, specialists and decision-makers to determine those impacts which should be given detailed consideration and to interpret consultants' reports. In this way, they will not only help reduce delays in assessing likely impacts, but also help reduce the time taken to process applications.

The questions can be used in several stages during appraisal of a proposed development and should be most useful when completing the impact matrix and using the results from specific assessment techniques. Please provide details and do your best to answer the following questions in the study.

The questions, while covering a wide range of impacts, are not all-embracing or applicable to every development. If you have other important information or suggestions, please write on the back.

I GENERAL INFORMATION

1 Agent

(1) The Name of Company:
Address:

Phone:
Experience:

(2) The Name of Responsibility:
Address:

Phone:

(3) The Name of Researchers:
Address:

Phone:
Educational Background:

Description Employment and Research Experience:

2 Development Unit

(1) The Name of Company:
Address:

Phone:
Experience:

(2) The Name of Responsibility:
Address:

Phone:

(3) The Name of Designer:
Address:

Phone:
Educational Background:

Description Employment and Research Experience:

3 Items of Proposed Development

4 Development Site and the Total Areas of Land

5 Development Investment

6 Details of the Proposed Development Project and its Processes
Please provide details of:
(1) Please indicate on 1:10,000 or 1:5,000 scale maps of all sites considered and within any adjacent region.
(2) Who was the land owner? And did you take into account all of the land? (Please offer the copies for the supporting documents and paste them up)
(3) TIf future development phases are envisaged then indicate them on the map.
(4) Do you have another substitute plan or site?

7 Site Utilisation
(1) Please complete the table below to provide details of all proposed major buildings and structures. See notes for details of specific terms used in the table. At the same time show the site utilisation on the maps.

Land-use	Type of building/ structure	Height	Width	Length	Base Dia.	Load
Factory building						
Storage						
Office/administrative						
Housing/residence						
Car parking						
Refuse plant						
Roads						
Dam						
Mine						
Quarry						
Recreation facilities						
Agricultural						
Forestry						
Green belt						
Others						

NOTES:

Type — Relates to the function of a building or structure not its design or colouration.

Base diameter — Only applies to circular structures, e.g. cooling towers, storage tanks, reservoir, etc.

Load — Is the weight bearing factor which each type of building or structure places upon underlying geological substrata.

Green belt — An area surrounding development which may supplement recreation facilities and improvement the quality of living environment.

(2) The position of all existing buildings (including those on land immediately adjoining the site) and the new land use (all proposed buildings), please distinguish existing from proposed indicating the level of all proposed buildings.
(3) Any trees or natural features to be retained and those to be removed.
(4) A selection of photomontages showing the proposed development superimposed on the existing landscape from different angles and viewpoints.
(5) Specific landscaping proposals to be undertaken to help relate the development to its surroundings. These proposals should be supplemented with an appropriate written statement.

8 Employment Characteristics

(1) How long will the construction phase be:..............workdays
(2) Please indicate the envisaged structure in the form of the table below, to cover all employees by occupation group, e.g. management, bricklayers, general labourers, technicians,

engineers, etc., during the construction phase and when the development is operational (the same table).

Occupational Group	Male Percentage (%)	Female Percentage (%)	Total
Grand Total			

(3) Please indicate what percentage of the labour requirements in each occupation group that it is hoped will be drawn from: (the construction phase and when the development is operational)
(i) the local district
(ii) the region or county in which the district
(iii)any region or county adjacent to that specified in (ii)

(4) Will the work require skilled labour? If so, give details of these in terms of types and numbers required (the construction phase and when the development is operational)

(5) What proportion of the workforce would be preferred in the following age groups? Please indicate in the form of the table below during the construction phase and when the development is operational.

Age structure	Male Percentage (%)	Female Percentage (%)	Total
Under 18			
19-20			
21-24			
25-29			
30-39			
40-49			
50-59			
60-65			
over 65			

9. Financial Characteristics

(1) Please indicate the financial characteristics during construction and first fully operational year, e.g. the anticipated average annual income per head at present prices within the occupation groups, major inputs required, source of raw materials, major product outputs, destination of products, etc.

(2) Do you need to borrow the money from the government, bank or private enterprises? And how much money will you borrow?

10. Site Preparation

Please detail the specific site locations for sewage, sewerage, the pipeline of electrical, water or gas, soil and water conservation, etc. and should be given of size and position of such operations. At the same time show the site preparation on the maps.

11. Infrastructure Requirements

Please indicate the infrastructure requirements, e.g. raw material demand, transport requirement, water demand, electricity demand, gas demand and housing demand, census, etc.

12. Environmental Implications

Please indicate the factors of environmental significance in the short term and long term that include noise, vibration, floodlighting, gaseous emissions, particulate emissions, nuclear emission, odours, dust, aqueous discharges, effluent quality parameters, solid or liquid wastes or by-products, etc.

13. Emergency Services

Please indicate the emergency services, for example, fire and medical services, control of pollution, etc., and the hazardous substance to be stored or used in process, some pipelines present a risk of hazardous events.

II IDENTIFICATION AND APPRAISAL OF LIKELY IMPACTS

Please detail evaluation the following question do your best.

1. Physical Characteristics of the Site and its Surroundngs

A. Land

(a) Does the geology of the area present problems with regard to the type of development under consideration?
(b) Does the development involve excavation or earthquake which may have detrimental consequences, e.g. soil erosion, landslide, mudflow, earthflow or creep, etc.
(c) Does the general character of the local topography impose constraints on the design and siting of the proposed development?
(d) What is the grade or classification of land to be developed?

B. Water

(a) Is the proposed development likely to affect the drainage pattern of the area?
(b) Is the proposed development likely to result in changes to other hydrological characteristics of the area?
(c) Is the proposed development likely to affect the flow of underground water?
Where the development is to take place at a coastal or estuarine location the following hydrographic factor should be taken into consideration:
(d) Are any proposed developments below the high water mark likely to affect the sea bed characteristics of the area?
(e) Are any of the hydrographic characteristics of the area likely to impose constraints on the design and siting of the proposed development?

(f) Where dredging operations are considered necessary are there any constraining factors which could influence or even prevent work taking place?
(g) Would any hyrographic characteristics in the area prevent satisfactory completion and/or operation of any part of the proposals?

C. Climate

(a) Are there any climate factors relating to the area which could be constraints upon the proposed development?
(b) Are any climate factors of the area (particularly inversion) likely to influence the pattern of pollution, e.g. noise and air pollution?

D. Land use and landscape character

(a) Is the proposed development compatible with surrounding land uses such as agriculture, forestry, recreation, etc.
(b) Will the proposed development substantially alter the landscape quality of the area?
(c) Will the proposed development have a substantial zone of visual influence?
(d) How far are existing land-uses within the zone of visual influence compatible with the character of the proposed development?
(e) Is the scale of the proposed development compatible with that of the local landscape?
(f) Are there any trees or buildings on the site worthy of preservation?
(g) Are the materials to be used in the permanent structure and buildings of the development in character with those of the local area?
(h) Are the landscaping proposals submitted by the applicant satisfactory?
(i) Has consideration been given to a satisfactory scheme for site restoration should the proposed development cease operation?
(j) Has an appropriate means of financing the implementation of the restoration scheme been agreed should the company cease to be a viable concern?

2. Ecological Characteristics of the Site and its Surroundings

E. Ecosystem character

(a) Are there any endangered and unique species of fauna and flora in the area? Please detail the class name, amount and habitats.
(b) Are the development and the existing habitats compatible:
(c) If "Yes" what conservation methods will be necessary to protect the habitats?
(d) (i) If the development unit described conservation methods that will be used to protect sensitive habitats, are these likely to be successful?

(ii) Are the claims of the development unit with respect to these conservation methods realistic?

(e) If the development and habitats are not compatible what communities will be at risk from:
   (i) Physical destruction?
   (ii) Changes of groundwater level?
   (iii) Changes in quality of standing or flowing water, oxygen content, salinity, turbidity, flow rate and temperature?
   (iv) Chemical pollution, eutrophication and specific toxins?
   (v) Changes in silting patterns?
   (vi) Air pollution of both water bodies and terrestrial habitats?
   (vii) Dust deposition?
   (viii) Changes in nutrient status of terrestrial habitats?
   (ix) Changes in the new species of fauna and flora was import in the habitats at first time?
   (x) Opening up of other areas to increased recreation pressure by the construction of access routes, roads and pathways?
   (xi) Others.

(f) In each of the above cases what, if any, habitats are at risk?

(g) What is the quality of the habitats regardless of status?

(h) What dependent habitats or communities will be at risk, including non-residents and migrants? What is their status?

(i) Can any of these habitats be recreated within a short period (5 to 10 years)?

3. <u>Human Activity Patterns in the Area</u>

F. <u>Employment structure</u>

(a) What effect will the development have upon the economic base of the area?

(b) What kinds of development are most likely to be affected in the area?

(c) Is the development likely to reduce unemployment in the area?

(d) Will an improvement in the unemployment situation be temporary or permanent?

(e) Is the development likely to take advantage of any spare labour capacity such as under-employment that exists in the area?

(f) What are the implications of the applicant's stated labour requirements for the employment structure of the area?

(g) Is the scale and rate of projected employment growth acceptable in the local context?

(h) Will pressure be placed upon particular skills and age ranges?

(i) Is the proposed development likely to result in a movement for labour away from existing employment in the area, and would this have any detrimental affects for the future?

(j) Is the development likely to present a wider range of opportunities for local school leavers than has previously been the case?

(k) Is the development likely to result in a significant influx of non-local labour?
(l) What would be the effecft on the local labour market if the non-local construction labour remained in the area after the development was completed?

G. Demographic aspects

(a) What is the likely level of population growth in the area should the development take place?
(b) Would such a level of growth be acceptable?
(c) What is the likely effect of the development upon local migration flows?
(d) Is the envisaged level of population change likely to affect the existing age/sex structure of the area?
(e) Are the envisaged population changes likely to affect the lifestyle, religious and cultural attitudes of the population?
(f) Is the development likely to have an influence on the tourist trade in the area?

H. Transport

(a) Is the development likely to lead to increase in the volume of public or private transport (road, sea and air) in the area?
(b) Is the existing road network of an acceptable standard to carry the additional traffic without danger to other road users?
(c) Would some other mode of transport prove more acceptable for transport of materials?
(d) Is there likely to be any damage to the local environment adjacent to the proposed routes?
(e) Could any traffic management schemes be introduced to reduce environmental damage and traffic hazards?
(f) Could temporary access roads, where present, be put to community use after the construction period?
(g) Would the development require additional road schemes to be implemented over and above the planned level of future provision?
(h) Is the mode of transport proposed for the distribution of products acceptable to the agency, or should other alternatives be investigated?
(i) Is the proposed development likely to influence the viability of rail services in the area?
(j) Is existing rail capacity sufficient to meet any increase in traffic?
(k) Where a demand is likely for sea or air transport, does the area already have the necessary basic infrastructure?
(l) If there is a need sea or air transport to construct berthing and other related facilities, is there likely to be any detrimental effect on the local environment?
(m) What are the likely environment implications of providing such facilities, and are these compatible with the general character of the local area?

4. Infrastrucutre Services

I. Electricity

(a) Will the proposed development lead to demands which exceed the planned level of provision in the area?
(b) Can these demands be met satisfactorily by the electricty board?
(c) Where new transmission lines are required, will these have a detrimental effect on the local environment?
(d) Are satisfactory emergency supply facilities provided in the event of a major power failure?
(e) In the event of a major power failure would there be a risk in terms of damage to the processing units, danger to the local community, and pollution of the enviroment?

J. Gas

(a) Will the proposed development lead to demands which exceed the planned level of provision in the area?
(b) How dependent will the development be upon public gas supplies?
(c) Where new pipelines are required, will these have any detrimental effects on the local environment?
(d) In the event of major gas supply failure would there be a risk in terms of damage to the processing units, damage to the local community, and pollution of the environment?

K. Water

(a) Will the proposed development lead to demands which exceed the planned level of provision in the area?
(b) How dependent will the development be upon public water supplies?
(c) Will the development lead to the provision of additioanl abstraction schemes in the area or the construction of a new supply reservoir?
(d) Where new supply pipelines are required will these have any detrimental effects on the local environment?
(e) Are satisfactory emergency supply facilities available in the event of a major supply failure?
(f) In the event of a major water supply failure would there be a risk in terms of damage to processing units, danger to the local community, and pollution of the environment?

L. Sewage

(a) Will the proposed development lead to demands which exceed the planned level of provision in the area?
(b) Are there any major constraints which would prevent the necessary facilities being provided?
(c) Where new pipelines would be required, are these likely to have any detrimental effects on the local environment?
(d) Are satisfactory emergency facilities available if the plant were to experience a major processing failure?

(e) In the event of a major processing failure would there be a risk to the health of the local community or pollution of the environment?

M. Finance

(a) What effects will the proposed development have on the financial programmes of relevant development of the government or private?
(b) How significant will be the local area's share of revenue from raw material purchase?
Cross reference (c) to (f) to subsection F (employment structure)
(c) How do the proposed wage rates during construction compare with those of existing employment in the local area?
(d) Where the construction wage rates are high, is this likely to lead to a movement away from existing employment or restrict growth in locally important development?
(e) How do the proposed wage rates during project operation compare with those of existing employment in the local area?
(f) Where wage rates during project operation are higher, is this likely to lead to a movement away from existing employment or restrict growth in locally important development?

N. Education

(a) Will the proposed development lead to an increase in demand for specific types of development training in the area?
(b) Can this be catered for adequately at existing technical colleges or other education institutes?
(c) Will the development put pressure on existing standards of provision at nursery, junior or secondary schools in the area?
(d) Do any schools in the area have sufficient spare capacity to accommodate the influx of children of new families moving to the area?
(e) Will the proposed development lead to demands which exceed the planned level of future education provision in the area?

O. Housing

(a) Will the estimated number of houses required for incoming workers necessitate additional land being released for housing development?
(b) Would the release of additional land for housing be enviromentally acceptable?
(c) Would the release of additional land for housing development place an unacceptable strain on existing and planned infrastructure services?
(d) Does the development require emphasis to be placed on the private sectors of the housing?
(e) Would the type of housing required lead to possible social imbalance within the communities in which they are built?
(f) Where a construction camp, or alternative facility, is to be provided, is the site chosen by the development unit acceptable or should others be considered?

(g) Is the standard of provision of camp site facilities acceptable to the development unit?
(h) Is the design and layout of the camp site facilities acceptable to the development unit?
(i) Could a workers' camp or other housing facility be put to community use after termination of the construction period?

P. Telecommunications

(a) Will the proposed development interfere with existing telecommunication networks?

5. Social and Community Services

Q. Health service facilities

(a) What will be the effects of increased population arising from the new installation on existing facilities?
(b) Will the projected provision of health service facilities meet the increased demand?
(c) What additional provisions will be necessary?

R. Emergency services - fire and ambulance

(a) What will be the effects of the increased population arising from the new installation on existing emergency services?
(b) Will the projected provision of emergency services meet the increased demand?
(c) What additional provision will be necessary?
(d) In emergencies, are the safety provisions and emergency services provided by the development unit at the installation adequate?
(e) Are the existing local resources capable of dealing with any emergency?
(f) Is the time delay for arrival of local emergency services significant?
(g) What increased provision would be necessary to meet any emergency such as nuclear explosion, etc?

6. Existing Levels of Environmental Pollution

S. Air Pollution

(a) Will the installation significantly alter the levels of atmospheric pollutants in the area?
(b) Will the release of atmospheric pollutants be a hazard to human health, crops, livestock, wildlife and stonework?
(c) Will inversion lead to a local build up of high levels of pollutants from the new installation?
(d) Will there be significant synergistic effects with existing pollutants in the atmosphere?
(e) Will the distribution of wind direction cause significant fumigation of areas sensitive to atmosphere pollution?

(f) Will the installation produce significant quantities of particulate matter which will be a nuisance to the local community?
(g) Will the installation produce offensive odours?

T. Water pollution

(a) Will effluents, treated or untreated, have a significant effect on the flora and fauna of the river, canal, lake, estuary of coastal waters?
(b) Will effluents find their way into surface water by means of underground waters?
(c) Are there stretches downstream where effluents are likely to change the flora and fauna?
(d) Will there be significant synergistic effects with existing pollutants in the receiving waters and/or between constituents of the effluents?
(e) Will there be significant potentiation effects with existing constituents of the effluents or receiving water?
(f) Will the discharges lead to the build up of locally high level of pollutants?
(g) Will variations in water flow (e.g. seasonal) cause a significant increase in the concentration of pollutants?
(h) Will salinity gradients and/or current movements in estuaries lead to locally high build up of pollutants and cause problems of dispersion?
(i) Will fishing (commercial and recreational) be affected by discharges?
(j) Will other water-based activities such as water-skiing, canoeing, sailing, etc., be affected by discharges?
(k) Will there be any odour likely to cause offence?
(l) What dependent communities or species of animals and birds are likely to be affected by a change in the aquatic flora and fauna?
(m) Are there any sensitive plant communities dependent on the receiving waters for their supply which are likely to be adversely affected by discharge (including fires) from the development?
(n) Do any horticultural or agricultural enterprises use receiving waters for irrigation?

U. Noise and vibration

(a) Will the installation significantly alter background noise levels?
(b) If these levels increase, will the introduced noise levels be of a magnitude to cause complaints from residents either during day or night-time?
(c) Will the levels have any adverse effect on the functioning of schools, hospitals and old people's homes or on informal recreation areas either during day or night-time?
(d) Are the levels likely to have a significant effect on the wildlife of high quality habitat?
(e) Will the levels exacerbate an already existing situation "creeping" ambient noise levels?
(f) If so, is this significant in the local context, especially if other installations are likely to follow?

(g) Will vibration from blasting, pile-driving, etc. cause human discomfort and annoyance?
(h) Will vibration cause structural damage to ancient monuments and other old buildings?
(i) Will vibration cause structural damage to other buildings, especially houses, schools, hospitals, etc?

V. Solid or liquid waste and by-product disposal

(a) How do the proposals relate to existing waste disposal plans and to waste disposal plans being formulated?
(b) Would an alternative means of disposal be more appropriate?
(c) Would an alternative disposal site be more appropriate?
(d) What would be the visual impact of a disposal site or a disposal plant and what means could be taken to reduce visual impact?
(e) What would be the aesthetic and potential health impact on nearby residents?
(f) What would be the potential surface water pollution from the proposed disposal area?
(g) What would be the chemical and biological characteristics of leachate generated within the site?
(h) What quantities of leachate would be generated?
(i) How would leachate affect water resources?
(j) What proportion of liquid waste would be deposited and how would this affect leachate production?
(k) What measures could be taken to reduce or treat leachate?
(l) Would transport of the waste be a hazard?
(m) How much traffic would be generated and what would be its impact?
(n) What is the proposed after-use of the site and how would it relate to plans for the area and plans being formulated?
(o) Would any special site management have to be introduced to realise the proposed after-use?

W. Nuclear pollution

(a) Will the installation significantly alter the levels of temperature of nuclear energy in the area?
(b) Will the release of nuclear pollution be a hazard to human health, crops, livestock, wildlife and stonework?
(c) How far leachate affect all resources if nuclear pollution occurred?
(d) What are the likely impacts of the disposal of nuclear waste or radioactive waste?
(e) Can nuclear waste or radioactive waste be disposed of satisfactorily?

X. Chemical pollution

(a) Will the apply significantly alter the levels of quantity of chemical such as pesticides, fertilizers, etc. in the area?
(b) If the chemical drugs are imported first time, do you have the report about the characteristics and experiment in the foreign country?
(c) How would leach away the poisonous matter from human health, crops, livestock and wildlife?

(d) What are the likely impacts of the disposal of chemical waste?

Y. Secondary cumulative pollution

(a) Will the installation have different effect from what the pollutiions themselves would have when not action upon by the external factor?
(b) How would leachate affect all resources if secondary cumulative pollution occurred?
(c) What are the likely impacts of the disposal of secondary cumulative pollution?

Z. Risk and hazard

(a) Will the development introduce a significant hazard to the public?
(b) Are there specific environmental conditions (for example, distribution of wind direction and topographic factors) which, in the event of major release, would direct toxic gases or flammable vapour clouds on to local residences and/or local communities?
(c) What other less significant hazards are associated with the development?
(d) What are the worst possible effects of all levels of hazard in terms of death, injury and damage to property?
(e) What are the risks associated with the different levels of hazard?
(f) Are these risks acceptable?
(g) Is there a possibility that numbers of the local community may be killed if the worst possible hazardous event were to occur?
(h) Is the risk of this event acceptable?
(i) Does the installation significantly increase risks which are present from existing plants or other development?
(j) Is the resulting cumulative risk acceptable?

7. Others or Suggestions

If the agency can analyse and answer the list of questions in Figure 6, the impact statement will be strengthened.

The review panel consists of about thirty members, there are the delegation of the relevant organizations and the academics or specialists of physical, chemical, ecological, geographical, economic, botanical, zoological, environmental, aesthetic, agricultural and forestry, etc. When the EIS is sent to the organization in charge of environmental protection, it will be investigated within two months by the review panel, then the review panel will offer reviewed opinions. If the developer and agency accept the reviewed opinions, they will take the EIS back to revise. If the development unit and agency do not accept the reviewed opinions or the EIS is rejected, then an appeal may be lodged with the Cabinet or senior department heads for resolution. If the EIS has no problems, then the developer can apply the license for the development license.

5. MONITORING PHASE

Monitoring is very important. It can be subdivided into three main types in terms of its importance for EIA. These are baseline monitoring, impact monitoring and emission monitoring. So monitoring may be carried out in support of a wide range of management objectives. Thus, the objectives of monitoring may be classified in various ways. Munn (1980) identified the following objectives for monitoring:

(1) to determine present conditions;
(2) to determine trends;
(3) to understand phenomena;
(4) to validate and/or calibrate environmental models;
(5) to make short-term predictions;
(6) to make long-term assessment;
(7) to optimize the utility and/or cost-effectiveness of any of the above; and
(8) to control.

Monitoring systems may be operated at various levels, depending upon the nature of the problem in question and the jurisdiction of the monitoring concerned both of developer and agency. Monitoring is an important tool in the process of environmental impact assessment and in any follow-up assessment and control programmes. It should be recognised that there is little experience in the application of monitoring environmental impact assessment. Somewhat wider experience exists in monitoring programmes for selected pollutants at the local or national scale, but even here monitoring has been predominantly used in support of regulation. Descriptive monitoring which supports the identification and estimation of risks or impacts is at a fairly early stage of development, and substantial efforts are required to ensure progress in this development area.

CHAPTER 6

SUGGESTIONS AND CONCLUSIONS

1. SUGGESTIONS

There are many defects in an environmental impact assessment system that need to be improved for Taiwan. The author prudently offers ten suggestions for promoting environmental assessment work in the future. These are:

(1) To establish the policy of environmental/natural resources conservation and to draft environment impact assessment legislation: A policy and law will be of benefit to both the developer and the government. They must be responsive to the social and cultural traditions of the people. Though there are many policies which deal with environmental aspects, there is a need for synthesis to make a conservation strategy or a fundamental law. It is meant to guide the course of development and environmental conservation. The law of environmental impact assessment will include the following:

(i) a statement indicating when an EIA is necessary;

(ii) an indication of what the EIA must contain;

(iii) a section which empowers a certain body to review the EIA and another body to settle disputes; and

(iv) an indication of the legal-administrative sanctions if the law is not complied with (Ahmed, 1985).

(2) To establish the environmental data bank: The problem of a lack of data becomes one of finding ways to proceed with the EIA without such data. The possible solution which was suggested was to synthesise data. Therefore, there is the need for a central repository of environmental data. So it will be necessary to assemble all of the academics and specialists who research into the environment and to finish the Geography Information System (GIS) quickly. As such this information will then help to promote and execute the order of environmental/natural resources conservation.

(3) To develop the techniques of environmental impact assessment: Environmental impact assessment is a synthetic and collective learning. But there is a need for specialists who can blend all knowledge to analyse and judge assessments objectively. So it is necessary to specify the decision-maker's training in a speciality inside or outside the country.

(4) To increase investment in EIA: The environment needs significant investment in both time and human power to prohibit pollution and to protect human health and promote environmental quality. However, the organization in charge of environmental protection lacks the ability to invest sufficiently and therefore cannot produce a significant level of environmental protection.

(5) To improve land use strategy: Land once used often cannot be returned to its former state. Such attempts take long periods of time. Therefore great care must be taken and detailed plans formulated to ensure that sufficient types of specific land use are catered for, e.g. urban, green belt, recreational, agricultural. In many cases by concentrating similar land uses in specific areas the task of sound environmental management is, to some extent, made easier.

(6) To establish a monitoring system: For example, all the industrial estate developments, the busy communication networks, etc. must establish a monitoring system to test the nature of the pollution and to find its source, with the ultimate aim of improving the environment and preventing accidents. As such the monitoring system is a very important tool in the post development period.

(7) To strengthen technical aspects of environmental impact assesment: As the environment encompasses a very wide rangeof areas, it becomes necessary to encourage academics and specialists to create models of environmental impact assessment techniques. These will serves as good reference material for the consultant companies or agencies who undertake research into impact assessment.

(8) To improve education within the field of environmental/natural resources conservation: There are basically two ways: first, to

increase lectures in the university programmes and by training post-graduate students to research and study this topic; secondly, to increase public knowledge via television programmes, newspapers, magazines, etc., and to devise various schemes of public participation such as games, painting, debates, etc.

(9) To encourage public participation in this area: The environment belongs to the people. Hence, one of the most significant aspects of EIA is the involvement of the affected public in the environmental impact study. This has taken two forms: first, the inclusion of local values in the EIA process which occurs at the scoping stage. The cost or benefit of an impact is a direct function of the social and cultural values of the people who are affected. The second form of public involvement is direct comment by the public on the EIA. The objective is to inform the public of various aspects of the project and to seek their comments. However, in many cases the interactions are between the Government and the public.

(10) National and international seminars and training inititatives: From these events it is possible to gain knowledge of techniques from other countries. AUltimately that will improve our policy and the techniques of impact assessment for environmental/natural resources conservation.

2. CONCLUSIONS

This paper has outlined the intensive step-by-step approach that has been undertaken in many reports in the introduction of an EIA procedure. From this variety of foreign case studies an attempt has been made to design a proposed environmental impact assessment system for Taiwan. Whilst this paper is only a superficial account of environmental impact assessment, it hopefully will act as an aid to decision-makers especially in their drafting of series of guidelines, handbooks or policies. At the same time, the author hopes to have the chance to research more fully the field of environmental/natural resources conservation and environmental impact assessment.

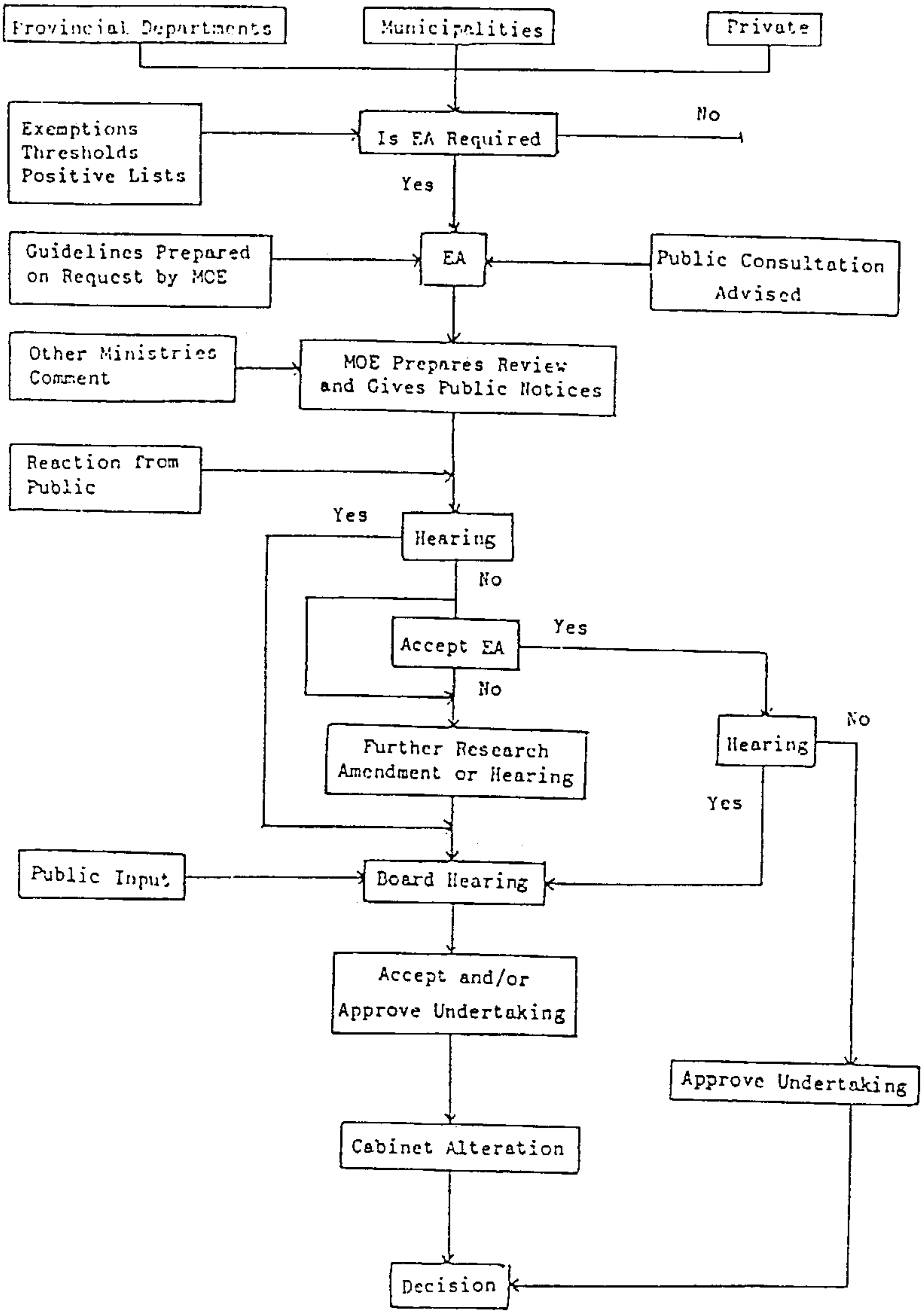
APPENDIX A : ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

A1 Summary of the Main Features of the Canadian Federal Ontario EIA Procedures in Comparison to those of the USA

System	Federal Environmental Assessment and Review Process	Ontario Environmental Assessment Act	U.S. National Environmental Policy Act
Type of procedure	Cabinet policy	Legislated	Legislated
Relationship with existing decision-making process	Semi-integrated	Integrated	Integrated based on policies in law
Body controlling procedure	Federal Environmental Assessment and Review Office (FEARO)	Ontario Ministry of the Environment (MOE)	Council on Environmental Quality (CEC)
Who is responsible for EIA preparation	Proposing federal department	Proponent	Lead agency or joint agencies
Field of application	Projects, federal departments and agencies and proponents requiring federal funds or lands.	Projects, plans, programme level. Provincial, municipal then private sectors (phased introduction).	Projects, plans, legislative level. Some exemptions in regulations.
How are activities identified	Self-assessment and precedent.	Exemptions for provincial projects and positive list for private sector.	Self assessment and negative declaration.
Definition of environment	Natural, physical, social and economic.	Natural, physical, social and economic.	Human environment, natural and physical and relationship of people to that environment.
Body for whom the EIS is prepared	FEARO	MOE	Lead agency.
Use of scoping	IEE identifies significant impacts also guidelines.	?	Yes.

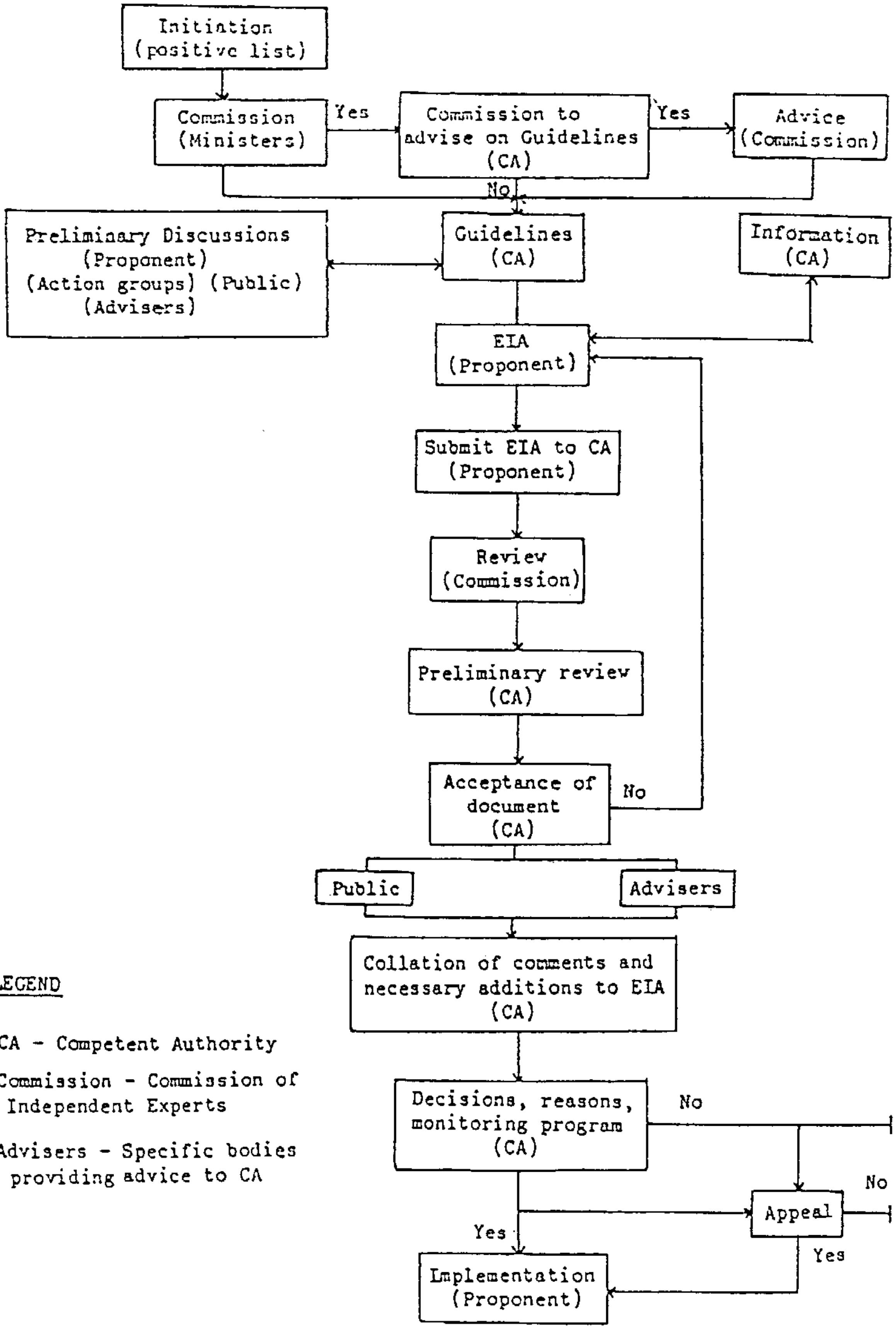
Use of guidelines	Generic and project specific guidelines.	General guidelines, some generic but normally project specific.	General guidelines (CEQ) and generic guidelines (departments).
Public involvement	Early involvement with publication of project guidelines continues to submission of the EIS.	Suggested but only begins formally when EIS submitted.	Yes, incorporated into agency procedures.
Hearings or meetings	Always.	Ministers opinion, one hearing body, Environmental Assessment Board (EAB).	Possible, depends on individual agency procedures.
Decision-making body	Minister of the Environment plus minister of sponsoring department.	Minister of the Environment or EAB.	Lead agency plus others when necessary.
How is decision made	Based on recommendations by FEARO. Final decision by cabinet.	All minister comment on EIS, minister may alter EAB decision. Cabinet approval.	Review by federal agencies, public and others. Lead agency decides on basis of EIS and other information.
Appeal	To cabinet.	To cabinet.	To courts.
Monitoring	Recommendations from panel, Ministers can require a monitoring programme.	MOE with relevant ministries can require monitoring.	May be done by agencies.

A.2 Ontario Environmental Assessment Process



MOE: Ontario Ministry of Environment

Proposed Environmental Impact Assessment Process for The Netherlands

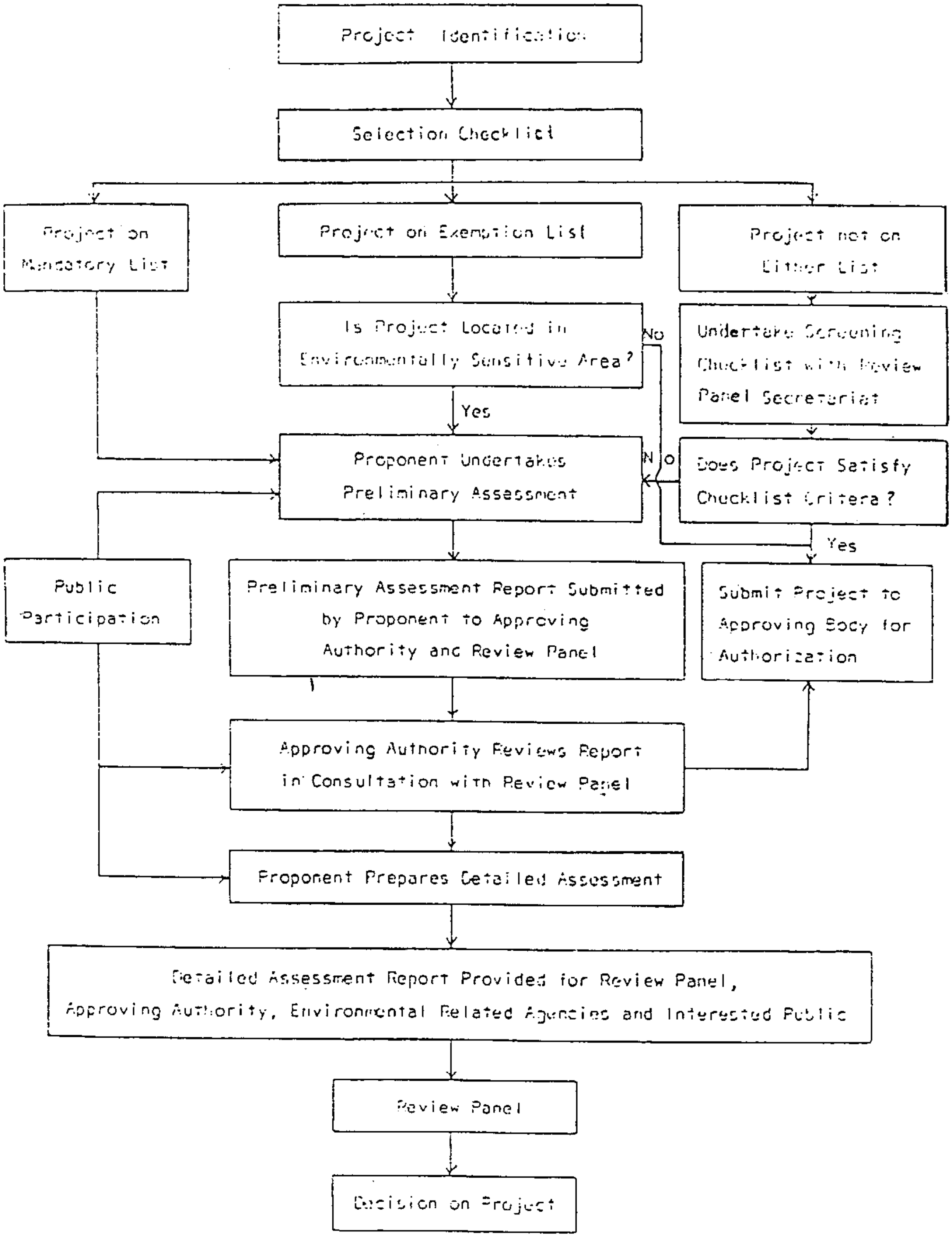


LEGEND

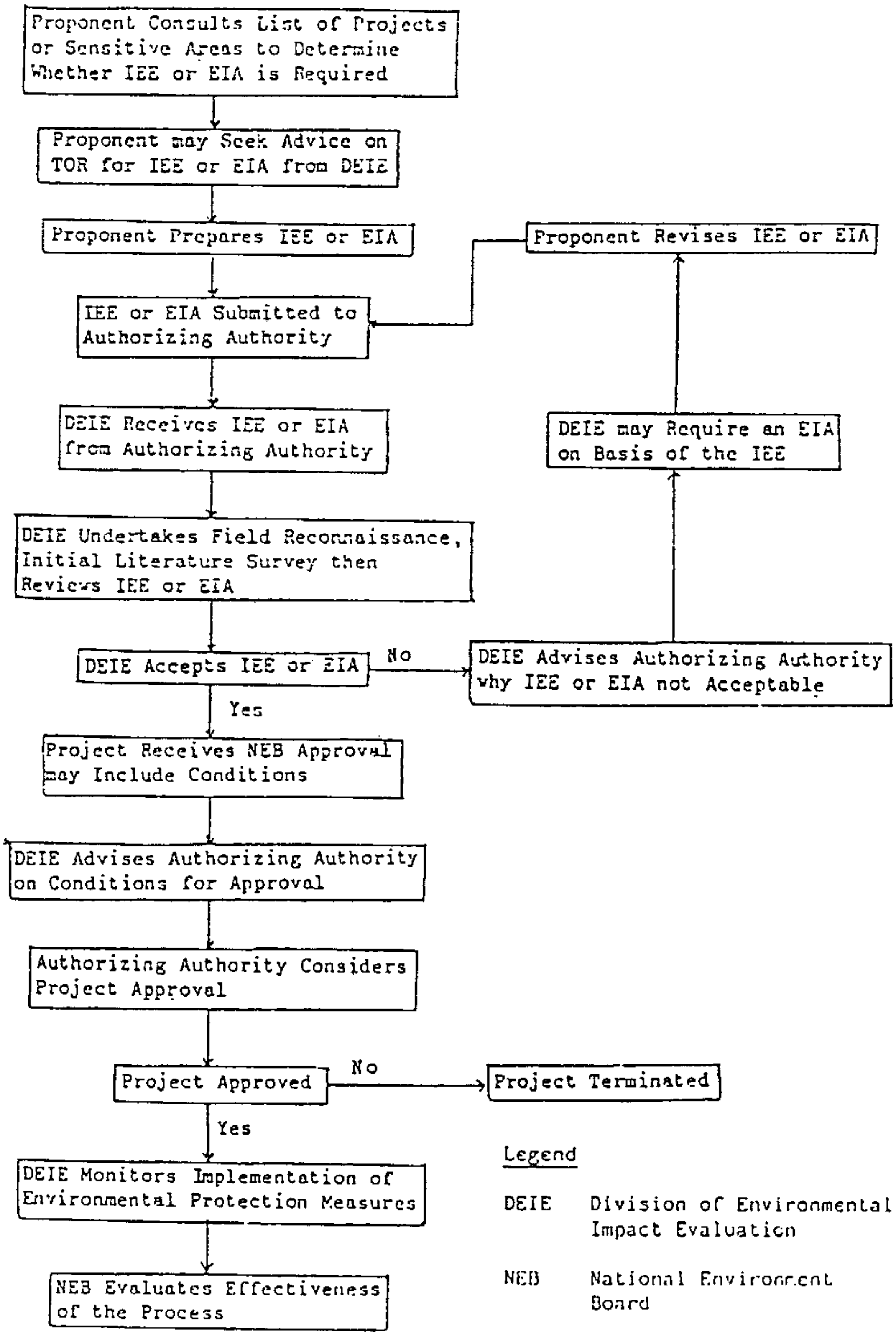
CA - Competent Authority

Commission - Commission of Independent Experts

Advisers - Specific bodies providing advice to CA


Project Identification
Selection Checklist
Project on Mandatory List
Project on Exemption List
Project not on Either List
Is Project Located in Environmentally Sensitive Area?
No
Yes
Undertake Screening Checklist with Review Panel Secretariat
Proponent Undertakes Preliminary Assessment
No
Does Project Satisfy Checklist Critera?
Yes
Public Participation
Preliminary Assessment Report Submitted by Proponent to Approving Authority and Review Panel
Submit Project to Approving Body for Authorization
Approving Authority Reviews Report in Consultation with Review Panel
Proponent Prepares Detailed Assessment
Detailed Assessment Report Provided for Review Panel, Approving Authority, Environmental Related Agencies and Interested Public
Review Panel
Decision on Project

A.5 Environmental Impact Assessment Procedure in Thailand



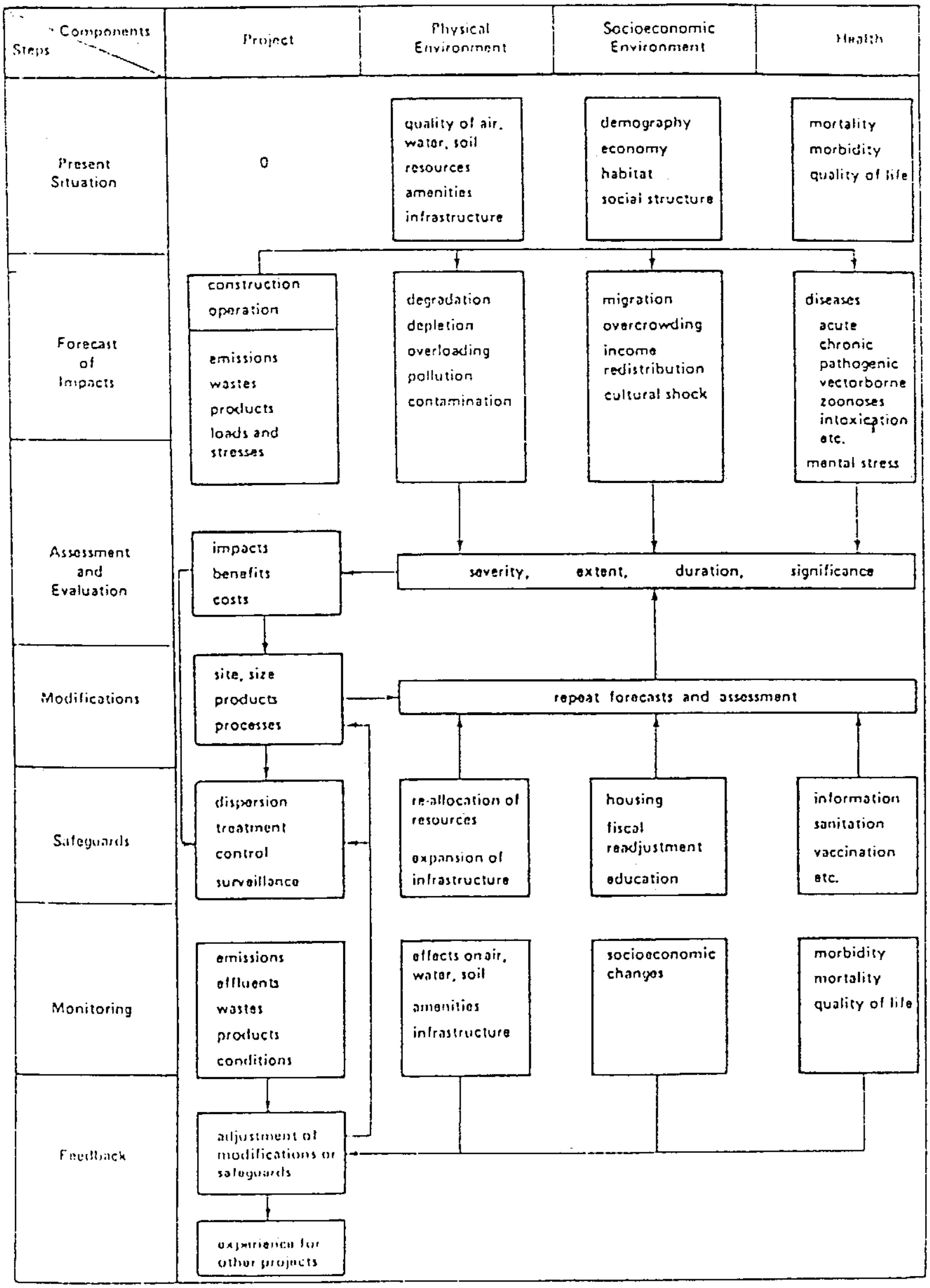
Legend

DEIE	Division of Environmental Impact Evaluation
NEB	National Environment Board
TOR	Terms of Reference
IEE	Initial Environment Examination

A.6 Summary of the Main Features of the Dutch EIA Procedure

Type of Procedure	Legislative and integrated.
Body controlling process or procedure.	Ministry of Housing, Physical Planning and Environmental Management is responsible for the law and regulations only.
Who is responsible for EIA preparation?	Proponent.
Field of application.	All levels; national, provincial, municipal and Private. Phased introduction.
How are activities identified?	Positive lists.
Definition of environment.	Physical, natural, cultural, historic and health.
Body for whom the EIS is prepared.	The competent authority.
Use of scoping.	Possible.
Use of guidelines.	General, generic and specific guidelines will be used.
Public involvement.	Proposed.
Hearings or meetings.	Dependent upon competent authority procedures.
Decision-making body.	Competent authority.
How is decision made?	As part of overall approval on project.
Appeal.	Proposed, where existing decision-making permits.
Monitoring.	Individually by regional inspectors.

A.7 Environmental Health Impact Assessment Process



APPENDIX B : CRITERIA, PROCESS AND EXAMPLES OF SCREENING

B.1 Criteria for Making Screening Decisions

Several general criteria can be used when making a decision as to the environmental effect of an activity. These criteria are not mutually exclusive but are interrelated.

Magnitude: defined as the probable severity of each potential impact. Will the impact be irreversible? If reversible, what will be the rate of recovery or adaptability of an impact area? Will the activity preclude the use of the impact area for other purposes?

Prevalence: defined as the extent to which the impact may eventually extend as in the cumulative effects of a number of stream crossings. Each one taken separately might represent a localized impact of small importance and magnitude, but a number of such crossings could result in a widespread effect. Coupled with the determination of cumulative effects is the remoteness of an effect from the source activity. The deterioration of fish production resulting from access roads could affect sport fishing in an area many miles away and for months or years after project completion.

Duration and Frequency: the significance of duration and frequency can be explained as follows. Will the activity be long-term or short-term? If the activity is intermittent, will it allow for recovery during inactive periods?

Risks: defined as the probability of serious environmental effects. The accuracy of assessing risk is dependent upon the knowledge and understanding of the activities and the potential impact areas.

Importance: defined as the value that is attached to a specific area in its present state. For example, a local community may value a short stretch of beach for bathing or a small marsh for hunting. Alternatively, the impact area may be of a regional, provincial or even national importance.

Mitigation: Are solutions to problems available?

(Adapted from FEARO, 1978)

B.2 A Screening Process for EIA

WHAT IS THE DECISION PROBLEM?

1. Range of choice:- associated with site, design, construction, method and post-construction operation.

2. Choice of associated protection projects:- to alleviate expected impacts.

WHAT IS THE DEGREE OF POTENTIAL IMPACT BOTH DIRECT AND INDUCED?

1. Nature of impacting activities - type of impact:-

   Change in the physical environment e.g. introduction of toxic materials, change in water table.

   Change in biotic components, e.g. planting, harvesting, pest control.

   Change in spatial size and form of ecosystem, e.g. reduction of habitat, erection of barriers.

2. Nature of impacting activities - likelihood of impact:- Certainty or probability distribution.

3. Nature of ecosystem(s) affected:-
   (a) Importance of ecosystem e.g. critical resources such as nature reserves or national parks.

   (b) Ecological consequences.

B.3 EXAMPLE OF SCREENING TEST TABLE

Climate and Air Quality

Sub-element	Potential Impact(s)	Required Information	Sources of Information
Precipitation/ humidity	Will the project have an impact upon the local precipitation/humidity pattern? Will the project be sited in a "high risk" area?	Precipitation/ humidity data incl- uding unusual cond- itions - flash floods, etc.	Meteorological records; existing residents in area.
Temperature	Will the project have an impact upon the local temperature pattern?	Temperature data, including extremes.	Meteorological records.

EXAMPLE OF BASELINE SUMMARY TABLE

Sub-element	Objectives	Required Information/ Specialist(s)	Methodology	Findings/ Measurements
Precipitation/ humidity	Protection of life/human health	Precipitation/humidity data; unusual conditions - flash floods, very high rainfall, hail, fog, snow. Meteorolo- gist.	Location of site; estimate risk potential; measurement of micro-climate.	Risk of unusual conditions; nature and char- acter of micro- climate.
Temperature	Protection of life/human health.	Temperature data; unusual conditions - extremes in temperature; heat dome(s), frequency and extent of temperature inversions; valley downwash conditions; ventilation potential. Meteorologist.	Location of site; estimate risk potential; measurement of micro-climate.	Risk of unusual conditions; nature and char- acter of micro- climate.

B.4 Screening Table for Water Impacts

Subelement	Potential Impact(s)	Required Information	Sources of Information
Hydrological balance	Will the project alter the hydrological balance?	Extent of project; source of water - ground or other. Importance of groundwater in maintaining area rivers, streams, lakes, ponds, wells, flora and fauna.	Developer Hydrologist/ hydrogeologist
Groundwater regime	Will the project affect the groundwater regime, e.g. in terms of quality, quantity, depth/gradient of water table and direction of flow? Will alterations to water table depth alter structural qualities of soil? Will dewatering methods be necessary to undertake excavations?	Extent of project; source of water supply; waste disposal practices; proposed surface cover. Ground conditions - permeability, percolation, water table, location of recharge area, slope proximity to streams or other waterbodies.	Developer Geological maps/ survey; local well-drillers; soils engineer.
Drainage/channel pattern	Will the project impede the natural drainage pattern and/or induce alteration of channel form?	Existence, nature and pattern of drainage; soil characteristics.	Site visit; geological maps.
Sedimentation	Will the project induce a major sediment influx into area water bodies?	Location of construction and cleaning activities. Erosion potential of site soils. Direction of runoff flow, % slope on site. Erosion and sediment control plan for site.	Developer Soils surveyor Site visit; topographical map Developer
Flooding	Will there be risk to life and materials due to flooding?	Extent of project; 100-year flood plain.	Developer Geological survey
Water quality	Does potable water supply meet established standards - WHO, etc? Will receiving waters meet established standards? Will waters be adequately accommodated and treated? Will groundwater suffer contamination by surface seepage, intrusion of saline or polluted water?	Whether existing water quality meets standards for intended usage; capacity of waste treatment plant/sewerage system to accommodate project wastes. Water disposal plan; source of water. Location of groundwater recharge.	Health/waste disposal authorities Developer Hydrologist/ hydrogeologist
Surface waters	Will the project impair existing surface waters through filling, dredging, water extraction or discharge; waste discharge or other detrimental practices? Will recreation or aesthetic values be endangered? Will the project affect dry weather flow characteristics?	Location of project; location of construction and clearing activities. Source of water supply and site of waste disposal; dams/obstructions; flow characteristics over an extended period. Ecological characteristics; recreation uses.	Developer Civil engineer/ hydrologist Aquatic biologist - area survey

(FROM: UNEP © 1980)

APPENDIX C : CHECKLIST METHODOLOGIES

C.1 Typical Simple Checklist
(From Interim Guide for Environmental Assessment 1975)

PHYSICAL

1. Geology
   - 1.1 Unique Features
   - 1.2 Mineral Resources
   - 1.3 Slope Stability/Rockfall
   - 1.4 Depth to Impermeable Layers
   - 1.5 Subsidence
   - 1.6 Consolidation
   - 1.7 Weathering/Chemical Release
   - 1.8 Tectonic Activity/Vulcanism
2. Soils
   - 2.1 Slope Stability
   - 2.2 Foundation Support
   - 2.3 Shrink-Swell
   - 2.4 Frost Susceptibility
   - 2.5 Liquefaction
   - 2.6 Erodibility
   - 2.7 Permeability
3. Special Land Features
   - 3.1 Sanitary Landfill
   - 3.2 Wetlands
   - 3.3 Coastal Zones/Shorelines
   - 3.4 Mine Dumps/Spoil Areas
   - 3.5 Prime Agricultural Land
4. Water
   - 4.1 Hydrologic Balance
   - 4.2 Ground Water
   - 4.3 Ground Water Flow Direction
   - 4.4 Depth to Water Table
   - 4.5 Drainage/Channel Form
   - 4.6 Sedimentation
   - 4.7 Impoundment Leakage and Slope Failure
   - 4.8 Flooding
   - 4.9 Water Quality
5. Biota
   - 5.1 Plant and Animal Species
   - 5.2 Vegetative Community
   - 5.3 Diversity
   - 5.4 Productivity
   - 5.5 Nutrient Cycling
6. Climate and Air
   - 6.1 Macro-Climate Hazards
   - 6.2 Forest and Range Fires
   - 6.3 Heat Balance
   - 6.4 Wind Alteration
   - 6.5 Humidity and Precipitation
   - 6.6 Generation and Dispersion of Contaminants
   - 6.7 Shadow Effects
7. Energy
   - 7.1 Energy Requirements
   - 7.2 Conservation Measures
   - 7.3 Environmental Significance

SOCIAL

8. Services
   - 8.1 Education Facilities
   - 8.2 Employment
   - 8.3 Commercial Facilities
   - 8.4 Health Care/Social Services
   - 8.5 Liquid Waste Disposal
   - 8.6 Solid Waste Disposal
   - 8.7 Water Supply
   - 8.8 Storm Water Drainage
   - 8.9 Police
   - 8.10 Fire
   - 8.11 Recreation
   - 8.12 Transportation
   - 8.13 Cultural Facilities
9. Safety
   - 9.1 Structures
   - 9.2 Materials
   - 9.3 Site Hazards
   - 9.4 Circulation Conflicts
   - 9.5 Road Safety and Design
   - 9.6 Ionizing Radiation
10. Physiological Well-Being
    - 10.1 Noise
    - 10.2 Vibration
    - 10.3 Odor
    - 10.4 Light
    - 10.5 Temperature
    - 10.6 Disease
11. Sense of Community
    - 11.1 Community and Organization
    - 11.2 Homogeneity and Diversity
    - 11.3 Community Stability and Physical Characteristics
12. Psychological Well-Being
    - 12.1 Physical Threat
    - 12.2 Crowding
    - 12.3 Nuisance
13. Visual Quality
    - 13.1 Visual Content
    - 13.2 Area and Structure Coherence
    - 13.3 Apparent Access
14. Historic and Cultural Resources
    - 14.1 Historic Structures
    - 14.2 Archaeological Sites and Structures

Courtesy of the U.S. Department of Housing and Urban Development.

C.2 Simple Checklist Methodology for Gas Pipeline Projects (Federal Power Commission, 1971)

Category	Comments
Land Features and Uses	Identify present uses and describe the characteristics of the land area. Land uses -- Describe the extent of present uses, as in agriculture, business, industry, recreation, residence, wildlife, and other uses, including the potential for development; locate major nearby transportation corridors, including roads, highways, ship channels, and air traffic patterns; locate transmission facilities and their placement (underground, surface, or overhead); identify water resources. Topography, physiography, and geology -- Provide a detailed description of the topographical, physiographical, and geological features within the area of the proposed action. Include U.S. Geological Survey Topographic Maps, aerial photographs (if available), and other such graphic material. Soils -- Describe the physical characteristics and chemical composition of the soils, including the relationship of these factors to land slope.
Species and Ecosystems	Identify those species and ecosystems that will be affected by the proposed action. Species -- List in general categories, by common and scientific names, the plant and wildlife species found in the area of the proposed action and indicate those having commercial and recreational importance. Communities and associations -- Describe the dominant plant and wildlife communities

(Continued)

Category	Comments
	and associations located within the area of the proposed action. Provide an estimate of the population densities of major species. If data are not available for the immediate area of the proposed action, data from comparable areas may be used.
	Unique and other biotic resources -- Describe unique ecosystems or rare or endangered species and other biotic resources that may have special importance in the area of the proposed action.
Socio-economic Considerations	If the proposed action could have a significant socio-economic effect on the local area, discuss the socio-economic future of the area without the implementation of the proposed action; describe the economic development in the vicinity of the proposed action, particularly the local tax base and per capita income; and identify trends in economic development and/or land use of the area, from both an historical and a prospective viewpoint. Describe the population densities of both the immediate and generalized area. Include distances from the site of the proposed action to nearby residences, cities, and urban areas and list the populations of these areas. Indicate the number and type of residences, businesses, and industries that will be directly affected and those requiring relocation if the proposed action occurs.
Air and Water Environment	Describe the prevailing climate and the quality and quantity of the air and water resources of the area.
	Climate -- Describe the climatic conditions that have prevailed in the vicinity of the

(Continued)

Category	Comments
	proposed action: extremes and means of monthly temperatures, precipitation, and wind speed and direction. In addition, indicate the frequency of temperature inversions, fog, smog, and destructive storms such as hurricanes and tornadoes.
	Hydrology and hydrography -- Describe surface waters, fresh, brackish, or saline, in the vicinity of the proposed action and discuss drainage basins, physical and chemical characteristics, water use, water supplies, and circulation. Describe the ground water situation, water uses and sources, aquifer systems, and flow characteristics.
	Air, noise, and water quality -- Provide data on the existing quality of the air and water (indicate the distance(s) from the proposed action site to monitoring stations) and the mean and maximum noise levels at the site boundaries.
Unique Features	Identify unique or unusual features of the area, including historical, archeological, and scenic sites and values.

C.3 Checklist of Potential Impacts from Impoundment Projects (U.S. Environmental Protection Agency, 1976)

Category	Potential Impacts and Issues
Construction Phase	Sediment pollution and stream siltation
	Pesticides, petrochemicals, and other potential pollutants
	Quantification of erosion and sediment generation
	Relevant criteria for sediment pollution
	Protection of water quality during construction -- general
	Erosion and sediment control techniques
	Treatment of polluted water from construction site
	Activity scheduling
	Components of solid waste from construction operations
	Disposal of chemicals and containers
	Summary of solid waste impacts
	Air pollution sources at construction sites
	Noise generators at impoundment construction site
	Typical construction noise levels
	Rough estimation of noise impacts
	Damaging effects of noise

(Continued)

Category	Potential Impacts and Issues
Impoundment Area	Probable land use impacts
	General methodology for evaluating land use changes and impacts
	Loss of stream and bottom land
	Relocation impacts
	Recreational development--general
	Secondary air pollution impacts (parking facilities)
	Solid waste generation at recreational areas
	Impact of land inundation on impoundment water quality
	Organic decomposition and dissolved oxygen deficiency
	Solution of iron and manganese
	Loss of wildlife habitat
	Assimilative capacity changes--general
	Primary determinants
	Critical water quality conditions
	Effects of stratification and density currents
	Eutrophication and associated impacts
	Consideration of evaporation
	Shift from river to lake environment and reduction of a species diversity
	Sedimentation in impoundment
	Modeling of impoundment water quality

(Continued)

Category	Potential Impacts and Issues
	Estimating significance of site conditions with respect to impoundment water quality
	Potential for erosion in reservoir
	Relationship of morphometry to potential eutrophication and weed problems
	Nutrient sources and loadings
	Quantification of influent water quality
	Changes in point and nonpoint pollution sources
	Probability of water quality problems in stratified reservoirs
	Evaluation of reservoir fisheries
	Summary of water quality parameters that may be affected by impoundment and relevant criteria
	Thermal criteria for fisheries
Downstream and Areas of Water Use	Influence of land acquisition policy on reservoir development
	Induced development in region
	Land use impacts due to increased flood protection
	Land use impacts of irrigation impoundments
	Evaluation of water pollution from irrigation
	Policy concerning use of flood plains
	Prevention of water quality degradation from irrigation projects
	Impacts of water quality changes on downstream biota
	Impact of dam as barrier

(Continued)

Category	Potential Impacts and Issues
	Flow regime changes--general
	Quantification of hydrographic modification
	Seasonal and diurnal flow variations
	Minimum release requirements
	Low-flow augmentation analysis
	Effects on riparian vegetation
	Flow requirements for salmon and other species
	Temperature changes--general
	Important categories of fish species
	Effects of outlet location and impoundment operation
	Possible thermal effects on downstream species composition
	Thermal criteria for fisheries
	Effects on downstream uses

C4 Section of US Aid Questionnaire Checklist (Developed by US Aid, 1981)

Remark: This format was developed by USAID. It can be used as a guide to project impact identification and in the scoping process. The planning checklists (Exhibit 1) will assist project planners for use in filling out the Impact Matrix (Exhibit 2), but no one matrix and checklist can be designed to fit all projects. Revisions and modifications will be required since the matrix is <u>not</u> a substitute for thinking through.

Using this format, the planners should first determine the major project components and list them on the left column of the impact matrix, then using appropriate portions of the planning checklist as a guide, determine the potential impact of each project component as listed across the top of the matrix.

The abbreviated scale is interpreted as follows:

ND - Not Determinable	O - None or Insignificant
HA - High Adverse	LB - Low Beneficial
MA - Medium Adverse	MB - Medium Beneficial
LA - Low Adverse	HB - High Beneficial

Exhibit 3, a complete matrix of rural roads potential impacts, will show that siting decisions for penetration roads may have major environmental consequences.

Courtesy of US Agency for International Development

EXHIBIT 1

PROJECT IMPACT MATRIX

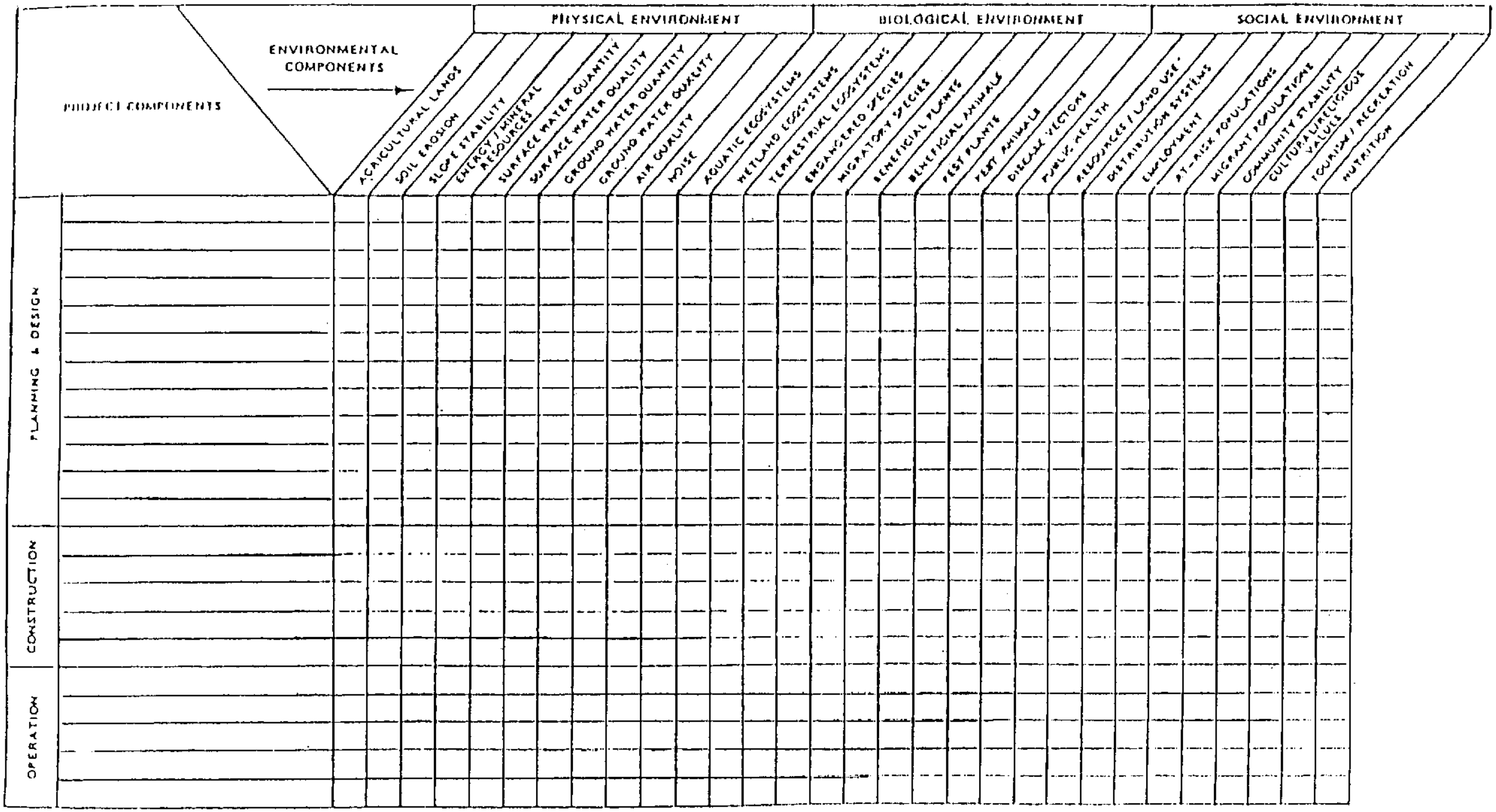


EXHIBIT 2

PROJECT PLANNING CHECKLIST

To be used as a guide in assessing each major project decision as to its environmental impact

A. PROJECT TYPE (Road, Industry, etc.): ____________________

B. PROJECT PHASE (Planning/Design, etc.): ____________________

C. PROJECT COMPONENT (Routing, Site location, etc.): ____________________

D. PROJECT DECISION POTENTIAL IMPACTS:

1. Agricultural Lands

a) Are there cultivable lands in the project area?	Yes___	No___	Unk___
b) Will project decision result in more or improved cultivable land?	Yes___	No___	Unk___
c) Will project decision result in less or damanged cultivable land?	Yes___	No___	Unk___

ESTIMATED IMPACT ON AGRICULTURAL LAND ...ND..HA..MA..LA..O..LB..MB..HB

2. Soil Erosion

a) Will project decision help to prevent soil loss or erosion?	Yes___	No___	Unk___
b) Will project decision directly cause or worsen soil loss or arosion?	Yes___	No___	Unk___
c) Could project decision indirectly lend to practices that could cause soil loss or erosion?	Yes___	No___	Unk___
d) Is it necessary to consult a soils scientist?	Yes___	No___	Unk___

ESTIMATED IMPACT ON SOIL EROSION .... ND..HA..MA..LA..O..LB..MB..HB

3. Slope Stability

a) Does project decision involve actual modification of slopes?	Yes___	No___	Unk___
b) Will project decision affect stability of slopes indirectly?	Yes___	No___	Unk___
c) Will project decision result in other conditions that could affect slope stability?	Yes___	No___	Unk___
d) Could project decision cause people, livestock or property to be located where existing unstable slopes could be a hazard?	Yes___	No___	Unk___
e) Is it necessary to consult a geotechnical engineer?	Yes___	No___	Unk___

ESTIMATED IMPACT ON SLOPE STABILITY .....ND..HA..MA..LA..O..LB..MB..HB

4. Energy-Mineral Resources

a) Do energy-mineral resources exist in project area? Yes___ No___ Unk___
b) Will project decision help to develop, now or in the future, important energy-mineral resources? Yes___ No___ Unk___
c) Will project decision cause significant consumption of additional energy-mineral resources such as engine fuels? Yes___ No___ Unk___
d) Could project decision prevent or impede future development of essential energy-mineral resources? Yes___ No___ Unk___
e) Is it necessary to consult with a minerals agency or mining engineer? Yes___ No___ Unk___

ESTIMATED IMPACT ON ENERGY/MINERAL RESOURCES .... ND..HA..MA..LA..O..LB..MB..HB

5. Surface Water Quantity

a) Do surface water resources exist in project area? Yes___ No___ Unk___ Yes___ No___ Unk___
b) Is information available on present and future demands on water resources as result of the project? Yes___ No___ Unk___
c) Will project decision help to increase or preserve available surface water supplies by such things as improved drainage/run-off conditions? Yes___ No___ Unk___
d) Will project decision increase demand or cause loss of available surface water either directly or indirectly? Yes___ No___ Unk___
e) Is it necessary to consult a hydrologist? Yes___ No___ Unk___

ESTIMATED IMPACT ON SURFACE WATER QUANTITY .... ND..HA..MA..LA..O..LB..MB..HB

6. Surface Water Quality

a) Is information available on present water quality? Yes___ No___ Unk___
b) Will project decision lead to additional natural or man made discharges into surface waters? Yes___ No___ Unk___
c) Will project decision help to improve or protect surface water quality? Yes___ No___ Unk___
d) Could project decision cause deterioration of surface water quality either directly or indirect? Yes___ No___ Unk___
e) Is it necessary to consult a water quality engineer or agency? Yes___ No___ Unk___

ESTIMATED IMPACT ON SURFACE WATER QUALITY .... ND..HA..MA..LA..O..LB..MB..HB

7. Ground Water Quantity
   a) Do ground water resources exist in project area? Yes___ No___ Unk___
   b) Is information available on present and future demands on water resources as result of the project? Yes___ No___ Unk___
   c) Will project decision help to increase or preserve available ground water supplies by such things as improving recharge conditions? Yes___ No___ Unk___
   d) Will project decision increase demand or cause loss of available ground water either directly or indirectly? Yes___ No___ Unk___
   e) Is it necessary to consult a geohydrologist? Yes___ No___ Unk___

   ESTIMATED IMPACT ON GROUND WATER QUANTITY .... ND..HA..MA..LA..O..LB..MB..HB

8. Ground Water Quality
   a) Is information available on present water quality? Yes___ No___ Unk___
   b) Will project decision cause any natural or man made discharges into ground aquifers? Yes___ No___ Unk___
   c) Will project decision help to improve or protect ground water quality? Yes___ No___ Unk___
   d) Could project decision cause deterioration of ground water quality either directly or indirectly? Yes___ No___ Unk___
   e) Is it necessary to consult with a ground water quality specialist Yes___ No___ Unk___

   ESTIMATED IMPACT ON GROUND WATER QUALITY .... ND..HA..MA..LA..O..LB..MB..HB

9. Air Quality
   a) Is information available on existing air quality? Yes___ No___ Unk___
   b) Will project decision produce any air emissions directly? Yes___ No___ Unk___
   c) Will project decision help to reduce existing air pollution sources such as open burning operations? Yes___ No___ Unk___
   d) Could project decision lead to practices that worsen air quality such as causing increased road traffic or industrialization? Yes___ No___ Unk___

9. (Cont.)

e) Could project decision lead to a charge in engine use or fuel combination that could cause serious air problems? Yes___ No___ Unk___

f) Is it necessary to consult an air quality specialist? Yes___ No___ Unk___

ESTIMATED IMPACT ON AIR QUALITY ......ND..HA..MA..LA..O..LB..MB..HB

10. Noise

a) Is noise now a problem in project area? Yes___ No___ Unk___

b) Will project help in reducing undesirable noise conditions? Yes___ No___ Unk___

c) Will project cause temporary or sustained increases in noise generating conditions such as heavy machinery or road travel? Yes___ No___ Unk___

d) Could project cause movements of people to high noise level locations? Yes___ No___ Unk___

e) Is it necessary to consult a noise specialist? Yes___ No___ Unk___

ESTIMATED IMPACT ON NOISE .... ND..HA..MA..LA..O..LB..MB..HB

11. Aquatic Ecosystems

a) Are there any aquatic ecosystems of the types listed below which, by nature of their size, abundance or type, can be considered significant or unique?

rivers?	Yes___	No___	Unk___
streams?	Yes___	No___	Unk___
lakes?	Yes___	No___	Unk___
ponds?	Yes___	No___	Unk___

b) Are these systems essentially:

pristine?	Yes___	No___	Unk___
moderately degraded?	Yes___	No___	Unk___
severely degraded?	Yes___	No___	Unk___

c) Are these systems used by the local people:

i) Consumptively

For drinking water?	Yes___	No___	Unk___
For irrigation?	Yes___	No___	Unk___
For livestock?	Yes___	No___	Unk___

ii) Non-consumptively

For Washing and Bathing?	Yes___	No___	Unk___
For Waste Disposal?	Yes___	No___	Unk___

11. (Cont.)

For Transportation?	Yes___	No___	Unk___
For Harvest of non-domesticated plants or animals as food, fiber fur or other useful product?	Yes___	No___	Unk___
d) Will the project directly affect consumptive use of water?	Yes___	No___	Unk___
e) Will the project directly or indirectly affect either non-consumptive or consumptive uses of these ecosystems by:			
Use or production of toix materials (both during construction and/or operation) which might enter these systems?	Yes___	No___	Unk___
Alteration of drainage patterns?	Yes___	No___	Unk___
Increasing erosion?	Yes___	No___	Unk___
Causing increase in populations so as to place added stress on their systems?	Yes___	No___	Unk___

ESTIMATED IMPACT ON AQUATIC ECOSYSTEMS .... ND..HA..MA..LA..O..LB..MB..HB

12. Wetland Ecosystems

a) Are there any wetland ecosystems of the types listed below which, by nature of their size, abundance or type, can be considered to be significant or unique?			
Marsh?	Yes___	No___	Unk___
Swamp?	Yes___	No___	Unk___
Bog?	Yes___	No___	Unk___
Flood Plain?	Yes___	No___	Unk___
Estuary?	Yes___	No___	Unk___
b) Are these systems:			
pristine?	Yes___	No___	Unk___
Moderately degraded?	Yes___	No___	Unk___
severely degraded?	Yes___	No___	Unk___
c) Are these systems used by local people for:			
Drinking Water?	Yes___	No___	Unk___
Livestock Water?	Yes___	No___	Unk___
Washing and Bathing?	Yes___	No___	Unk___
Waste Disposal?	Yes___	No___	Unk___
Agriculture?	Yes___	No___	Unk___
Harvest of non-domesticated plants or animals as food, fur, or fiber.	Yes___	No___	Unk___

12. (Cont.)

d) Is there currently a trend towards draining wetlands in the project area for conversion to some other use?	Yes___	No___	Unk___
e) Will the project either directly or indirectly affect wetlands by:			
Changing population or land use practices so as to increase drainage of wetlands for use as agricultural, industrial or urban land?	Yes___	No___	Unk___
Use or production (either during construction and/or operation) of toxic materials which might enter wetlands?	Yes___	No___	Unk___
Use the water directly?	Yes___	No___	Unk___
Alter drainage patterns so as to affect wetlands?	Yes___	No___	Unk___
Increase erosion so as to affect wetlands?	Yes___	No___	Unk___

ESTIMATED IMPACT ON WETLAND ECOSYSTEMS.......................ND..HA..MA..LA..O..LB..MB..HB

13. Terrestrial Ecosystems

a) Are there any terrestrial ecosystems of the types listed below which, by nature of their size, abundance or type, could be classified as significant or unique?			
Forest?	Yes___	No___	Unk___
Savanna?	Yes___	No___	Unk___
Grassland?	Yes___	No___	Unk___
Desert?	Yes___	No___	Unk___
b) Are these ecosystems:			
Pristine?	Yes___	No___	Unk___
Moderately Degraded?	Yes___	No___	Unk___
Severely Degraded?	Yes___	No___	Unk___
c) Are there present trends towards alternation of these ecosystems through cutting, burning, etc. to produce agricultural, industrial, or urban land?	Yes___	No___	Unk___
d) Does the local population use these ecosystems to obtain non-domesticated:			
Food plants?	Yes___	No___	Unk___
Medicinal plants?	Yes___	No___	Unk___
Wood products?	Yes___	No___	Unk___
Fiber?	Yes___	No___	Unk___
Fur?	Yes___	No___	Unk___
Food Animals?	Yes___	No___	Unk___

13. (Cont.)

e) Will the project require clearing or alteration of:
Small areas of land in these ecosystems? Yes___ No___ Unk___
Moderate areas of land in these ecosystems? Yes___ No___ Unk___
Large areas of land in these ecosystems? Yes___ No___ Unk___

f) Does the project rely on any raw materials (wood, fiber) from these ecosystems? Yes___ No___ Unk___

g) Will the project decrease use of products from these ecosystems by producing or providing substitute materials? Yes___ No___ Unk___

h) Will the project cause increased population growth in the area, bringing about increased stress on these ecosystems? Yes___ No___ Unk___

ESTIMATED IMPACT ON TERRESTRIAL ECOSYSTEMS .... ND..HA..MA..LA..O..LB..MB..HB

14. Endangered Species

a) Is the existence of endangered species in the project area:
Very unlikely Yes___ No___ Unk___
Probable Yes___ No___ Unk___
Highly probable Yes___ No___ Unk___
Documented fact Yes___ No___ Unk___

b) Are these species:
Of scientific interest only Yes___ No___ Unk___
Of scientific interest and highly sought after by local people for food, hides, sale to animal dealers. Yes___ No___ Unk___

c) Will the project affect the habitat of these animals:
Directly by destruction of habitat? Yes___ No___ Unk___
Indirectly by altering habitat through changing drainage, land use. Yes___ No___ Unk___

d) Will the project increase ease of access to these habitats? Yes___ No___ Unk___

e) Will the project increase population in the project area, thus placing increased pressure on these species and/or on their habitat? Yes___ No___ Unk___

ESTIMATED IMPACT ON ENDANGERED SPECIES .... ND..HA..MA..LA..O..LB..MB..HB

15. Migratory Species

a) In the project area are there any:

Migratory fish?	Yes___	No___	Unk___
Migratory birds?	Yes___	No___	Unk___
Migratory Mammals?	Yes___	No___	Unk___
b) Are these species used by local people for food, fur, or other products?	Yes___	No___	Unk___
c) Will the project require any dams, roads, pipelines or other alignments which could interfere with these migratory animals?	Yes___	No___	Unk___
d) Will the project destroy any habitats (resting, feeding, reproductive) which are critical to these species?	Yes___	No___	Unk___
e) Will increased population place additional stress on these species?	Yes___	No___	Unk___

ESTIMATED IMPACTS ON MIGRATORY SPECIES .... ND..HA..MA..LA..O..LB..MB..HB

16. Beneficial Plants

a) Do non-domesticated plants occur in the project area which are used or sold by local people as:

Food?	Yes___	No___	Unk___
Fiber?	Yes___	No___	Unk___
Fuel?	Yes___	No___	Unk___
Ornament?	Yes___	No___	Unk___
Medicine?	Yes___	No___	Unk___
Forage?	Yes___	No___	Unk___
Building Materials?	Yes___	No___	Unk___

b) Do these plants occur in:

Undisturbed habitats?	Yes___	No___	Unk___
Moderately disturbed habitat?	Yes___	No___	Unk___
Severely disturbed habitat?	Yes___	No___	Unk___

c) Are these plants:

Utilized heavily?	Yes___	No___	Unk___
Utilized moderately?	Yes___	No___	Unk___
Utilized only occasionally?	Yes___	No___	Unk___

d) Is this use:

Peculiar to the local population?	Yes___	No___	Unk___
Universal in the region or country?	Yes___	No___	Unk___

16. (Cont.)

e) Will the project:

Decrease habitat for these plants?	Yes___	No___	Unk___
Increase habitat for these plants?	Yes___	No___	Unk___
Increase access to these plants?	Yes___	No___	Unk___
Provide substitute products or the necessary money to replace the use of these plants?	Yes___	No___	Unk___
Increase use of these plants through increased population?	Yes___	No___	Unk___

ESTIMATED IMPACT ON BENEFICIAL PLANTS .... ND..HA..MA..LA..O..LB..MB..HB

17. Beneficial Animals

a) Do non-domesticated animals occur in the project area which are used or sold by the local people as:

Souvenir products?	Yes___	No___	Unk___
Food?	Yes___	No___	Unk___
Fur?	Yes___	No___	Unk___
Pets?	Yes___	No___	Unk___

b) Do these animals occur in:

Utilized heavily?	Yes___	No___	Unk___
Utilized moderately?	Yes___	No___	Unk___
Utilized only occasionally?	Yes___	No___	Unk___

d) Is this use:

Peculiar to the local population?	Yes___	No___	Unk___
Universal to the region or country?	Yes___	No___	Unk___

e) Will the project:

Decrease habitat for these animals?	Yes___	No___	Unk___
Increase habitat for these animals?	Yes___	No___	Unk___
Increase access to these animals?	Yes___	No___	Unk___
Provide substitute products or necessary money to replace the use of these animals?	Yes___	No___	Unk___
Increase the use of these animals by increased population?	Yes___	No___	Unk___

ESTIMATED IMPACTS ON BENEFICIAL ANIMALS .... ND..HA..MA..LA..O..LB..MB..HB

18. Pest Plants

a) Are there currently any pest plant problems in the project area? Yes___ No___ Unk___
b) Are there any potential pest plant species known to exist in the project area? Yes___ No___ Unk___
c) Are these pest plants associated with:

Severely disturbed land?	Yes___	No___	Unk___
Agricultural land?	Yes___	No___	Unk___
Stagnant or polluted water?	Yes___	No___	Unk___

d) Will the project? Yes___ No___ Unk___

Increase habitat for pest plants?	Yes___	No___	Unk___
Decrease habitat for pest plants?	Yes___	No___	Unk___
Provide opportunity for control of pest plants?	Yes___	No___	Unk___
Increase the possibility of introduction of pest plants through increased commerce?	Yes___	No___	Unk___

ESTIMATED IMPACTS ON PEST PLANTS ..... ND..HA:.MA..LA..O..LB..MB..HB

19. Pest Animals

a) Are there currently any problems with pest animals in the project area? Yes___ No___ Unk___
b) Are there any animals in the project area which, under altered ecological conditions, have the potential for becoming pest species? Yes___ No___ Unk___
c) Are these species associated with:

Severely degrated land?	Yes___	No___	Unk___
Agricultural land?	Yes___	No___	Unk___
Aquatic habitats?	Yes___	No___	Unk___

d) Will the project:

Increase habitat for pest animals?	Yes___	No___	Unk___
Decreased habitat for pest animals?	Yes___	No___	Unk___
Increase the possibility of introduction of pest animals through increased commerce?	Yes___	No___	Unk___
Provide the opportunity for control of pest animals?	Yes___	No___	Unk___

ESTIMATED IMPACT ON PEST ANIMALS .... ND..HA..MA..LA..O..LB..MB..HB

20. Disease Vectors

a) Are there known disease problems in the project area transmitted through vector species such as mosquitos, flies, snails, etc.? Yes___ No___ Unk___

b) Are these vector species associated with:

Aquatic habitats?	Yes___	No___	Unk___
Forest habitats?	Yes___	No___	Unk___
Agricultural lands?	Yes___	No___	Unk___
Degraded habitats?	Yes___	No___	Unk___
Human settlements?	Yes___	No___	Unk___

c) Will the project:

Increase vector habitat?	Yes___	No___	Unk___
Decrease vector habitat?	Yes___	No___	Unk___
Provide opportunity for vector control?	Yes___	No___	Unk___

d) Will the project work force be a possible source of introduction of disease vectors not currently found in the project area? Yes___ No___ Unk___

e) Will increased access to and commerce with the project area be a possible source of disease vectors not presently occurring in the project area? Yes___ No___ Unk___

f) Will the project provide opportunities for vector control through improved standards of living? Yes___ No___ Unk___

ESTIMATED IMPACT ON DISEASE VECTORS ....ND..HA..MA..LA..O..LB..MB.

21. Public Health

a) Are vector-borne diseases an important part of the local public health situation? Yes___ No___ Unk___

b) Are there clinics or other diseae control programs in operation of planned for the area? Yes___ No___ Unk___

c) Will the project decision result in an increase in disease vector density or distribution? Yes___ No___ Unk___

d) Will the project decision result in workers or other persons entering the area with contagious or vector-borne diseases? Yes___ No___ Unk___

e) Will the project decision result in clearing operations that could expose workers to disease vectors? Yes___ No___ Unk___

21. (Cont.)

f) Will the project decision increase the hazard of accident to the local population? Yes___ No___ Unk___

g) Will the project decision improve opportunities for the local population to receive health care? Yes___ No___ Unk___

h) Is it necessary to consult with a public health specialist? Yes___ No___ Unk___

ESTIMATED IMPACT ON PUBLIC HEALTH .........ND..HA..MA..LA..O..LB..MB..HB

22. Resource/Land Use

a) Are the natural resources of the area under intensive use pressure? Yes___ No___ Unk___

b) Are lands in the project area intensively developed? Yes___ No___ Unk___

c) Will the project decision increase pressure on land resources? Yes___ No___ Unk___

d) Will the project decision result in decreased holdings by small land owners? Yes___ No___ Unk___

e) Will the project decision increase depletion rates of natural resources? Yes___ No___ Unk___

f) Should a land use planner be consulted? Yes___ No___ Unk___

ESTIMATED IMPACT ON RESOURCES AND LAND USE.................................ND..HA..MA..LA..O..LB..MB..HB..

23. Conventional/Nonconventional Energy Sources

a) Will the project increase the demand for conventional energy hour sources (petroleum, hydropower)? Yes___ No___ Unk___

b) Will the project increase the demand for nonconventional energy sources (fuelwood, dung, agricultural wanton) Yes___ No___ Unk___

c) Should an energy planner be consulted? Yes___ No___ Unk___

ESTIMATED IMPACT ON ENERGY SOURCES.........ND..HA..MA..LA..O..LB..MB..HB

24. Distribution Systems

a) Are the production/distribution networks for agricultural and manufactured commodities fully understood? Yes___ No___ Unk___

b) Will the project decision enhance the equitable distribution of these products? Yes___ No___ Unk___

c) Will the project decision increase the demand for certain commodities within or outside the area? Yes___ No___ Unk___

24. (Cont.)

d) Will the project decision decrease the demand for certain locally produced goods? Yes___ No___ Unk___

e) Will the project decision improve the ease with which consumers in the area obtain commodities? Yes___ No___ Unk___

f) Will the project decision decrease the production of certain vital commodities? Yes___ No___ Unk___

g) Is it necessary to consult a social anthropologist? Yes___ No___ Unk___

ESTIMATED IMPACT ON DISTRIBUTION SYSTEM..................................ND..HA..MA..LA..O..LB..MB..HB

25. <u>Employment</u>

a) Is the potential work force in the area fully employer? Yes___ No___ Unk___

b) Will the project decision substantially increase the rate of employment? Yes___ No___ Unk___

c) Will the project decision remove job opportunities in the area? Yes___ No___ Unk___

d) Will the project decision result in drawing workers from other local employers? Yes___ No___ Unk___

e) Is it necessary to consult with a socioeconomist? Yes___ No___ Unk___

ESTIMATED IMPACT ON EMPLOYMENT............ND..HA..MA..LA..O..LB..MB..HB

26. <u>At-Risk Population</u>

a) Are the adverse impacts of the project unequally distributed in the target population? Yes___ No___ Unk___

b) Have the at-risk groups been identified? Yes___ No___ Unk___

c) Have all possible actions been identified that would lessen the impact on at-risk groups? Yes___ No___ Unk___

d) In the assistance of a social anthropologist required to adequately answer these questions? Yes___ No___ Unk___

ESTIMATED IMPACT ON AT-RISK POPULATION.....ND..HA..MA..LA..O..LB..MB..HB..

27. Migrant Populations

a) Are there presently certain mobile groups in the target population? Yes___ No___ Unk___

b) Will the project decision result in immigration of people to the area? Yes___ No___ Unk___

c) Are local institutions and agencies adequately geared to handle this influx? Yes___ No___ Unk___

d) Will the project decision result in the movement of people out of the area? Yes___ No___ Unk___

e) Can their probable destinations be predicted? Yes___ No___ Unk___

f) Are local institutions and agencies or receiving agencies able to handle these migrant groups? Yes___ No___ Unk___

g) Is it necessary to consult a social anthropologist? Yes___ No___ Unk___

ESTIMATED IMPACT ON MIGRANT POPULATIONS....ND..HA..MA..LA..O..LB..MB..HB..

28. Community Stability

a) Are the interrelationships of various social groups in the project area understood? Yes___ No___ Unk___

b) Will the project decision establish institutions that will improve these interrelationships? Yes___ No___ Unk___

c) Will the project decision create competition among social groups that would reduce community cohesion? Yes___ No___ Unk___

d) Is it necessary to consult a social anthropologist? Yes___ No___ Unk___

ESTIMATED IMPACT ON COMMUNITY STABILITY..................................ND..HA..MA..LA..O..LB..MB..HB

29. Cultural and Religious Values

a) Have studies been conducted of the cultural values of the project area? Yes___ No___ Unk___

b) Are the cultural characteristics unique to the project area adequately known? Yes___ No___ Unk___

c) Will the project decision adversely affect the religious attitudes of area residents? Yes___ No___ Unk___

d) Are there special superstitions or religious taboos that will affect the acceptance of the project by the target population? Yes___ No___ Unk___

e) Is it necessary to consult a social anthropologist? Yes___ No___ Unk___

ESTIMATED IMPACT ON CULTURAL AND RELIGIOUS VALUES...........................ND..HA..MA..LA..O..LB..MB..HB

30. Tourism and Recreation

a) Is there at present a significant degree of tourism in the area? Yes___ No___ Unk___
b) Is there unexploited tourism or recreation potential in the area? Yes___ No___ Unk___
c) Will the project decision result in more effective utilization of present or future tourism opportunities? Yes___ No___ Unk___
d) If so, will this adversely affect the lifestyles of local people? Yes___ No___ Unk___
e) Will the project decision adversely affect an existing or potential tourist or recreation attraction? Yes___ No___ Unk___

ESTIMATED IMPACT ON TOURISM AND RECREATION..........................ND..HA..MA..LA..O..LB..MB..HB

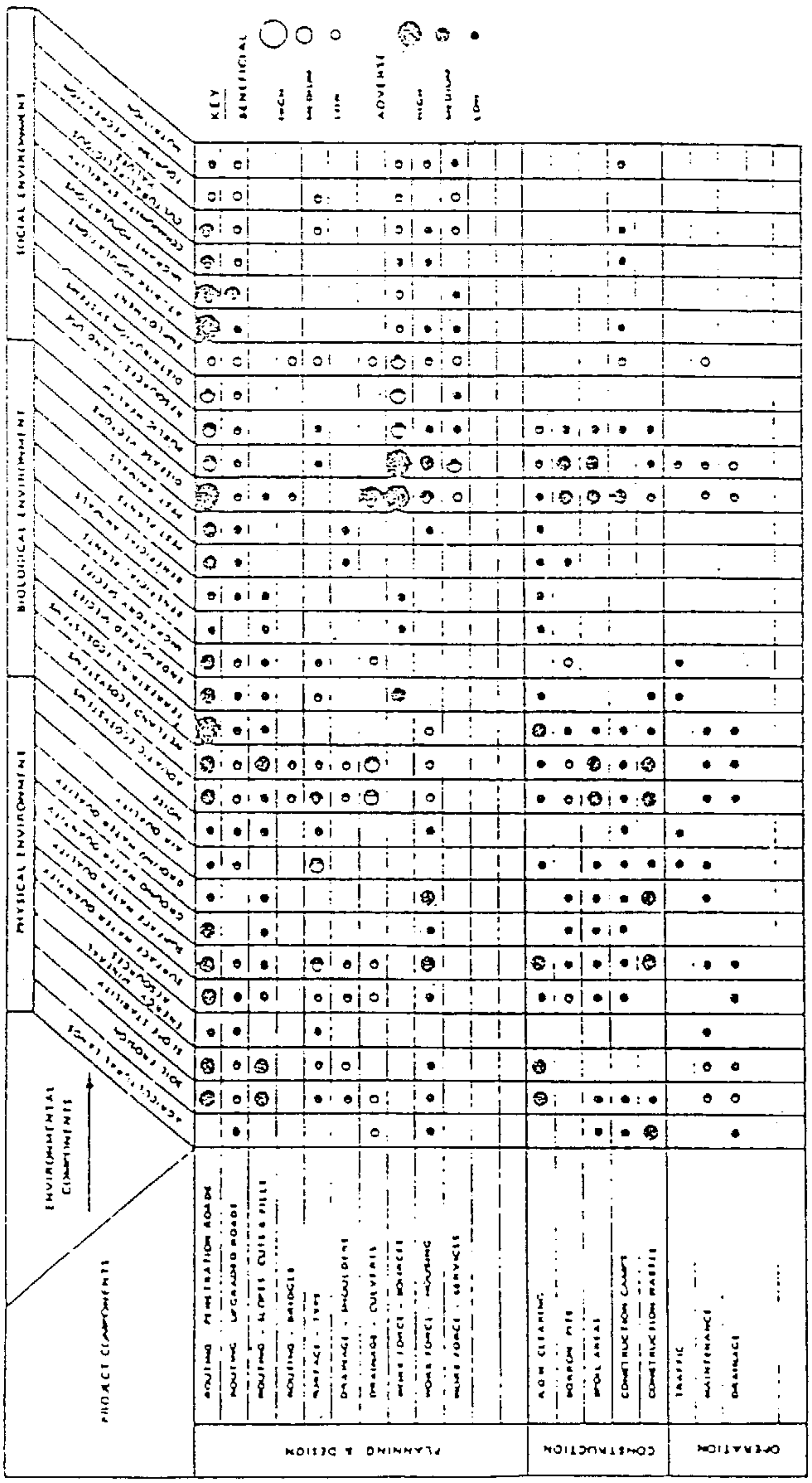
31. Nutrition

a) Have adequate data been gathered on the nutritional levels in the project area? Yes___ No___ Unk___
b) Do these data differentiate among various population subgroups, by age, sex or social level? Yes___ No___ Unk___
c) Will the project decision result in changed food habits in the target population? Yes___ No___ Unk___
d) Will these changes result in higher caloric levels and improved nutritional characteristics? Yes___ No___ Unk___
e) Are the services of a nutrition specialist required? Yes___ No___ Unk___

ESTIMATED IMPACT ON NUTRITION.......ND..HA..MA..LA..O..LB..MB..HB

EXHIBIT J

RURAL ROADS POTENTIAL IMPACTS



C.5 Descriptive Checklist for Land Development Projects (Schaenman, 1976)

Factor	Bases for Estimates
I. Local Economy	
Public Fiscal Balance	
1. Net change in government fiscal flow (revenues less expenditures).	Public revenues: expected household incomes by residential housing type; added property values. Public expenditures: analysis of new service demand, current costs; available capacities by service.
Employment	
2. Change in numbers and percent employed, unemployed, underemployed, by skill level.	Direct from new business; or estimated from floor space, local residential patterns, expected immigration, current unemployment profiles.
Wealth	
3. Change in land values.	Supply and demand of similarly zoned land, environmental changes near property.
II. Natural Environment	
Air Quality	
Health	
4. Change in air pollution concentrations by frequency of occurrence and number of people at risk.	Current ambient concentrations, current and expected emissions, dispersion models, population maps.
Nuisance	
5. Change in occurrence of visual (smoke, haze) or olfactory (odor) air quality nuisances, and number of people affected.	Baseline citizen survey, expected industrial processes, traffic volumes.
Water Quality	
6. Changes in permissable or tolerable water uses and number of people affected - for each relevant body of water.	Current and expected effluents, current ambient concentrations, water quality model.
Noise	
7. Change in noise levels and frequency of occurrence, and number of people bothered.	Changes in nearby traffic or other noise sources, and in noise barriers; noise propagation model o nomographs relating noise levels to traffic, barriers, etc.; baseline citizen survey of current satisfaction with noise levels.
Wildlife and Vegetation	
8. Change in diversity and population size (abundance) of wildlife and vegetation (including trees) of common species.	Wildlife and vegetation inventory; expected removal of cover or changes to habitats.
9. Change in numbers of rare or endangered species.	Changes in amount and quality of (a) habitat by animal type; (b) green space, or (c) number of mature trees.

(Continued)

Factor	Bases for Estimates
Natural Disasters	
10. Change in number of people and value of property endangered by: flooding, earthquakes, landslides, mudslides, and other natural disasters, by frequency of occurrence.	Flood plain and other hazard maps; changes in local topography and sewerline; change in percent permeable cover; stream flow and hydraulic models.
III. Aesthetics and Cultural Values	
Attractiveness	
11. Change in number and percent of citizens who are satisfied with neighborhood appearance.	Baseline citizen survey of ratings of current attractiveness and identification of problems and assets; visual simulation of proposed development using retouched photos, drawings or 3-D models for assessing future preferences using a sample of citizens.
View Opportunities	
12. Change in number or percent of citizens satisfied with views from their homes (or businesses).	Baseline citizen survey; geometric analysis of structures to identify view opportunities before and after development.
Landmarks	
13. Number and perceived importance of cultural, historic, or scientific landmarks to be lost, made less accessible, or made more accessible.	Inventory and importance ranking of landmarks; survey of citizens and scholars regarding importance.
IV. Public and Private Services	
Drinking Water	
Availability	
14. Change in frequency duration and severity of water shortage incidents, and number of people affected.	Current usage, expected new demand; projected supplies.
Quality	
15. Changes in salinity and other indices of drinking water quality and safety, and number of people affected.	Expected effluents from new development; purification process used; current and expected usage; profile of underground water systems.
Hospital Care	
Emergency Care Availability	
16. Change in number of citizens	Maps of population distribution and emergency facilities; number of emergency vehicles (if any), expected calls, and dispatch policy.
Availability/Crowdedness	
17. Change in potential bed need versus bed supply of area hospitals, by type of clinical service (medical, surgical, pediatric, obstetrical).	Current patient hospital bed days per 1000 population by sex-age group and medical service; available bed capacities; expected population by sex-age group.

(Continued)

Factor	Bases for Estimates
Crime Control	
Crime Rate	
18. Change in rate of crimes in existing community.	Current crime rates and case histories of similar neighborhood changes; changes in community lighting, sightlines, hiding places, people mix.
Feeling of Security	
19. Change in percent of people feeling a lack of security from crime.	Baseline citizen survey plus the data above.
Fire Protection	
20. Change in fire incidence, property loss, and casualty rates.	Incident rates by occupancy types; people mix; available water supply; available fire suppression equipment and manning; likely building materials; site plan if available.
Recreation-Public Facilities	
Overall Satisfaction	
21. Change in number and percent of households satisfied with public recreation opportunities.	Baseline citizen surveys, and expected changes in facilities and environment (noise, air quality, dangers).
22. Change in number or percent of households using facilities (viewed relative to nominal capacity), by facility.	Citizen survey.
Accessibility	
23. Change in number and percent of households with access to various types of recreation facilities within x minutes travel, by type of facility and mode of travel.	Maps of facilities and distribution of population; citizen survey of travel mode.
Recreation-Informal Settings	
Overall Satisfaction	
24. Change in number or percent of households satisfied with recreation in informal outdoor spaces in neighborhood.	Baseline citizen survey and observation of current usage patterns; physical environment changes expected.
Availability	
25. Change in availability of informal physical settings for recreation and number of people affected.	Changes in open space and physical environment expected.
Education	
Accessibility/Convenience	
26. Change in number and percent of households satisfied with accessibility of schools.	Citizen survey; changes in available path, nearby traffic conditions en route to schools.
27. Change in number and percent of students within x minutes, by type of school and travel mode.	Map of school and population distribution; busing records.

(Continued)

Factor	Bases for Estimates
28. Number and percent of students having to switch schools or busing status.	Relation of capacity to expected demands, and school board policy.
Crowdedness	
29. Change in school crowdedness indicators: e.g., student-teacher ratios, number of shifts.	Citizen survey; expected change in noise, traffic hazards, air quality, other hazards.
Transportation-Mass Transit	
Satisfaction	
30. Change in number and percent of households satisfied with mass transit service.	Citizen survey, expected service changes, expected change in factors affecting satisfaction.
	Usage levels, from fares and surveys.
Accessibility	
31. Change in number and percent of citizens residing (or working) within x feet of public transit stop.	
Transportation-Pedestrians	
Satisfaction/Accessibility	
32. Change in number and percent of households satisfied with walking conditions and walking opportunities in their neighborhood.	Baseline citizen survey, estimated changes in physical walking conditions; additions or removals of desired destinations.
Safety	
See measures 33 and 34 below.	N/A
Transportation-Private Vehicles	
Safety	
33. Change in number and percent of households satisfied with traffic safety (vehicle and pedestrian).	Baseline citizen survey, changes in traffic and traffic controls; circulation patterns.
34. Change in number and severity of accidents per 1,000 persons by pedestrians and riders.	Accident frequency and causation data: changes in traffic and traffic controls, circulation patterns, expected traffic volumes.
Travel Time	
35. Change in vehicular travel times between selected origins and destinations, by time of day and day of week.	Current traffic volumes; changes in street layout, width and traffic controls; estimated net new vehicular trips.

(Continued)

Factor	Bases for Estimates
Parking Availability	
36. Change in average time needed to find acceptable parking space within x feet of residence (or desired destinations) in neighborhood of development, by time of day and day of week.	Current spaces available; new demand and supply; math model for estimating parking times.
37. Percent of drivers finding neighborhood parking satisfactory.	Baseline citizen survey; expected changes in supply and demand for spaces.
Shopping	
38. Change in number and percent of households satisfied with shopping opportunities.	Baseline citizen survey: change in physical conditions around shopping areas.
39. Change in number and percent of households within x minutes travel time to shopping, by type store and mode of travel.	Map showing location of stores and population, before and after development.
Energy Services	
40. Change in the frequency and duration of energy shortages, and the number of people affected, by fuel type.	Current and expected usage and supply in community; design and construction of buildings, type of manufacturing activity expected.
Housing	
41. Change in number and percent of housing units that are substandard and the number of people living in them.	Current housing stock conditions number to be removed or improved.
42. Change in number and percent of housing units relative to need, by type of housing (price, owner/rental, number of bedrooms, style, etc.)	Current profile of housing units added or destroyed; past housing chain effects in distribution of population by income level, indicators of latent demand for housing.
V. Other Social Impacts (in addition to those included above)	
People Displacement	
43. Number of residents (or workers) displaced by development, and whether satisfied with move.	Number of persons living in building to be destroyed; special survey of them.
Special Hazards	
44. Number of children physically at risk from "special" hazards created by development (e.g., machinery, junk, unguarded deep water).	Physical outdoor changes expected.

(Continued)

Factor	Bases for Estimates
Sociability/Friendliness	
45. Change in social interaction patterns (e.g., frequency of neighboring, community activities).	Baseline survey of current neighboring and community activity patterns; changes in availability of community and small group meeting places; changes in physical barriers (e.g., highways, fences, heavy traffic, buildings which hinder access from one area of a neighborhood to another or footbridges or removal of barriers linking the areas); changes in people mix.
Privacy	
46. Change in number and percent of households satisfied with privacy in outdoor areas around home.	Citizen survey; geometric analysis of sightlines; changes in sight and sound barriers.
Overall Contentment with Neighborhood	
47. Change in number and percent of citizens satisfied with their residential (or work) neighborhood.	Citizen survey using data from other measures.

C.6 Section of Checklist Developed by Clark et al., 1981.

EXISTING LEVELS OF ENVIRONMENTAL POLLUTION

Air pollution

a. Will the installation significantly alter the levels of atmospheric pollutants in the local authority area?
b. Will the release of atmospheric pollutants be a hazard to human health, crops, livestock, wildlife and stonework?
c. Will inversion lead to a local build up of high levels of pollutants from the new installation?
d. Will there be significant synergistic effects with existing pollutants in the atmosphere?
e. Will the distribution of wind direction cause significant fumigation of areas sensitive to atmospheric pollution?
f. Will the installation produce significant quantities of particulate matter which will be a nuisance to the local community?
g. Will the installation produce offensive odours?

Water pollution

a. Will effluents, treated or untreated, have a significant effect on the flora and fauna of the river, canal, lake, estuary or coastal waters?
b. Will effluents find their way into surface water by means of underground waters?
c. Are there stretches downstream where effluents are likely to change the flora and fauna?
d. Will there be significant synergistic effects with existing pollutants in the receiving waters and/or between constituents of the effluents?
e. Will there be significant potentiation effects with existing constituents of the effluents or receiving waters?
f. Will the discharges lead to the build up of locally high levels of pollutants?
g. Will variations in water flow (e.g. seasonal) cause a significant increase in the concentration of pollutants?
h. Will salinity gradients and/or current movements in estuaries lead to locally high build up of pollutants and cause problems of dispersion?
j. Will fishing (commercial and recreational) be affected by discharges?
k. Will other water-based activities such as water-skiing, canoeing, sailing etc. be affected by discharges?
l. Will there be any odour likely to cause offence?
m. What dependent communities or species of animals and birds are likely to be affected by a change in the aquatic flora and fauna?
n. Are there any sensitive plant communities dependent on the receiving waters for their supply which are likely to be adversely affected by discharges (including fines) from the development?
p. Do any horticultural or agricultural enterprises use receiving waters for irrigation?

C.7 Assignment of Scales for Water Quality Impact in Housing and Urban Development Methodology (Voorhees and Associates, 1975)

Scale	Comments
A+	Clearly beneficial effects are likely to occur.
A	Water quality standards are met for water uses intended by project. Wastewater will be discharged into wastewater treatment system with available capacity.
B	Water quality standards are met for water uses intended by project. Wastewater may not receive "best available" treatment. Ground water may be polluted. Ameliorative actions are possible.
C	Existing water quality is at or below official standards. Project may cause pollution of ground water.
C-	Project will cause surface or ground water quality standards to be exceeded.

C.8 Weighting-Ranking Checklist for Wastewater Treatment Plant Site Evaluation (Wilson, 1980)

Factor to be considered	Significance of Factor	Importance to decision (2 = most)	Ranking (Scale 1 = worst; 3 = best) Site A	Site B	Site C
1. Construction cost	One-time cost with federal share	1	2	2.5	3
2. Operating cost	Ongoing cost; includes energy costs (all local share)	2	1	2	3
3. Non potable reuse	"Safe", economic benefit; key is proximity to users	2	1	2	3
4. Potable reuse	More long-range than 3; best sites are near well field or water plant; industrial sewage should not be present	1	3	2.5	1
5. Odor potentials	Assumes good plant design and operation	2	2	1	3
6. Other land use conflicts	Potential to interfere with agricultural/ residential land	1	2	1	3
7. Site area available	Future expansion capability, flexibility	2	3	2	1
8. Relationship to growth area	Assumes growth to State line (in 50 year time frame)	1	3	2	1
9. Construction impacts	Reworking of lines	1	1	2	3
10. Health of workers	Air pollution	1	3	3	2
11. Implementation capability	Land acquisition problems	1	3	1	2
12. Operability	One plant is better than two	1	1	2	3
13. Performance reliability	Assumes equal treatment plants	1	2	2	2
14. TOTAL	Ranking times Importance, added up Highest number - best site		34	32	40

C.9 Evaluation of Treatment Alternatives for Twining, New Mexico (U.S. Environmental Protection Agency, (1981)

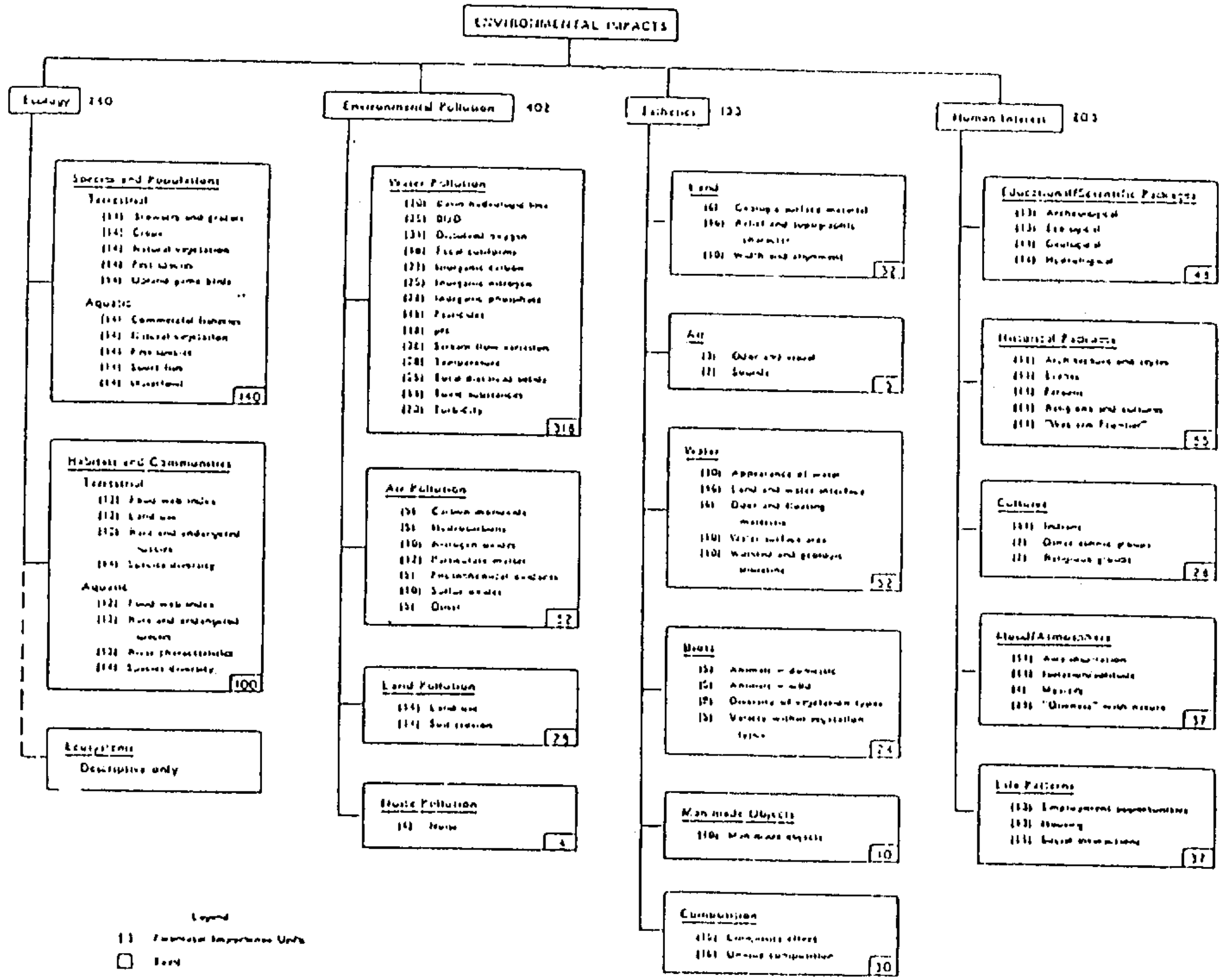
ISSUES are identified by letter, as follows. A = Cost. B = Reliability. C = Water quality. D = Water supply. E = Construction impacts. F = Land use (growth). G = Community conflict. H = Benefits to region.

Name of alternative	Brief description of alternative	Ratings on ISSUES a/ A	B	C	D	E	F	G	H
1. Conventional - new plant	Build new plant in Twining using advanced technology which needs energy, chemicals	1	2	2	2	1	2	1	3
2. Aquaculture	Build new plant in Twining using new technology which grows algae in ponds inside a greenhouse	1	2	2	2	1	2	1	2
3. Septic tanks	Abandon the sewer system; everyone uses septic tanks	1	1	3	2	1	1	1	3
4. Greywater/ blackwater	Some sewage goes to existing (renovated) plant; toilet wastes to composting toilets	2	3	2	2	1	2	1	3
5. Storage and discharge	Store the winter sewage and discharge it in spring when river can better assimilate nutrients	1	2	3	1	[illegible]	2	1	3
6. Total detention	Pipe sewage to ponds near Arroyo Seco and evaporate it	3	1	1	3	3	2	2	2
7. Land application (farming)	Pipe sewage to ponds near Arroyo Seco and let farmers use it for irrigation	2	2	2	1	3	2	3	2
8. Pipeline to Rio Grande	Renovate existing Twining plant; build pipeline to Rio Grande (west of Arroyo Honda) and discharge sewage there	2	2	1	3	2	2	2	[illegible]
9. Holding tanks	Store sewage in ponds in Twining and use trucks to haul it to the Town of Taos sewage plant	1	2	1	3	1	2	2	3
10. Regional plant in Hondo Valley	Pipe sewage to a new regional sewage plant near Arroyo Honda	2	3	1	3	3	3	3	1
11. Regional plant in Taos	Pipe sewage to Town of Taos sewage plant	2	3	1	3	2	3	3	1

(Continued)

12. Rehabilitation	Renovate existing plant and add on advanced processes for nutrient removal	1	3	2	2	1	2	1	3
13. Total treatment	Build very complex plant in Twining which would turn sewage into drinking water for use by Twining	3	3	1	2	1	2	1	3
14. Greywater evaporation	Combine alternatives 4 and 5: compost toilets, greywater evaporation	3	3	1	3	3	2	2	2
15. Aquaculture + snowmaking	Combine alternatives 2 and 3	2	2	3	1	1	2	1	2

a. 1 = less impact (best rating); 2 = intermediate impact; 3 = more impact.



C 10 Battelle Environmental Evluation System (Dee et al., 1972)
(Weighting-scaling Checklist for Water Resources Projects)

C.11 Checklist used in EES.
(From Dee et al., 1973)

ECOLOGY

Terrestrial species and populations
Browsers and grazers (14)
Crops (14)
Natural vegetation (14)
Pest species (14)
Upland game birds (14)

Aquatic species and populations
Commercial fisheries (14)
Natural vegetation (14)
Pest species (14)
Sport fish (14)
Waterfowl (14)

Terrestrial habitats and communities
Food web index (12)
Land use (12)
Rare and endangered species
Species diversity (14)

Aquatic habitats and communities
Food web index (12)
Rare and endangered species (12)
River characteristics (12)
Species diversity (14)

Ecosystems
Descriptive only

AESTHETICS

Land
Geologic surface material (6)
Relief and topographic character (16)
Width and alignment (10)

Air
Odour and visual (3)
Sounds (2)

Water
Appearance of water (10)
Land and water interface (16)
Odour and floating material (6)
Water surface area (10)
Wooded and geologic shoreline (10)

Biota
Animals—domestic (5)
Animals—wild (5)
Diversity of vegetation types (9)
Variety within vegetation types (5)

Man-made objects
Man-made objects (10)

Composition
Composite effects (15)
Unique composition (15)

PHYSICAL/CHEMICAL

Water quality
Basin hydrologic loss (20)
Biochemical oxygen demand (25)
Dissolved oxygen (31)
Faecal coliforms (18)
Inorganic carbon (22)
Inorganic nitrogen (25)
Inorganic phosphate (28)
Pesticides (16)
pH (18)
Streamflow variation (28)
Temperature (28)
Total dissolved solids (25)
Toxic substances (14)
Turbidity (20)

Air quality
Carbon monoxide (5)
Hydrocarbons (5)
Nitrogen oxides (10)
Particulate matter (12)
Photochemical oxidants (5)
Sulphur oxides (10)
Other (5)

Land pollution
Land use (14)
Soil erosion (14)

Noise pollution
Noise (4)

HUMAN INTEREST/SOCIAL

Education/scientific
Archeological (13)
Ecological (13)
Geological (11)
Hydrological (11)

Historical
Architecture and styles (11)
Events (11)
Persons (11)
Religions and cultures (11)
" Western Frontier " (11)

Cultures
Indians (14)
Other ethnic groups (7)
Religious groups (7)

Mood/atmosphere
Awe inspiration (11)
Isolation/solitude (11)
Mystery (4)
" Oneness " with nature (11)

Life patterns
Employment opportunities (13)
Housing (13)
Social interactions (11)

APPENDIX D ; MATRIX METHODOLOGIES

D.1 Actions and Environmental Items in Leopold Interaction Matrix

Actions

Category		Description
A Modification of regime	a	Exotic fauna introduction
	b	Biological controls
	c	Modification of habitat
	d	Alteration of ground cover
	e	Alteration of groundwater hydrology
	f	Alteration of drainage
	g	River control and flow modification
	h	Canalization
	i	Irrigation
	j	Weather modification
	k	Burning
	l	Surface or paving
	m	Noise and vibration
B Land transformation and construction	a	Urbanization
	b	Industrial sites and buildings
	c	Airports
	d	Highways and bridges
	e	Roads and trails
	f	Railroads
	g	Cables and lifts
	h	Transmission lines, pipelines, and corridors
	i	Barriers including fencing
	j	Channel dredging and straightening
	k	Channel revertments
	l	Canals
	m	Dams and impoundments
	n	Piers, seawalls, marinas, and sea terminals
	o	Offshore structures
	p	Recreational structures
	q	Blasting and drilling
	r	Cut and fill
	s	Tunnels and underground structures
C Resource extraction	a	Blasting and drilling
	b	Surface excavation

Environmental items

Category		Description
A Physical and chemical characteristics		
1 Earth	a	Mineral resources
	b	Construction material
	c	Soils
	d	Land form
	e	Force fields and background radiation
	f	Unique physical features
2 Water	a	Surface
	b	Ocean
	c	Underground
	d	Quality
	e	Temperature
	f	Recharge
	g	Snow, ice, and permafrost
3 Atmosphere	a	Quality (gases, particulates)
	b	Climate (micro, macro)
	c	Temperature
4 Processes	a	Floods
	b	Erosion
	c	Deposition (sedimentation, precipitation)
	d	Solution
	e	Sorption (ion exchange, complexing)
	f	Compaction and settling
	g	Stability (slides, slumps)
	h	Stress-strain (earthquakes)
	i	Air movements
B Biological conditions		
1 Flora	a	Trees
	b	Shrubs
	c	Grass
	d	Crops
	e	Microflora
	f	Aquatic plants
	g	Endangered species
	h	Barriers

Actions		Environmental items	
Category	Description	Category	Description
	c Subsurface excavation and retorting		i Corridors
		2 Fauna	a Birds
	d Well dredging and fluid removal		b Land animals including reptiles
	e Dredging		c Fish and shellfish
	f Clear cutting and other lumbering		d Benthic organisms
			e Insects
	g Commercial fishing and hunting		f Microfauna
			g Endangered species
D Processing	a Farming		h Barriers
	b Ranching and grazing		i Corridors
	c Feed lots	C Cultural factors	
	d Dairying	1 Land use	a Wilderness and open spaces
	e Energy generation		
	f Mineral processing		b Wetlands
	g Metallurgical industry		c Forestry
			d Grazing
	h Chemical industry		e Agriculture
	i Textile industry		f Residential
	j Automobile and aircraft		g Commercial
			h Industry
	k Oil refining		i Mining and quarrying
	l Food	2 Recreation	a Hunting
	m Lumbering		b Fishing
	n Pulp and paper		c Boating
	o Product storage		d Swimming
E Land alteration	a Erosion control and terracing		e Camping and hiking
			f Picnicking
	b Mine sealing and waste control		g Resorts
		3 Aesthetic and human interest	a Scenic views and vistas
	c Strip mining rehabilitation		b Wilderness qualities
	d Landscaping		c Open-space qualities
	e Harbor dredging		d Landscape design
	f Marsh fill and drainage		e Unique physical features
F Resource renewal	a Reforestation		f Parks and reserves
	b Wildlife stocking and management		g Monuments
			h Rare and unique species or ecosystems
	c Groundwater recharge		
	d Fertilization application		i Historical or archeological sites and objects
	e Waste recycling		
G Changes in traffic	a Railway		
	b Automobile		j Presence of misfits
	c Trucking	4 Cultural status	a Cultural patterns (life-style)
	d Shipping		

Actions		Environmental items	
Category	Description	Category	Description
	e Aircraft		b Health and safety
	f River and canal traffic		c Employment
			d Population density
	g Pleasure boating	5 Manufactured facilities and activities	a Structures
	h Trails		b Transportation network (movement, access)
	i Cables and lifts		
	j Communication		
	k Pipeline		c Utility networks
H Waste replacement and treatment	a Ocean dumping		d Waste disposal
	b Landfill		e Barriers
	c Emplacement of tailings, spoils, and overburden		f Corridors
		D Ecological relationships	a Salinization of water resources
	d Underground storage		b Eutrophication
	e Junk disposal		c Disease–insect vectors
	f Oil well flooding		d Food chains
	g Deep well emplacement		e Salinization of surficial material
	h Cooling water discharge		f Brush encroachment
			g Other
	i Municipal waste discharge including spray irrigation	E Others	
	j Liquid effluent discharge		
	k Stabilization and oxidation ponds		
	l Septic tanks, commercial and domestic		
	m Stack and exhaust emission		
	n Spent lubricants		
I Chemical treatment	a Fertilization		
	b Chemical deicing of highways, etc.		
	c Chemical stabilization of soil		
	d Weed control		
	e Insect control (pesticides)		
J Accidents	a Explosions		
	b Spills and leaks		
	c Operational failure		
K Others			

RISKS / POPULATION	Transmissible by direct contact	Preventible through vaccination	Sexually transmitted	Acute respiratory	Transmitted by sylvatic vectors	Transmitted by urban or domiciliary vectors	Zoonoses	Water or food transmission	Malnutrition	Toxic. through contamination	Occupational	Traumatic	Mental	Chronic
Existing urban														
Existing rural														
Fishermen and families														
Project workers														
Organized workers														
Spontaneous services														
Marginal resettled														
Marginal displaced														
Marginal newly formed														
Visitors and tourists														
Downstream														

D.2 Matrix for Assessment of Environmental Health Risks on Different Population Categories (PEEM Secretariat, 1983)

Code: 5 - Much Augmented
4 - Moderately Augmented
3 - Unchanged
2 - Moderately Diminished
1 - Much Diminished

Note: This matrix is designed as a quantitative assessment of health problems: it must be used repeatedly as a project progreses, i.e. at the onset and after 1, 2, 5, 10 years, etc. The code is self-explanatory but may be modified to include actual case statistics if and when available.

	Currents	Wind	Water temperature	Light	Intertidal vegetation	Upland vegetation	Bacteria	Insects	Larvae	Shell fish	Crabs	Other crustaceans	Pelagic fish	Bottom fish	Waterbirds	Birds of prey	Song birds	Marsh & shore birds	Upland game birds	Aquatic mammals	Upland mammals
Currents		1																			
Wind						1															
Water temperature	1	1		1																	
Light																					
Intertidal vegetation	1		1	1																	
Upland vegetation				1			1	1									1	1	1		1
Bacteria			1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1
Insects	1	1	1		1	1	1														
Larvae	1		1		1		1			1	1	1	1	1							
Shell fish	1		1		1		1														
Crabs			1		1				1	1		1	1	1							
Other crustaceans			1		1		1	1	1	1	1		1	1							
Pelagic fish			1					1	1												
Bottom fish			1		1			1	1	1	1	1	1								
Waterbirds					1			1	1	1	1	1	1	1							
Birds of prey						1		1			1	1	1	1	1		1	1	1		1
Song birds						1		1		1		1	1	1							
Marsh & shore birds						1		1		1	1	1	1	1							
Upland game birds						1		1													
Aquatic mammals										1	1	1	1	1							
Upland mammals						1				1	1	1					1		1		

Note: A(1) in any cell indicates that the row component is dependent on the column component.

D.3 Component Interaction Matrix (From Environment Canada, 1974)

CURRENTS	WIND	WATER TEMPERATURE	LIGHT	INTERTIDAL VEGETATION	UPLAND VEGETATION	BACTERIA	INSECTS	LARVAE	SHELLFISH	CRABS	OTHER CRUSTACEANS	PELAGIC FISH	BOTTOM FISH	WATER BIRDS	BIRDS OF PREY	SONG BIRDS	MARSH & SHORE BIRDS	UPLAND & GAME BIRDS	AQUATIC MAMMALS	UPLAND MAMMALS	
4	1	4	3	4	2	3	3	4	4	4	4	4	4	4	4	3	3	3	4	3	CURRENTS
3	3	3	2	3	1	2	2	3	3	3	3	3	3	3	3	2	2	2	3	2	WIND
1	1	4	1	4	2	3	3	4	4	4	4	4	4	4	4	3	3	3	4	3	WATER TEMPERATURE
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LIGHT
1	2	1	1	5	3	4	4	5	5	5	5	5	5	5	5	4	4	4	5	4	INTERTIDAL VEGETATION
2	2	2	1	2	2	1	1	2	2	2	2	2	2	2	2	1	1	1	2	1	UPLAND VEGETATION
2	2	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	BACTERIA
1	1	1	2	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	INSECTS
1	2	1	2	1	2	1	2	2	1	1	1	1	1	2	2	2	3	2	2	2	LARVAE
1	2	1	2	1	2	1	2	2	2	2	2	2	1	2	2	2	3	2	2	2	SHELL FISH
2	2	1	2	1	3	2	2	1	1	2	1	1	1	3	3	3	4	3	3	3	CRABS
2	2	1	2	1	2	1	1	1	1	1	2	1	2	2	2	2	3	2	2	2	OTHER CRUSTACEANS
2	2	1	2	2	2	2	1	1	2	2	2	2	2	3	3	3	3	3	3	3	PELAGIC FISH
2	2	1	2	1	2	2	1	1	1	1	1	1	2	3	3	3	3	3	3	3	BOTTOM FISH
2	2	2	2	1	2	2	1	1	1	1	1	1	1	3	3	3	3	3	3	3	WATER BIRDS
2	2	2	2	2	1	2	1	2	2	1	1	1	1	1	3	1	1	1	3	1	BIRDS OF PREY
2	2	2	2	2	1	2	1	2	1	2	1	2	1	3	3	2	2	2	3	2	SONG BIRDS
2	2	2	2	2	1	2	1	2	1	1	1	2	1	3	3	2	2	2	3	2	MARSH & SHORE BIRDS
2	2	2	2	2	1	2	1	3	3	3	3	3	3	3	3	2	2	2	3	2	UPLAND & GAME BIRDS
2	3	2	3	2	3	2	2	2	1	1	1	1	1	3	3	3	4	3	3	3	AQUATIC MAMMALS
2	3	2	2	2	1	2	2	2	1	1	1	2	2	3	3	1	2	1	3	2	UPLAND MAMMALS

D.4 Minimum Link Matrix
(From Environment Canada, 1974)

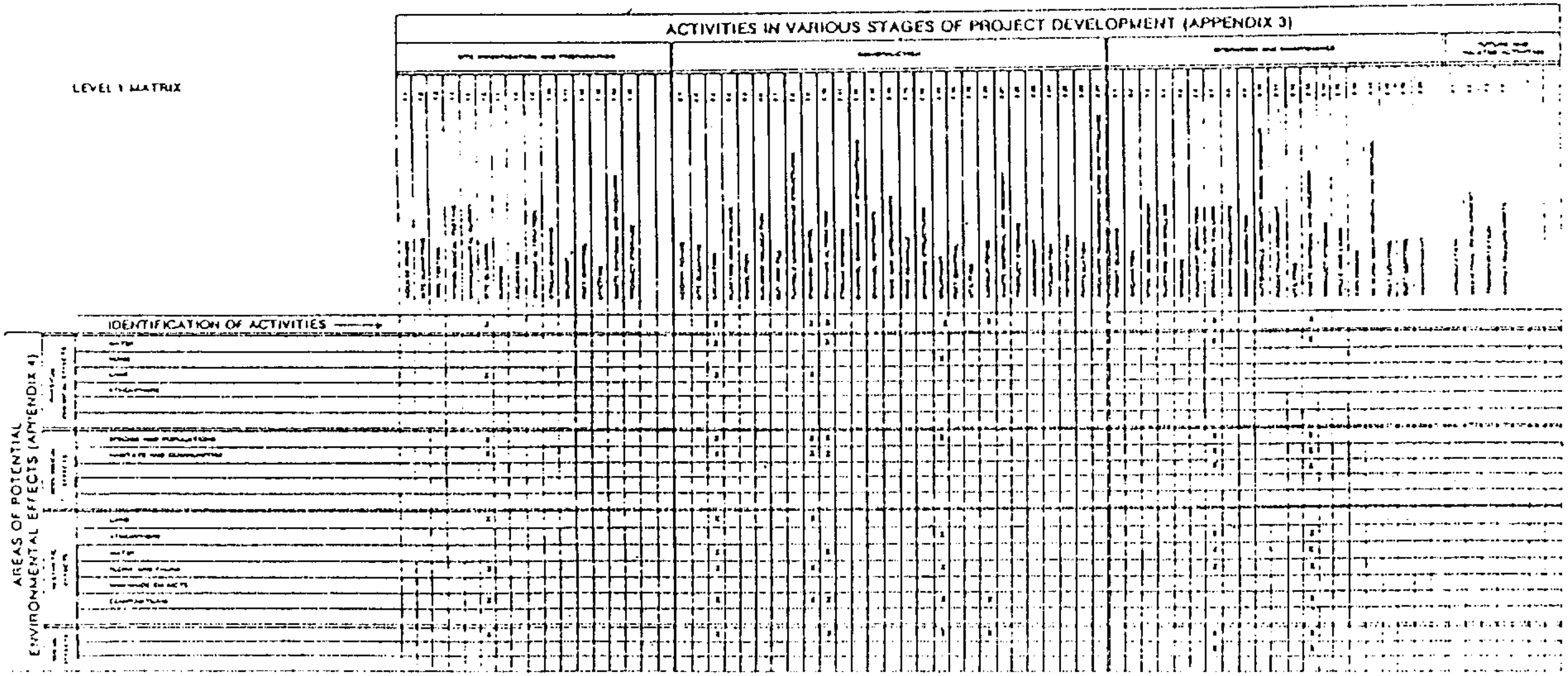
	Live plants	Roots	Standing Dead	Litter	Soil	Sheep	Sheep Dung	Dung Invertebrates	Slugs	Earthworms	Leachates
Live Plants											.169
Roots	1.0										
Standing Dead	1.0										
Litter			.597				.085		0.17		
Soil		.334		.645		.026	.010		.002	.092	
Sheep	.802		.198								
Sheep Dung						1.0					
Dung Invertebrates							1.0				
Slugs	.612						.188				
Earthworms				1.0							
Leachates	1.0										

D.5 Component Interaction Matrix for an Upland Grassland Ecosystem. (From Perkins, 1978)

	Live Plants	Roots	Standing Dead	Litter	Soil	Sheep	Sheep Dung	Dung Invertebrates	Slugs	Earthworms	Leachates
Live Plants	.198										.203
Roots	.196										.298
Standing Dead	.198										.298
Litter	.815		.615			.089	.089		.017		.135
Soil	.926	.334	.460	.737		.102	.076		.015	.092	.157
Sheep	1.19		.198								.198
Sheep Dung	1.17		.198			1.00					.192
Dung Invertebrates	1.14		.198			1.00	1.00				.169
Slugs	1.09		.037			.188	.188				.055
Earthworms	.802		.615	1.00		.089	.089		.017		.115
Leachates	1.20										.198

D.6 Upland Grassland Ecosystem Matrix summed to fifth order dependencies (From Perkins, 1978)

D.7 Level 1 Matrix
(from: FEARO, 1978)



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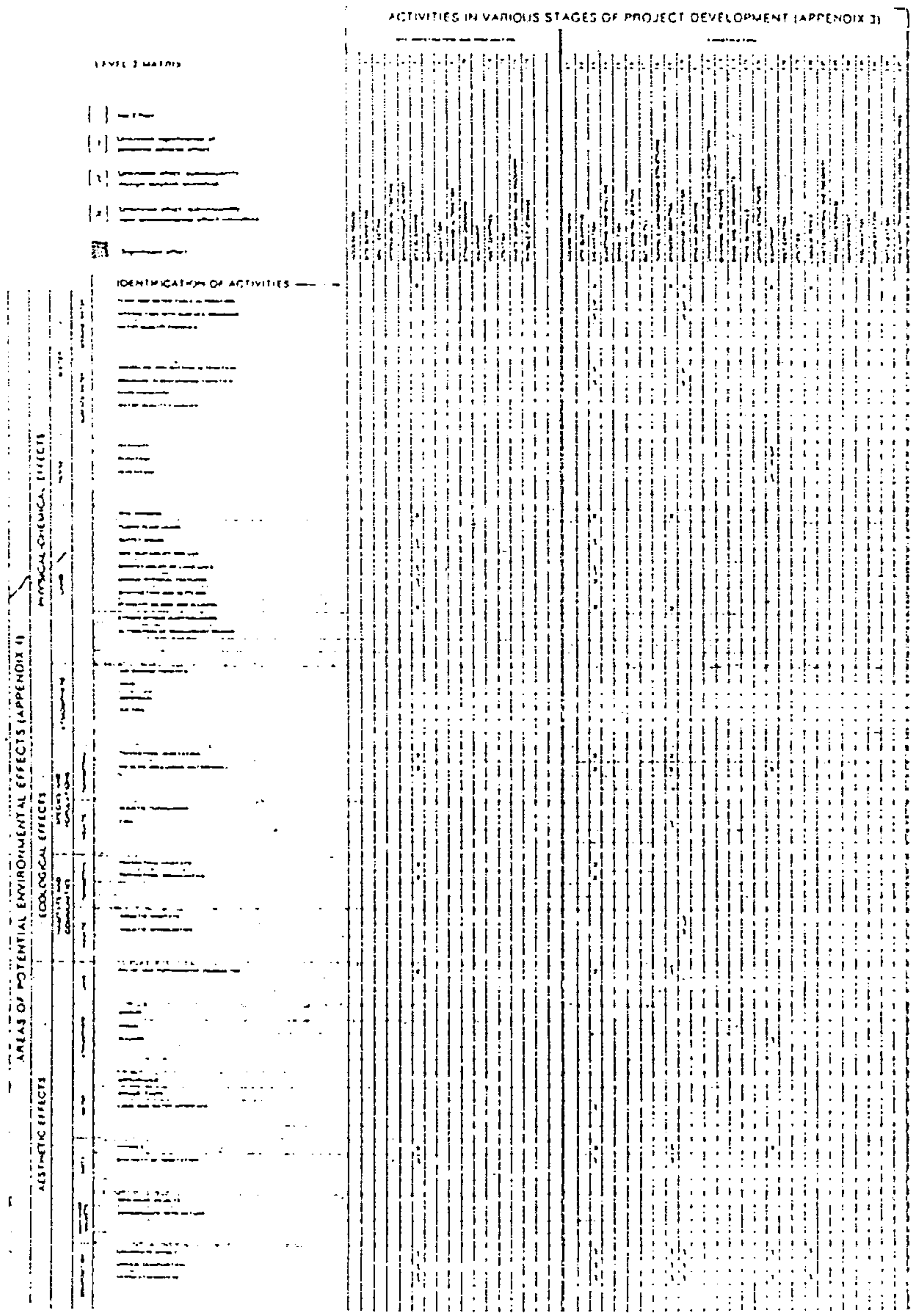
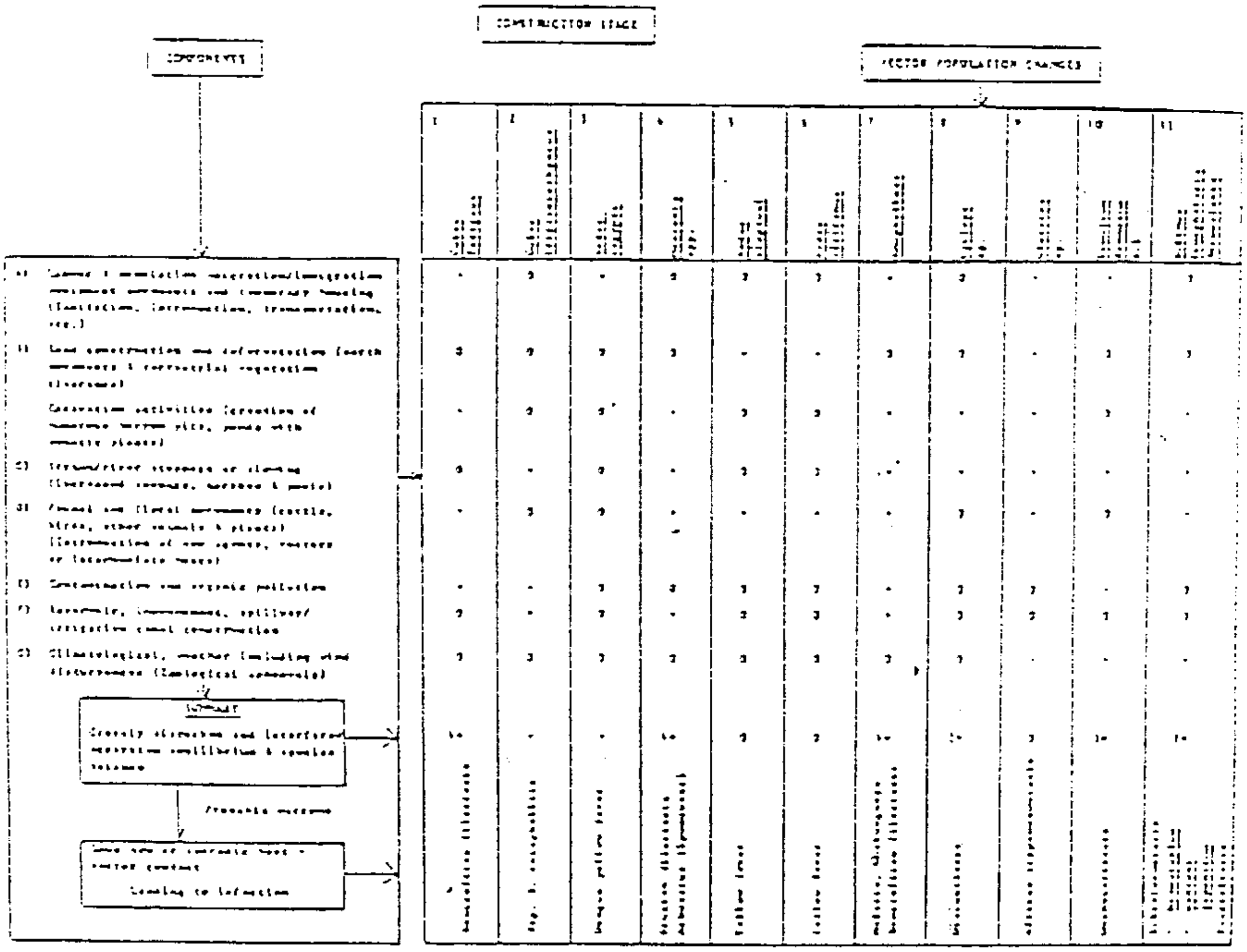
D.8 Section of a Level 2 Matrix (from: FEARO, 1978)



Reproduced by permission of The Minister of Supply and Services Canada.



D.9 Effects of a Water Resource Development Project on Vector Populations in the Construction Stage (PEEM Secretariat, 1983)

Key

0 = No change in the vector population

- = Decrease in the vector population

+ = Increase in the vector population

Note: All + and - symbols are only qualitative expressions of change.

D.10 Section of Matrix Developed by Parker and Howard. (Adapted from Parker and Howard, 1977).

	SOILS	SURFACE, INCLUDING STREAMS	STABILITY (SLIDES & SLUMPS)	MICROORGANISMS	BENTHIC ORGANISMS
DRILLING FLUID DISCHARGE	32110	33211	11000	44432	-----
EMPLACEMENT OF TAILINGS AND OVERBURDEN	33333	11110	11000	33211	-----
WELL DRILLING AND FLUID REMOVAL	11000	33211	-----	11111	-----
ALTERATION OF DRAINAGE	12344	11111	11110	33211	-----
MODIFICATION OF SURFACE OR PAVING	11111	11111	11111	21111	-----
MODIFICATION OF HABITAT	11111	11111	12321	44432	-----

D.11 PRESENTATION FORMAT FOR IEE INFORMATION IN THAILAND.

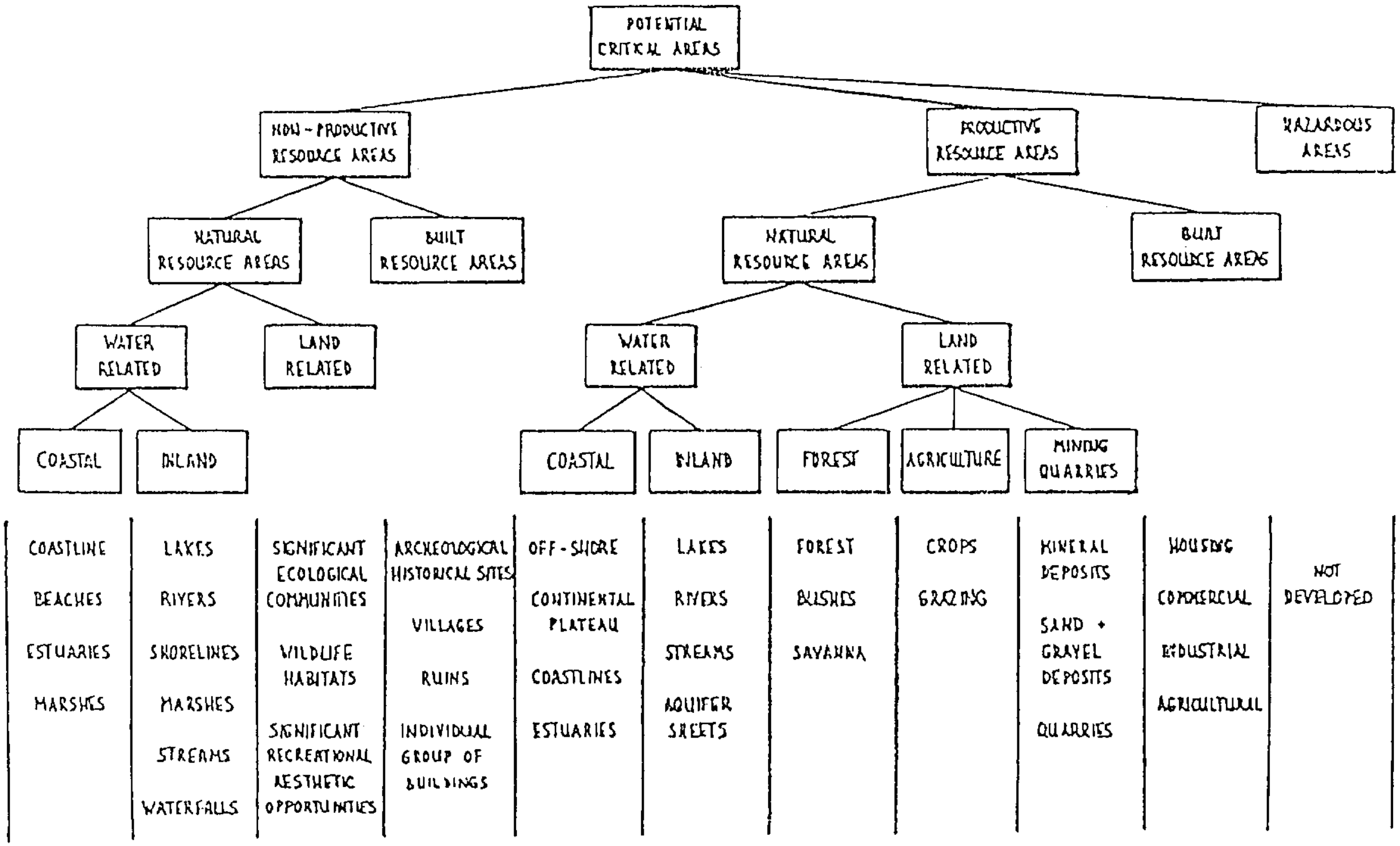
Type of Project \ Environmental Resource		Physical Resources									Ecological Resource				Human Use Values											Quality of Life Values			
		Surface Water Hydrology	Surface Water Quality	Ground Water Hydrology	Ground Water Quality	Climate	Air Quality	Land Quality: Pollution	Mineral Resources	Geology/Seismology	Fisheries	Aquatic Biology	Forests/Vegetative Cover	Terrestrial Wildlife	Industries/Manufactory	Highways/Railways	Navigation	Water Supply	Power	Agriculture	Housing	Recreation	Flood Control	Sewage Disposal	Solid Waste Disposal	Aesthetic	Public Health	Socio-Economic	Industrial Safety & Health
Impacts on Environment	Light Industry	1	-	1	-	-	1	1	1	-	-	-	-	-	3	1	1	1	1	1	1	1	-	1	1	1	1	1	2
	Heavy Industry	3	3	2	2	-	3	3	3	-	2	2	2	1	3	2	2	2	2	1	3	1	-	2	2	3	3	3	3
	Mineral Processing	3	3	2	2	-	3	3	3	-	2	2	2	1	3	2	2	2	2	1	3	1	-	2	2	3	3	3	3
Impacts of Environment on Project	Light	1	1	1	1	1	-	-	-	1	-	-	-	-	1	3	3	1	2	1	1	1	2	1	1	1	-	1	1
	Heavy	3	3	3	3	2	-	-	-	2	-	-	-	-	1	3	3	3	3	1	1	1	3	3	3	1	-	1	1
	Mineral Processing	3	3	3	3	2	-	-	-	2	-	-	-	-	1	3	3	3	3	1	1	1	3	3	3	1	-	1	1

NOTES: Numbers indicate usual magnitudes of significant impacts: (3) = major, (2) = intermediate, (1) = significant.

(From [illegible] Environment Board, [illegible])

APPENDIX E : OTHER INFORMATION

E.1 <u>List of Potential Critical Areas</u> (from Battelle, 1978)



Courtesy of Battelle, and reproduced with permission from the Commission of the European Communities.

E.2 CRITERIA TO AID IDENTIFICATION OF ENVIRONMENTALLY SENSITIVE AREAS

1. Distinctive and unusual land forms;
2. Importance of the ecological function of the areas to the maintenance of a natural system beyond its boundaries;
3. Unusual or high quality plant and/or animal communities;
4. Unusual habitat with a rarity value;
5. Unusual high diversity of biological communities due to a variety of geomorphological features, etc.;
6. Provision of a habitat for rate or endangered species;
7. Large area providing a habitat for species that require such extensive areas;
8. Area location in combination with natural featues providing a resource in scientific research or education terms;
9. Aesthetic value of the locality.

(Adapted from Eagles, 1981)

E 3 STAGES IN THE IDENTIFICATION OF ENVIRONMENTALLY SENSITIVE AREAS

1. Assemble interdisciplinary study team;
2. Adopt standardised criteria;
3. Locate sources of information eg government studies, local experts;
4. Utilize sensitive area criteria to identify possible sensitive areas;
5. Field validation of sensitive areas;
6. Compile background files on important elements within the sensitive area eg endangered species, hydrographic regime etc;
7. Final screening to identify sensitive areas;
8. Delineation of sensitive areas on topographic maps;
9. Detail reasons for criteria fulfillment of each delineated area;
10. Publish results.

(Adapted from Eagles, 1981)

E.4 LIST OF PROJECTS TO BE SUBJECT TO MANDATORY ENVIRONMENTAL ASSESSMENT

1. Crude oil refineries (excluding undertakings manufacturing only lubricants from crude oil) and installations for gasification and liquifaction (greater than 500 tonnes or more of coal or bituminous shale per day);
2. Thermal power stations and other combustion installations (with a heat output of 300 megawatts or more) and nuclear power stations and other nuclear reactors (except research installations for the production and conversion of fissionable and fertile materials whose maximum power does not exceed 1 kilowatt continuous thermal load);
3. Permanent storage or final disposal of radioactive waste (installations solely designed for that use);
4. Integrated works for the initial melting of cast-iron and steel;
5. Installations for the extraction, processing and transformation of asbestos and products containing asbestos (installations for asbestos-cement products - annual production greater than 20 000 tonnes of finished product, for friction materials - greater than 50 tonnes of finished product per annum, and for other uses of asbestos - more than 200 tonnes per annum;
6. Integated chemical installations;
7. Motorways and express roads and lines for long-distance railway traffic and airports (basic runway length of 2100m or more);
8. Trading ports, inland waterways and ports for inland waterways (permit passage of vessels over 1350 tonnes);
9. Waste disposal installations for the incineration, chemical treatment or landfill of toxic and dangerous wastes.

(From: Commission of the European Communities, 1985)

E.5 LIST OF PROJECTS TO BE SUBJECT TO AN ENVIRONMENTAL ASSESSMENT WHEN APPROPRIATE

1. Agriculture
   a) Projects for restructuring rural land holdings;
   b) Projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes;
   c) Water management projects for agriculture
   d) Initial afforestation where this may lead to adverse ecological changes and land reclamation for the purposes of conversion to another type of land use;
   e) Poultry rearing installations;
   f) Salmon breeding;
   g) Reclamation of land from the sea.

2. Extractive industry
   a) Extraction of peat;
   b) Deep drillings with the exception of drilling for investigating stability of the soil and in particular, geothermal drilling, drilling for the storage of nuclear waste material and drilling for water supplies;
   c) Extraction of minerals other than metalliferous or energy minerals, such as marble, sand, gravel, shale, salt, phosphates and potash;
   d) Extraction of coal and lignite by underground mining;
   e) Extraction of coal and lignite by opencast mining; –
   f) Extraction of petroleum;
   g) Extraction of natural gas;
   h) Extraction of ores;
   i) Extraction of bituminous shale;
   j) Extraction of minerals other than metalliferous and energy producing minerals by opencast mining;
   k) Surface industrial installations for the extraction of coal, petroleum, natural gas, ores as well as bituminous shale;
   l) Coke ovens (dry coal distillation);
   m) Installations for the manufacture of cement.

3. Energy industry
   a) Installations for the production of electricity, steam, and hot water (unless in Annex I);
   b) Industrial installations for carrying gas, steam and hot water; transmission of electricity by overhead cables;
   c) Surface storage of natural gas;
   d) Underground storage of combustible gases;
   e) Surface storage of fossil fuels;
   f) Industrial briquetting of coal and lignite;
   g) Installations for the production and enrichment of nuclear fuels;
   h) Installations for the reprocessing of irradiated nuclear fuels;
   i) Installations for the collection and processing of radioactive waste (unless in Annex I);
   j) Installations for hydroelectric energy production;

4. Production of metals
   a) Iron and steelworks, including foundries, forges, drawing plants and rolling mills (unless in Annex I);
   b) Installations for the production, including smelting, refining, drawing and rolling of non-ferrous metals, excluding precious metals;
   c) Pressing, drawing and stamping of large castings;
   d) Surface treatment and coating of metals;
   e) Boilermaking, manufacture of reservoirs, tanks and other sheet-metal containers;
   f) Manufacture and assembly of motor vehicles and manufacture of motor vehicle engines;
   g) Shipyards;
   h) Installations for the construction and repair of aircraft;
   i) Manufacture of railway equipment;
   j) Swaging by explosives;
   k) Installations for roasting and sintering metallic ores.

5. Manufacture of glass

6. Chemical industry
   a) Treatment of intermediate products and production of chemicals (unless in Annex I);
   b) Production of pesticides and pharmaceutical products, paint and varnishes, elastomers and peroxides;
   c) Storage facilities for petroleum, petrochemical and chemical products;

7. Food Industry
   a) Manufacture of vegetable and animal oils and fats;
   b) Packing and canning of animal and vegetable products;
   c) Manufacture of dairy products;
   d) Brewing and making;
   e) Confectionery and syrup manufacture;
   f) Installations for the slaughter of animals;
   g) Industrial starch manufacture installations;
   h) Fish-meal and fish-oil factories;
   i) Sugar factories.

8. Textile, leather, wood, paper industries
   a) Wool scouring, degreasing and bleaching factories;
   b) Manufacture of fibre board, particle board and plywood;
   c) Manufacture of pulp, paper and board;
   d) Fibre-dyeing factories;
   e) Cellulose-processing and production installations;
   f) Tanning and leather dressing factories.

9. Rubber industry
   a) Manufacture and treatment of elastomer-based products.

10. Infrastructure projects
   a) Industrial estates development projects;
   b) Urban develpment projects;
   c) Ski-lifts and cable cars;

d) Construction of roads, harbours, including fishing harbours and airfields (not in Annex I);
e) Canalisation and flood relief works;
f) Dams and other installations designed to hold or store it on a long term basis;
g) Tramways, elevated and underground railways, suspended lines or similar lines of a particular type used exclusively or mainly for passenger transport;
h) Oil and gas pipelines installations;
i) Installation of long distance aqueducts;
j) Yacht marinas.

11. Other projects
a) Holiday villages, hotel complexes;
b) Permanent racing and test tracks for cars and motor cycles;
c) Installations for the disposal of industrial and domestic waste (unless in Annex I);
d) Waste water treatment plants;
e) Sludge deposition sites;
f) Storage of scrap iron;
g) Test benches for engines, turbines or reactors;
h) Manufacture of artificial mineral fibres;
i) Manufacture, packing, loading or placing in cartridges of gunpowder and explosives;
j) Knackers' yard.

11. **Modifications to development project included in Annex I and projects in Annex I undertaken exclusively or mainly for the development and testing of new methods or products and not used for more than one year.**

(From: Commission of the European Communities, 1985)

E.6 ENVIRONMENTALLY SENSITIVE AREAS IN MALAYSIA

1. Any areas gazetted as a National Park, National Scenic and Nature Reserve, National Nature Monument, Wildlife Sanctuary, Wildlife Reserve, Marine Reserve, Catchment Reserve, Protective Forest Reserve, Virgin Forest Reserve or Virgin Forest Sanctuary.

2. Any area of special scenic or aesthetic character.

3. Areas containing or in the immediate vicinity of, an historic, religious, cultural or archaeological site.

4. Swamp, estuaries, lakes, rivers, and the shoreline (including mangrove areas and recreational beaches).

5. Coral reefs and major fishing grounds.

E.7 SECONDARY SCREENING CRITERIA IN MALAYSIA

1. <u>Siting</u>

   a) siting contrary to existing structure or local plan

   b) in an Environmentally Sensitive Area

2. <u>Resource Demand</u>

   a) require change of land use

   b) consumes naturally occurring non-renewable indigenous resources

   c) will take process water from inland waterways

3. <u>Waste</u>

   a) likely to emit dust, visible smoke, CO, HC, NOx, SOx or acidic gases

   b) will produce any hazardous substance as a primary or by-product

   c) will dispose of liquid or solid wastes other than through the local waste disposal authority using an established waste disposal system

   d) will discharge heat continuously while the plant is in operation either into cooling water or to atmosphere

4. <u>Labour</u>

   a) will require an imigrant labour force

   b) is likely to reduce net employment opportunities locally or on a national basis

5. <u>Infrastructure</u>

   a) is likely to over-reach capacity of amenities, utilities, local services or industry either directly or indirectly

   b) is essentially based on consumption or conversion of electricity or of solid, liquid or gaseous fuel

   c) is essentially a marine, air, road or river transportation project

6. <u>Regulations, Guidelines, Codes of Practice</u>

   a) conform to all regulations

   b) observe all current guidelines and codes of practice

E.8

NOTIFICATION OF TYPES AND SIZES OF PROJECTS OR ACTIVITIES REQUIRING EIA REPORTS

Types of Projects or Activities	Sizes
Dam or Reservoir	storage volume greater than 100,000,000 cubic metres or storage surface area greater than 15 square kilometres
Irrigation	irrigated area greater than 12,800 hectares
Commercial Airport	all sizes
Hotel or Resort facilities in environmentally sensitive areas such as areas adjacent to rivers, coastal areas, lakes or beaches or in the vicinity of national parks	greater than 80 rooms
Mass Transit System and Expressway	all sizes
Mining	all sizes
Industrial Estate	all sizes
Commercial Port and Harbour	with capacity for vessels of greater than 500 ton-gross
Thermal Power Plants	capacity greater than 10 MW
Petrochemical Industry	greater than 100 tons/day of raw materials require in production processes of oil refinery and/or natural gas separation

Oil Refinery	all sizes
Natural Gas separation or processing	all sizes
Chlor-Alkaline Industry	production capacity of each or combined product greater than 100 tons/day
Iron and/or Steel Industry	requiring iron ore and/or scrap iron as raw materials for production greater than 100 tons/day or using furnaces with combined capacity greater than 5 tons/batch
Cement industry	all sizes
Smelting Industry other than Iron and Steel	production capacity greater than 50 tons/day
Pulp Industry	production capacity greater than 50 tons/day

(Adapted from Evans, 1982)

E.9

Proposed List of Projects to be Subject to Mandatory EIA

1. Extractive industry
   Extraction and briquetting of solid fuels
   Extraction of bituminous shale
   Extraction of ores containing fissionable and fertile material
   Extraction and preparation of metalliferous ores

2. Energy industry
   Coke ovens
   Petroleum refining
   Production and processing of fissionable materials
   Generation of electricity from nuclear energy
   Coal gasification plants
   Disposal facilities for radioactive waste

3. Production and preliminary processing of metals
   Iron and steel industry, excluding integrated coke ovens
   Cold rolling of steel
   Production and primary processing of non-ferrous metals and ferro-alloys

4. Manufacturing of non-metallic mineral products
   Manufacture of cement
   Manufacture of asbestos-cement products
   Manufacture of blue asbestos

5. Chemical industry
   Petrochemical complexes for the production of olefins, olefin derivatives, bulk monomers and polymers
   Chemical complexes for the production of organic intermediates
   Complexes for the production of basic inorganic chemicals

6. Metal manufacture
   Foundries
   Forging
   Treatment and coating of metals
   Manufacture of aeroplane and helicopter engines

7. Food industry
   Slaughter-houses
   Manufacture and refining of sugar
   Manufacture of starch and starch products

8. Processing of rubber
   Factories for the primary production of rubber
   Manufacture of rubber tyres

9. Building and civil engineering
   Construction of motorways
   Intercity railways, including high speed tracks
   Airports
   Commercial harbours
   Construction of waterways for inland navigation
   Permanent motor and motorcycle racing tracks
   Installation of surface pipelines for long distance transport

(FROM: Commission of the European Communities, 1980)

	Flexibility	Screening	Alternative Sites	Fundamental Alternatives	Incremental Alternatives	No Development	Area Considered	Geophysical and Meteorological	Ecological	Socio-Economic	Induced	Synergistic etc	Positive and Negative Effects
McHarg Overlay			*	*	*			*	*	*			
Leopold Matrix		*	*	*	*	*	*	*	*	*			*
Dee Environmental Evaluation System			*	*	*	*	*	*	*	*			*
Sorensen Matrix Network			*	*	*		*	*	*	*	*		*
Holling Adaptive Modelling	*		*	*	*	*	*	*	*	*	*	*	*
PADC Manual	*	*			*	*	*	*	*	*	*	*	*

	Reversibility, Resource Commitment	Magnitude	Signifiance	Risk	Uncertainty	Resiliunce	Monitoring	Validity of Results	Construction	Operation	Long-Term	Post-Operational	Concise Communication	Cost	Time	Data	Personnel
McHarg Overlay		*	*							*			*				
Leopold Matrix	*	*	*	*				R	*	*	*						
Dee Environmental Evaluation System		*	*		*				*	*			*				
Sorensen Matrix Network		*	*		*		*						*				
Holling Adaptive Modelling	*	*	*	*	*	*	*	*		*			*				
PADC Manual	*	*		*			*		*	*	*		*		1		P

Key

Y Explicit Method Proposed or Statement made by Authors of Methods

R Reviewed

P Planning Department

1 1 Year

E.10 Comparison of Six EIA Methods

E.11

: IDENTIFICATION OF SIGNIFICANT CONFLICTS BETWEEN ENVIRONMENTAL PROCESSES AND HUMAN OBJECTIVES

Method	flooding	erosion	oil (etc) pollution	Biological requirements of fish	macrophyte growth process	silting and colonisation	pollution conflict with ecology	recreation conflict with ecology	ecology conflict with recreation
Present	*	*	*	*	⊗	⊗	⊗	⊗	⊗
McHarg	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
Leopold	*	⊗	*	⊗	⊗	⊗	*	*	⊗
Dee	⊗	⊗	*	⊗	⊗	⊗	*	*	⊗
Sorensen	*	*	*	⊗	⊗	*	*	*	⊗
Holling	?	?	?	?	?	?	?	?	?
Clark	*	⊗	*	⊗	⊗	*	*	*	⊗

Key Impact Identification * Probable ? Possible ⊗ Unlikely

E.12 EIS Substantive Format from 1979 CEQ Regulations (Council on Environmental Quality, 1978)

Section	Description
Summary	Each environmental impact statement shall contain a summary which adequately and accurately summarizes the statement. The summary shall stress the major conclusions, areas of controversy (including issues raised by agencies and the public), and the issues to be resolved (including the choice among alternatives).
Purpose and Need	The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action.
Alternatives Including the Proposed Action	This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment and the Environmental Consequences, it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public.
Affected Environment	The environmental impact statement shall succintly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced.
Environmental Consequences	This section forms the scientific and analytic basis for the comparisons of alternatives section. The discussion will include the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented.

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附件二

I Visits Undertaken

14 November 1986 : 1 day

Go to Battleby Display Centre
Visit Countryside Commission for Scotland

22 December - 28 December 1986 : 7 days (Accommodation in Wiltshire)

22 December 1986	Go to Westbury
23 December 1986	Visit Stonehenge, Cathedral in Salisbury
24 December 1986	Visit Lacock Avebury
25 December 1986	Visit Wiltshire
26 December 1986	Visit Eastcott
27 December 1986	Visit to Roman Baths and Museum in Bath Spa
28 December 1986	Return to Aberdeen

26 January 1987 - 28 January 1987 : 3 Days (Accommodation in Edinburgh)

26 January 1987	Go to Edinburgh
27 January 1987 28 January 1987	Seminar in Edinburgh University "6 Regional Training Workshops on the EEC Environmental Assessment Directive - Use and Practice"
28 January 1987	Return to Aberdeen

6 February 1987 - 8 February 1987 : 3 days (Accommodation in Inverness)

6 February 1987	Go to Inverness
7 February 1987	Visit Wyvis Forestry
8 February 1987	Go to Cromarty and Return to Aberdeen

24 February 1987 : 1 day

Go to Balmedie
The field work about Coastal Geomorphology

2 March 1987 : 1 day

Go to Balmedie
The field work about Coastal Geomorphology

11 March 1987 : 1 day

Go to Ythan Estuary
The field work about Coastal Geomorphology

23 March 1987 - 24 March 1987 : 2 days

Seminar in University of Aberdeen
"The Exploitation of Animals in Africa"

19 April 1987 - 25 April 1987 : 7 days (Accommodation in Cambridge)

"Land use and Soil Management Field Course"

19 April 1987 — Go to Cambridge

20 April 1987
- (i) The Cambridgeshire Landscape - from Gog and Magog Hills
- (ii) Calcareous Soils
- (iii) The Breckland

21 April 1987
- (i) Wicken Fen Nature Reserve (National Trust)
- (ii) Fenland Soil - a Wasting Asset

22 April 1987
- (i) Fenland Drainage - Denver Sluice
- (ii) Outmarsh and Recent Reclamation, N. Wootton, King's Lynn
- (iii) Commercial Farm. Mr. A.C. Keene, Wootton Marsh Farm

23 April 1987
- (i) The Brecklands
- (ii) Research on Black Fen Soils

24 April 1987
- (i) Clay Soils
- (ii) Visit to International Union for Conservation of Nature and Natural Resources (IUCN) Wildlife Trade Monitoring Unit (Free Afternoon)

25 April 1987 — Return to Aberdeen

<u>7 May 1987</u> : 1 day

Apply for Visa to Ireland for the Field Course
Go to Glasgow and return to Aberdeen

<u>17 May 1987 - 26 May 1987</u> : 10 days (Accommodation in Dublin)

17 May 1987 — Go to Ireland

18 May 1987
- (i) Visit Department of Environment
- (ii) Visit An Foras Forbartha Resource and Environment Policy Centre, UCD

19 May 1987
- (i) Visit Department of Botany, Trinity College
- (ii) Visit Department of Forestry and Wildlife
- (iii) Visit Irish Life Centre

20 May 1987
- (i) Visit Tara Mine

21 May 1987
- (i) Visit Trim Castle
- (ii) Visit National Park and Monument Park

22 May 1987
- (i) Visit Ennis (Accommodation in Limerick)
- (ii) Visit Limerick
- (iii) Visit Tourist Board

23 May 1987
- (i) Visit Aillwe Cave

24 May 1987
- (i) Visit Cliffs of Maher
- (ii) Visit with Farmer

25 May 1987
- (i) Visit Corrib Conservation
- (ii) Visit Connemara National Park

26 May 1987
- (i) Visit Coast
- (ii) Return to Aberdeen

9 June 1987 - 15 June 1987 : 7 days (Accommodation in London)

9 June 1987	Go to London
10 June 1987	Visit London Zoo
11 June 1987	Visit Green Belt and Parks
12 June 1987	Visit Museums for Safekeeping Culture and Relics
13 June 1987	Collect Some Information about Environment and Wildlife Conservation and Visit Monuments
14 June 1987	Visit the City Planning and Land Use
15 June 1987	Return to Aberdeen

27 June 1987 - 7 July 1987 : 11 days

27 June 1987	Go to London (Overnight in London)
28 June 1987	From London to Geneva (Accommodation in Geneva)
29 June 1987	Visit the Urban Planning and Land Use in Lausanne
30 June 1987	Visit Zoological, Geological etc Museums
1 July 1987	Visit CITES Secretariat
2 July 1987	Visit Museums, Parks, Land Use etc in Geneva
3 July 1987	Visit IUCN Headquarters, Visit Vivarium
4 July 1987	Visit Chillon Castle
5 July 1987	Visit Forest and Soil and Water Conservation in Vevey
6 July 1987	Return from Geneva to London (Overnight in London)
7 July 1987	Return to Aberdeen

II 5 July - 26 September 1987

"The Second Intensive Training Course on Environmental Impact Assessment" at University of Aberdeen

10 July 1987 : 1 day

Visit to Aberdeen

12 July 1987 - 25 July 1987 : 14 days

"Eighth International Seminar on Environmental Impact Assessment" at University of Aberdeen

15 July 1987 : 1 day

Field trip to Grampian Region to Study Oil and Gas Projects

19 July 1987 : 1 day

Field trip to Examine Land Use and Environmental Problems

27 July 1987 - 26 September 1987

Intensive Training Course

16 August 1987 - 21 August 1987 : 6 days

16 August 1987	(Overnight in Edinburgh)
17 August 1987	Visit Shell Exploration and Production NGL Plant, Fife (Accommodation in Edinburgh)
18 August 1987	Visit to Scottish Office, Edinburgh (Accommodation in Glasgow)

19 August 1987	Visit to Burrell Collection, Glasgow (Accommodation in Oban)
20 August 1987	Visit Places of Interest on West Coast of Scotland (Accommodation in Mallaig)
21 August 1987	Visit Fort William and Inverness Return to Aberdeen

考察美國濕地復育及
參加第十五屆濕地年會報告書

陳明義

中興大學植物系

湯曉虞

農委會林業處

出國時間：77.5.16—77.5.30

出國地點：美國

一、前　言

濕地（ Wetland ）係指陸地與水域之過渡地帶，或可稱為“ 垡 ”。濕地之水位接近土表，或者土壤為淺水所覆蓋。濕地之三要素為濕土（ hydric soil ）、水生植群（ hydrophytic vegetation ）與水域（ water regime ）。濕地立地條件特異，且具多項功能與價值，它已不再被視為廢地，其保育與管理經營已為世界各國所重視。

全美國之濕地原有二億一千五百萬英畝，開國至今約有一半已被毀除，近年每年約有 30 萬至 45 萬英畝的濕地消失。佛羅里達州西海岸 Tampa 海灣一帶之濕地分佈很廣，歧異度亦大，有關濕地之研究亦多。十五年來，Tampa 當地 Hillsborough Community College 之環境研究中心每年召開濕地年會，提供有關淡水與海岸濕地復育、創造及經營之研究心得，以供政府單位、規劃公司與環境團體之參考。

我國近年來亦十分重視濕地之保育與經營，為吸取這方面之新知與技術，行政院農業委員會遴派湯曉虞技正與中興大學陳明義教授考察南佛羅里達地區之濕地復育，並順道參加第十五屆濕地年會。以下茲就此行之工作與心得提出報告，以供參考。農委會之經費補助與自然文化景觀審議小組暨技術組之支持，特此致謝。

二、行程與年會概況

此次出國之行程詳列於附錄一，除考察南佛羅里達州之濕地外，並順道參加第十五屆年會。行程先安排參加五月十九日與二十日兩天在Tamp 之 Sheraton Grand Hotel 舉行之濕地年會，大會並於二十日下午安排野外參觀活動。濕地年會旨在發表與交換鹽濕地與淡水濕地之研究新知與復育技術，本次大會之主題包括：

1.淡水、河口與海岸濕地。

2.草澤與紅樹林重建。

3.礦區濕地復育。

4.再造、許可與管制政策。

5.經營技術。

此次大會參加人數多達三百餘人，發表之論文計有廿四篇（附錄二），另有多篇論文以海報展示。農委會在會場之台灣紅樹林海報（附錄三）以及發放之濕地相關摺頁，甚獲好評。藉由此次年會及會後參觀，吸取美國濕地之新知，可供國內參考。

三、美國濕地類型與分佈

濕地概分爲河口（ estuarine ）與淡水低濕地（ palustrine ）兩大類。河口區包括大部分海岸半含鹽濕地（ coastal brackish wetland ），諸如潮地鹽生草澤（ tidal salt marsh ）、紅樹林沼澤（ mangrove swamp ）、潮間灘地（ intertidal flat ）等。美國河口濕地之分佈如圖 1 所示。

淡水低濕地包括草澤地（ marshland ）、灌叢沼地（ scrub-shrub wetland ）與森林濕地（ forested wetland ）。森林濕地卽指低地森林，如落羽松沼澤林（ cypress swamp ）與低地濶葉林（ bottomland hardwood ）。美國淡水低濕地之分佈如圖 2 所示。

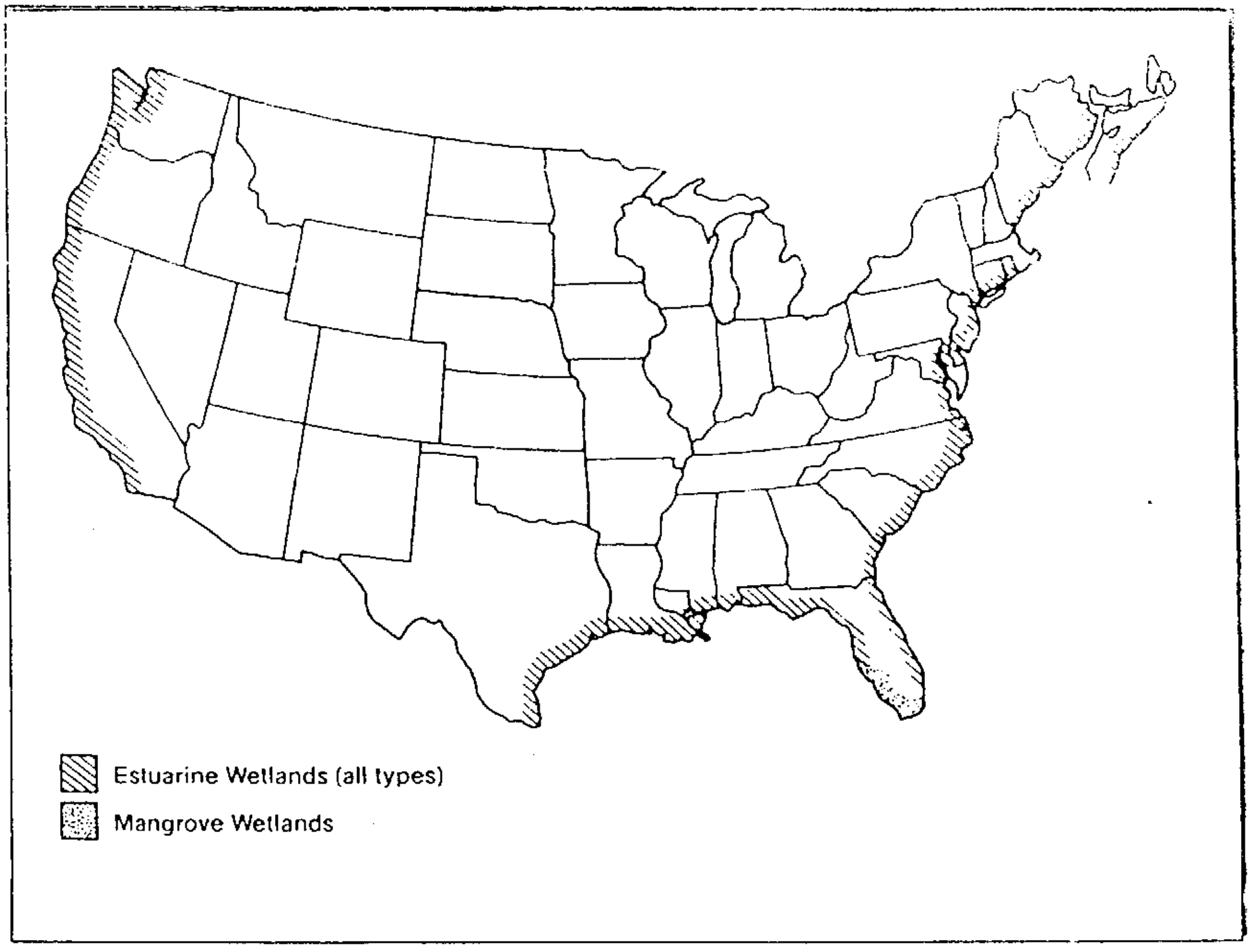


圖 1　美國河口濕地分佈

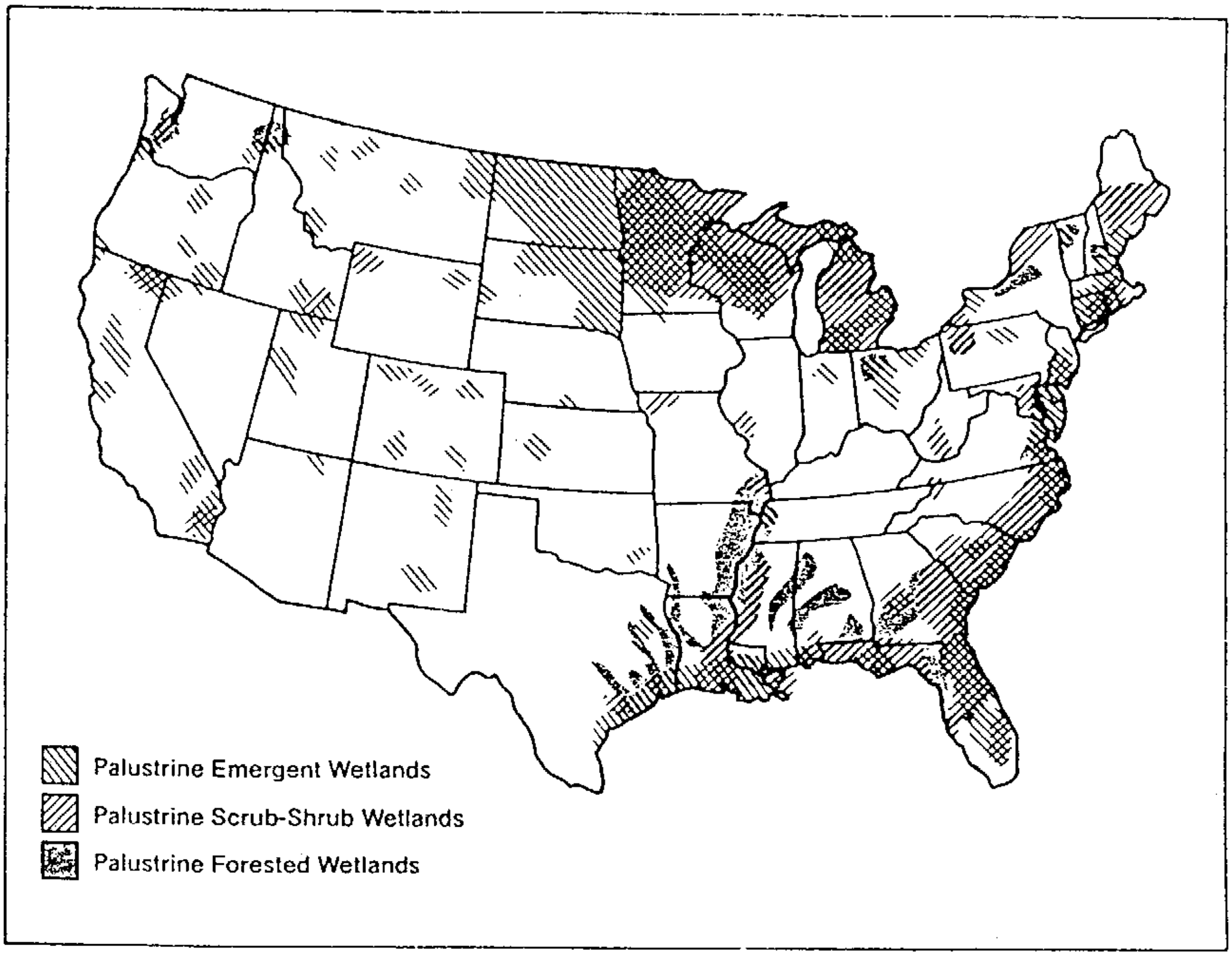


圖 2　美國淡水低濕地分佈

四、美國濕地功能與價值

1.經濟價值

美國濕地之經濟價值很高。聯部於 1986 年通過之 Emergency Wetland Resources Protection Act（EWRA）指出，濕地每提供價值 100 億美元的海洋漁獲量及價值 3 億美元之獸皮量。如在美國東南海岸區，有 96 %的商用及 50 %遊憩用魚貝類需依賴河口區完成其全部或部分生活期。1811年路易斯安那州濕地之蝦及鯡魚收獲量高達美金 2 億元。

又與濕地有關之自然研究、釣魚、打獵及其他戶外遊憩活動，全美國每年花費在 100 億美元以上。如 1985 年約兩百萬水鳥打獵者用掉一千萬打獵天數，獵取一千四百萬隻水鳥，打獵者共花費約三億美元。在 1980 年約有五千五百萬人用掉一百億美元在濕地鳥類之觀察與攝影。

2.地下水之補注與流出

濕地在水文上擔當重要角色，可補注地下水，維持地下水位，同時在乾季可釋出水量。麻州Lawrence Swamp之2,700英畝濕地，估計每天可補注800萬加侖的水至地下水層。

3.洪患之減除

濕地可緩留大量的水，減除洪患之發生。在威斯康辛州之一項研究報告中指出，具有濕地之集水區可減少80%的洪流。估計美國約有一億三千四百萬英畝的土地屬嚴重洪水區，當中三百萬英畝爲都會區，一億英畝爲農業區，然這些農業區以前大部分都是濕地。密西西比三角洲由於大量砍除低地濶葉林，而引發洪患。

4.養分與廢物之存留與轉換

濕地可存留養分與淤泥，而淨化污水。水生植群可吸取污物，在喬治亞州Alcovy河之一項研究報告指出，被雞糞與人類排泄物污染過的水，流經3哩的沼澤林後，水質顯獲改善，其淨化污水之功能估算每年高達一百萬美元以上。

5.暴風浪之緩除

海岸濕地可吸收及減緩大風浪之衝擊，以保護海岸線，避免被風浪大量冲失。海岸濕地開發，緩衝功能消失，暴風浪可能造成嚴重損失。Florida Key主要就是依賴紅樹林之保護而免除被冲失之危機。

6.野生動植物之庇護

濕地生物之歧異度很高，存活於美國濕地的植物約500種，爬蟲類190種，鳥類270種。

多種稀有生物依賴濕地而生存。1986年7月所列出之面臨威脅及瀕臨危險生物計有209種動物及109種植物，其中45%（94種）之動物與26%（29種）之植物直接或間接依賴濕地完成其生活期，另外，2500種以上的植物亟需聯邦政府的保護，而其中有700種與濕地有關。

五、美國濕地之現況

1700年代後期美國原存之濕地約兩億一千五百萬英畝，至1954年已有八千六百萬英畝（40%）被毀。1954年至1974年間，約一千一百萬英畝濕地急速消失。當中

95％直接與人類活動有關，約 80％（每年 44 萬英畝）係因農耕與排水而消失，餘爲房地產開發、開礦等之影響。目前每年消失之濕地約在 30 萬至 45 萬英畝之間。佛羅里達之主要河口區如圖 3 所示，該州發展甚爲迅速，濕地所承受之壓力亦相形加大。

1.佛羅里達州之紅樹林

全州之紅樹林樹種計有三種，分別爲：

(1) red mangrove（*Rhizophora mangle*）

(2) black mangrove（*Avicennia germinans*）

(3) white mangrove（*Laguncularia racemosa*）

第一種具支持根，生長最近水邊；第二種具直立呼吸根，分佈區域較前者靠近陸地；第三種葉基具兩腺體，分佈最靠近陸地。這三種皆屬熱帶種，遇極低溫時易受凍害。含鹽度、水溫、潮流與土壤亦影響其生長與分佈。

佛州之紅樹林面積約 469,000 英畝。在Gulf 海岸分佈於Cedar Key 一帶；大西洋海岸分佈於Cape Canaveral 一帶。紅樹林可保護海岸，淨化水質，庇護野生

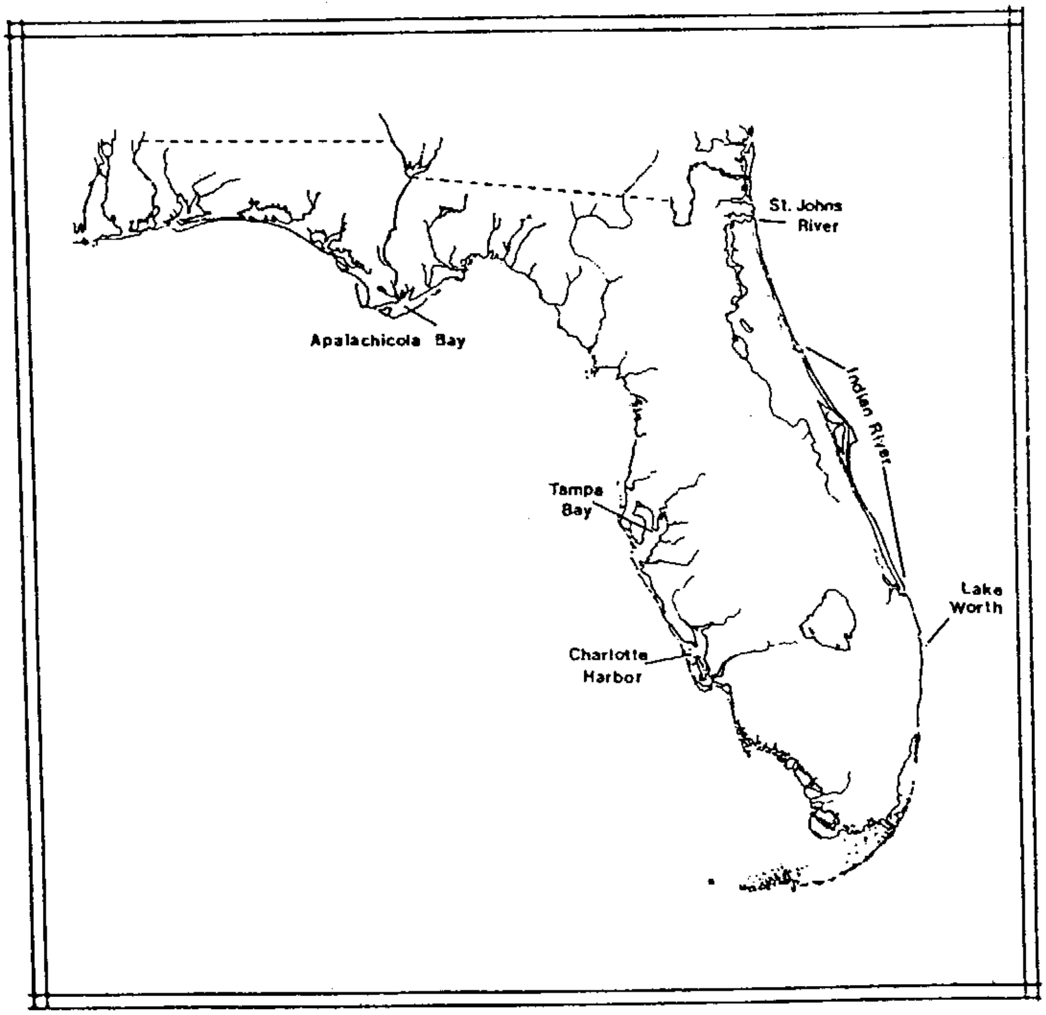


圖 3　佛羅里達州之主要河口區

動物，對海岸百姓有益，唯人爲活動一直威脅紅樹林之存留。Bureau of Marine Research（屬Florida Dept. of National Resources）正研究該州海岸生育地之改變。Tampa Bay 在過去 100 年來，隨著其快速發展，已毀除之濕地面積高達 44％，包括紅樹林與鹽生草澤。Charlottee Habor 都市發展不快，但仍有某些紅樹林消失。

在 Lake Worth 海岸，過去 40 年紅樹林減少 87％，被木麻黃與市鎮所取代，留剩之 276 英畝散生紅樹林現在已被嚴加保護。Indian River 是該州最大的鹽水潟湖，原有 8000 英畝紅樹林，現在只存有 1900 英畝未受干擾，餘已受防蚊計劃所影響。

該州及各地已立法保護紅樹林，非得Florida Dept. of Environmental Regulation 之許可，州有或私有土地上之紅樹林不得移除、修剪或干擾。

2.佛羅里達州之鹽生草澤

該州Gulf 海岸之鹽生草潭分佈於河口及較平靜之海岸綫。由Apalachicola Bay 南至Tampa Bay，海岸植群主要爲草澤，是該州最大的草澤區。由Cedar Key開始，紅樹林爲優勢植物。在大西洋海岸，草澤分佈在Daytona Beach 以北。

該州鹽生草澤之優勢植物爲 *Juncus roemerianus*、*Spartina patens*、*Spartina alterniflora* 與 *Cladium jamaicense*，後者叫 *Sawgrass*，是淡水植物，長在鹽生草澤上緣。

鹽沼地之功能一直被忽視，不斷地被排水與填土，估計至少已有 60,000 英畝（約佔 8％）的河口生育地已被填平。按Bureau of Marine Research 之研究，東北五郡之草澤約占全州的 11％，Nassau 郡之草澤消失主要是因爲 Intracoastal Waterway 之水道開挖，Duval 郡草澤亦已嚴重受損。St. John's Inlet 兩邊各 3.5 哩及 St. John's River 向北延伸 10 哩之草澤，自 1943 年來約有 36％ 被挖填掉。Lake Worth（Palm Beach 郡）之草澤在 1944 ～ 82 年間因土地開發而減少 51％。

該州鹽生草澤之消失與改變損及漁業及其他資源，州政府已立法保護鹽生草澤生態系，特別是 1984 年之Warren B. Henderson Wetlands Act，對鹽沼地之挖填作了嚴格的規定。

六、美國濕地之再造

美國由於濕地不斷地減少，於是緩和濕地損失（wetland loss mitigation）之工作日受重視。Fish and Wildlife Service 責成濕地開發者，務必提出減緩計劃（mitigation proposal），藉由濕地復原（wetland restoration）與創作（Wetland creation），以避免、改正、減緩或補償自然濕地破壞之衝擊。

濕地復原是就地把被破壞或退化之自然濕地回復至近似原來的面貌。濕地創作是在原非濕地之處人工創造濕地景觀（aquascaping），以補償因人為活動而消失之濕地之功能。Tampa Bay 之濕地雖因房地產業景氣而不斷被破壞，但有關當局嚴格規定業者務必妥善進行濕地復育或創造，以減緩濕地之損失。

七、大會參觀活動

參觀活動分鹽濕地與淡水濕地兩組進行。第一組係由Mangrove System 公司人員導引參觀Tampa 海灣潮灘鹽濕地之再造（mitigation）情形。當地主管機關嚴格審核鹽濕地之工程活動，並追蹤施工後之濕地重建或創造。工地旁之紅樹林生育地受損後，契約者大多先種植草澤植物如Spartina 等，接著由紅樹幼苗自然入侵拓植，再度形成紅樹林，俾發揮其原有功能。

本組參觀之地點為：

1. Tampa Bay 高爾夫球場之濕地再造。（照片 1）
2. Tampa Bay 公寓之濕地再造。（照片 2）
3. Hyatt Hotel 之濕地再造，並修築木棧道。（照片 3）

美國之濕地再造工作大多由這方面之專門公司負責，第二組之參觀活動亦係由Biological Research Associates公司負責導引。工程施工對淡水濕地之衝擊必須加以再造。最常見的是水邊造景（aquascaping littoral shelves），先將池塘整型，然後在水邊種植挺水草本植物或水生木本植物，俾達成濕地景觀與功能。本組參觀之地點有：

1. Tampa 海灣公園之濕地再造。（照片 4）
2. Cypress Point 公寓之濕地再造。（照片 5）
3. Tampa Telecom公園之濕地再造。（照片 6）
4. Hunter's Green 公司之濕地再造。（照片 7）

八、南佛羅里達濕地考察

自五月廿一日起開始考察南佛羅里達之濕地復育情形，六天內參觀九處濕地，地點如圖 4，並分述如下：

1. Cockroach Bay Environmental Studies Center

該中心係由主辦此次年會之Hillsborough Community College於1973年所設立，位於Tampa南方之Cockroach Bay紅樹林緣，該中心所擁有之紅樹林是全美國保存完整者之一（照片8），由Tampa電力公司所捐贈。本中心的任務是藉由教育、資訊與研究，宣導紅樹林濕地在生物學、生態學、經濟及美景方面之重要性。該中心設有1000呎長的木棧道（照片9）及多條步道，並備有船隻，以導引訪客認知海岸生育地之歧異性。除紅樹林外，本區尚含括其他植物相，諸如oak-pine scrub, cactus patch, salt barren等，及水鳥等野生動物（照片10）。

2. Cockscrew Swamp Sanctuary

Cockscrew Swamp Sanctuary （照片11）位於Big Cypress Swamp 之北端，所保存之落羽松原生林，高大茂密，樹齡達500年，是全美少數碩存之沼澤林地（照片12）。林區並孕育許多野生動、植物。在1950年代中期，該區面臨伐木、疏濬與開發等威脅，由於熱心團體與人員之捐錢、捐地，逐步獲取11,000英畝的林地，並於1964年正式交由National Audubon Society管理經營，除保育珍稀生物外，並藉以教育水、野生物與人之間的相互關係。

本沼澤保護區設有1.75哩長之環狀木棧道（照片13），採自導式教育方式，在木棧道上標有定點，配合自導手册，訪客可自行認知之植物相包括落羽松沼澤林、濕草原（wet prairie）、附生植物、樹島（hammock）、草澤（marsh）、松樹林（pineland）、野花群等，並可獲得火燒及颱風影響之機會教育。本區有多種鳥類棲息，全美國最大的wood stork族群棲於本保留區。其他野生動物包括鳥類、蛇類、青蛙類、蜥蜴類、烏龜類、哺乳類、鱷魚（照片14）、鹿等。

3. Rookery Bay National Estuarine Sanctuary

Rookery Bay位於Marco Island北方，為保護當地海岸紅樹林生態系，自1966年起，當地百姓與政府單位共同合作，分批共購得6,000英畝保護區，目前交由當地的Conservancy公司管理（照片15）。設有自然中心，提供解說服務。訪

客可由自導式木棧道或船行認識紅樹林生態體系。

4. Collier-Seminole State Park

此州立公園位於Marco Island北方，於1947年設立，以保存具代表性的植物相以及當地Seminole印第安人文化。總面積為6,423英畝，當中4,760畝為原生紅樹林保留區，餘為草澤（照片16、17）、松林、落羽松沼澤林及熱帶濶叶樹島（tropical hammock）。野生動物包括一些稀有種，諸如brown pelican、wood stork、bald eagle、red-cockaded woodpecker、crocodile、manatee、Florida black bear、Florida panther與mangrove for squirrel。公園內不可作消耗性的利用，如伐木、打獵、放牧及餵食野生動物。公園內備解說中心與步道，可提供自然教育。每天有限定的人數可以獨木舟探訪紅樹林保留區。

5. Big Cypress National Preserve

位於亞熱帶佛羅里達之Big Cypress Swamp，面積廣達620,000公頃，當中落羽松沼澤林（照片18）約佔⅓，餘為濕地松林、濶葉樹島（hammock）、濕草原（wet prairie）（照片19、乾草原（dry prairie）、草澤（marsh）與河口紅樹林（estuarine mangrove forest）。1974年美國國會將Big Cypress Swamp之40％（231,000公頃）設置為國家保留區（Nafional Preserve），由內政部國家公園局（National Park Service）管理。國家保留區係值得由聯邦保護之土地，但某些原先存在的人類利用與人類活動可繼續存在，此在大多數的國家公園內是不被允許的。

6. Everglades National Park

Everglades本質上是一條寬50哩、長100哩，由Okeechobee Lake 向南流之大河，但因區域廣大，又極度平坦，卻又不像河流。為保育本區之動植物資源，不被開發破壞，於1947年劃定566,000公頃為國家公園。又因本區之重要性及特殊性，本公園於1982年被UNESCO機構指定為一處World Heritage Site。本公園之植物相包括紅樹林、草澤（照片20）、落羽松林、濕草原（照片21）、樹島、濕地松林等。Florida Bay之紅樹林島甚多，船行其間，可探訪島群、海洋生物奇觀。

7. John Pennekamp Coral Reef State Park

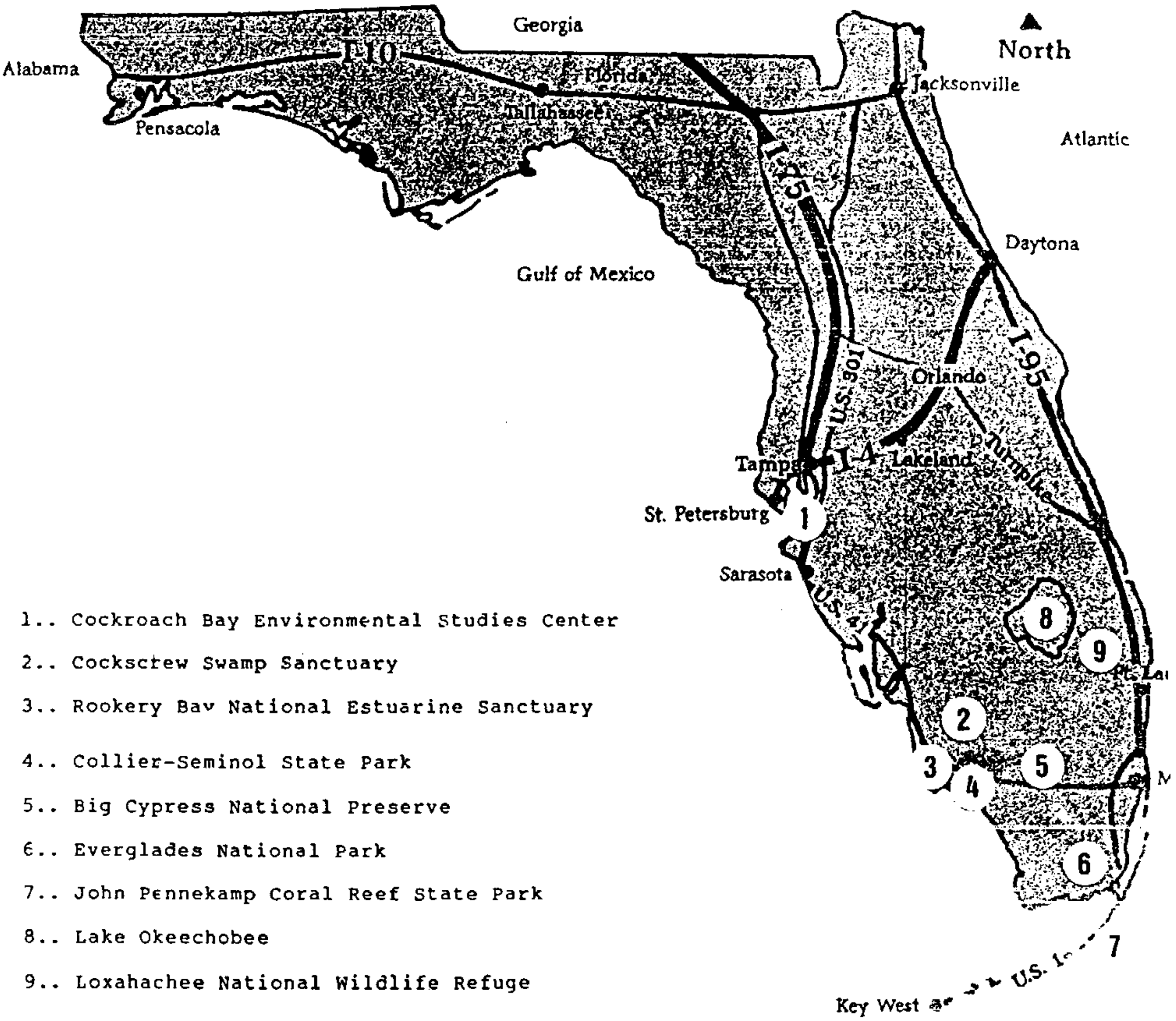
該公園位於 Florida Keys ，面積 178 平方浬，資源包括熱帶樹島（ tropical hammock ），紅樹林（照片 22 、 23 ）與珊瑚礁生物。訪客中心之展示十分豐富，紅樹林步道之設計尤具特色。另有海上船行，導引訪客認知海洋世界原貌。

8. Lake Okeechobee

位於 Everglades 之北方，湖域面積多達二十萬公頃，湖水原係自然向南溪流經 Everglades 出海。湖域大部份係呈草澤狀態（照片 24 ），目前四周已圍築大土堤，進行灌溉等多目標利用。湖之東岸設有 Pahokee State Park ，供遊憩用。

9. Loxahachee National Wildlife Refuge

本區位於 Lake Obeechobee 東南方，面積廣達 6 萬公頃，用以庇護沼澤生物。長期以來 Everglades 北邊沼澤地逐漸被排水，開發爲農地、種植甘蔗、草皮、水稻、芋頭、玉米等，本野生動物庇護區已淪爲農地，喪失原有之景觀與功能。



1.. Cockroach Bay Environmental Studies Center

2.. Cockscrew Swamp Sanctuary

3.. Rookery Bav National Estuarine Sanctuary

4.. Collier-Seminol State Park

5.. Big Cypress National Preserve

6.. Everglades National Park

7.. John Pennekamp Coral Reef State Park

8.. Lake Okeechobee

9.. Loxahachee National Wildlife Refuge

九、結語與建議

綜觀此次考察美國濕地復育及參加第十五屆濕地年會之結果摘要如下：

1.濕地具漁獲、遊憩等經濟價值，另具防洪、調節地下水、淨水、庇護野生動植物等生態功能，因而濕地之保育與經營日受重視，相關之研究與研討會亦日多。

2.全美國之濕地原有兩億一千五百萬英畝，但已一半以上因農耕、排水與填土工程、房地產業發展等人為活動而消失，目前每年減少之濕地約三十萬英畝。已逐步制定濕地有關之法令與政策，並積極推動濕地之復育與創作。

3.佛羅里達州濕地面積廣大，特別是南部之紅樹林、河口草澤、低濕草原、低地落羽松林與闊葉林。佛州南部發展很快，為保育濕地資源，四十年來已相繼設立 Everglades National Park、Big Cypress Preserve、Cockscrew Swamp Sanctuary、Rockery Bay National Estuarine Sanctuary、Cockroach Bay Environmental Studies Center 等。

4.Tampa Bay 之紅樹林與鹽生草澤面積廣大，唯該地區發展迅速，100 年來已有44%面積的濕地被毀除。佛州已立法保護濕地，非經該州Dept. of Environmental Regulation 之許可，不論州有或私有之濕地皆不得任意移除、修剪或干擾。另被許可利用之濕地，亦責成並追踪其復育或創作工作，以減緩及補償濕地之損失。

茲對於國內未來濕地復育工作提出下列五點建議：

1.我國台灣地區之濕地大多位於海岸河口區，隨著魚塭與工業區等之開發，面積日縮。政府單位曾列出十二個河口與內陸湖泊濕地，有些已劃定為保護區，有些尚待保護。大肚溪口、蘭陽溪口濕地與南部殘存紅樹林亟應加強保護。

2.國內濕地資源及其變遷宜長期調查，並建立基礎資料。應加速制定有關濕地保護之法案與政策。

3.重大工程活動引起之濕地損失應詳加評估，並規定其復舊或新造，且嚴加監督與追踪考核。

4.加強濕地復育人才之培育並鼓勵民間社團與業者等吸取濕地復育與新造之技術，並鼓勵參與這方面之工作。

5.濕地具多種功能，宜再加強濕地之解說教育並鼓勵濕地之鄉土環境教育，激發保護鄉土濕地資源之熱忱。

附錄一　行程表

5月16日	桃園中正機場→Los Angeles
5月17日	Los Angeles→Atlanta→Tampa
5月18日	濕地參觀Tampa Bay
5月19日	年會
5月20日	年會（下午野外參觀）
5月21日	Cockroach Bay Environmental Studies Center
5月22日	Cockscrew Swamp Senctuary
5月23日	Rookey Bay National Estuarine Sanctuary及Collier-Seminole State Park
5月24日	Big Cypress National Pressure
5月25日	Everglades National Parks 及John Pennekamp Coral Reef State Park
5月26日	Lake Okeechobee及Loxahachee National Wildlike Refuge
5月27日	Miami→Los Angeles
5月28日	濕地資料收集
5月29日	Los Angeles→San Francisco→中正機場
5月30日	抵達桃園中正機場

附錄二

Mangrove Forest of Taiwan (ROC)

*Ming-Yih Chen**
*Hsiao-Yu Tang***

In Taiwan, mangrove forests live in the muddy and wet soil in the west coast from Tanshui to Tungkang. There are six mangrove species, in which *Avicennia marina* and *Kandelia candel* are common, *Rhizophora mucronata* and *Lumnitzera racemosa* are endangered, and *Bruguiera gymnorrhiza* and *Ceriops tagal* are extinct.

Besides the major tree species, there are *Myoporum bontioides, Excoecaria agallocha, Phragmites communis, Zoysia matrella, Cyperus malaccensis* subsp. *monophyllus*, etc. in mangrove ecosystems. Associated fauna includes high diversity of fish, crustaceans, mollusks, etc.. Due to increasing pressure from human activities, some egretries have been removed from inland to mangroves.

Traditional products of fuelwood, dye and tannin from mangroves are no more important in Taiwan now, but its ecological functions are quite significant. The mongrove provides a nursery area for fish and other marine organisms which form part of the estuarine and nearshore fishery. Mangrove leaf litter decomposes to form fine particulate debris which nourishes plant-feeding marine organisms. Mangrove also provides the nesting and perching area for birds that are of great value for bird watching.

The rate of disappearance of mangroves in Taiwan has been alarming. Almost all the mangroves at Kaohsiung have disappeared due to port, industrial and urban developments during the past sixty years. Two native species at Kaohsiung, *Ceriops tagal* and *Bruguiera gymnorrhiza*, were already extinct. Mangrove at Yungan, Tungkang and Tainan are being unnecessarily destroyed by the diking of fish pond and canal. Some mangroves in the west coast are being converted to fish ponds.

The rapid disappearance of mangroves in Taiwan are deeply concerned. Mangroves at Tanshui estuary and Tungshih coast have been proposed as natural reserves. Actually, aquaculture and mangrove can coexist if properly planned and mangroves can play a beneficial role in bank stabilization as well as in windbreaking. Suitable habitats such as abandoned salt evaporation ponds and fish ponds can be naturally recolonized by some species of mangrove, and new mangrove systems will also be established by artificial planting.

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**Sr. specialist, Forestry Department, Council of Agriculture, Taipei, Taiwan 10728, R.O.C.

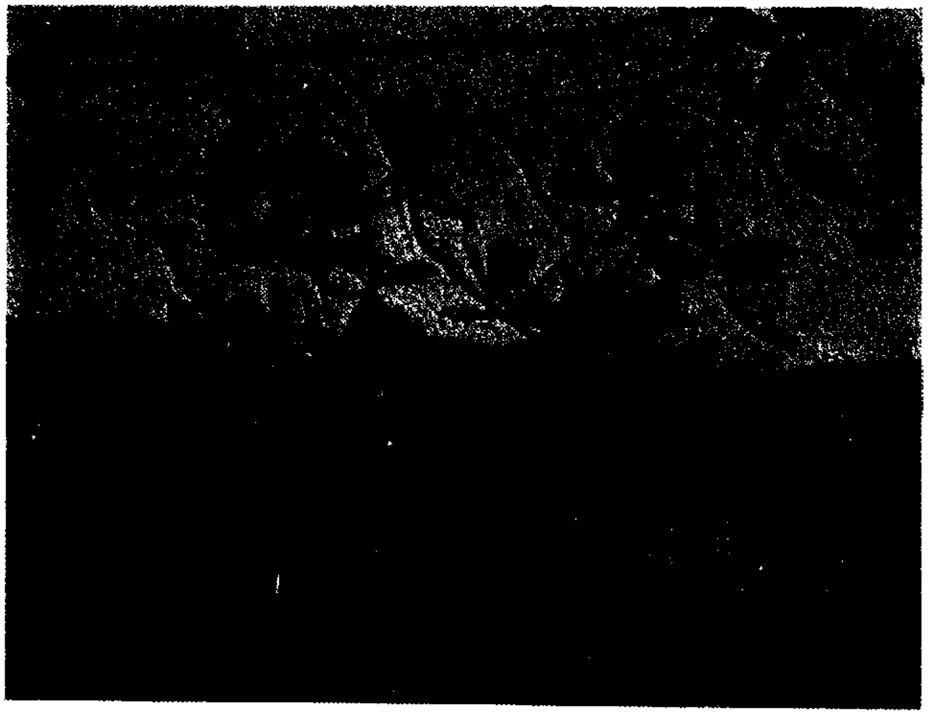
附錄三

Agenda

The 15th Annual Conference on

Wetlands Restoration and Creation

May 19 - 20, 1988
Sheraton Grand Hotel, Tampa, Florida



Sponsored by
Hillsborough Community College
Institute of Florida Studies
Environmental Studies Center

Thursday, May 19, Morning Session

7:30-8:15	**Registration**
8:15-8:30	**Welcome**, Dr. Andreas Paloumpis, President, Hillsborough Community College
8:30-8:50	Kevin M. Berg and John A. Prokes, Swanson Environmental Inc., Farmington Hills, Michigan **Diversification in Wetland Mitigation: A Case Study, Coppercreek Development Project, Farmington Hills, Michigan**
8:50-9:10	Cathleen Short, U.S. Fish and Wildlife Service **Wetland Creation and Restoration Through Mitigation Banking Associated with the Section 10/404 Regulatory Process**
9:10-9:30	James E. Kundell, Carl Vinson Inst. of Government, **Management of Georgia's Marshlands Under the Coastal Marshlands Protection Act of 1970**
9:30-9:50	Eugene Jaworski, Eastern Michigan University, Ypsilanti, MI **Role of Local Governments Regarding Wetland Management in Michigan**
9:50-10:30	Break and Poster Session
10:30-10:50	Hal D. Bryan, Kentucky Transportation Cabinet **A Saltwater Wetland in Northeastern Kentucky**
10:50-11:10	Bill J. Good, Ph.D., Louisiana Geological Survey, Baton Rouge, LA **Coastal Vegetation and Wetland Restoration Program of the Louisiana Geological Survey**
11:10-11:30	Donald W. Field, NOAA, Rockville, MD. **The Distribution and Areal Extent of Coastal Wetlands in the Gulf of Mexico**
11:30-11:50	Peter A. Clark, Tampa Bay Regional Planning Council **Cumulative Impact Assessment - A Watershed Approachment**
11:50-Noon	Announcements
Noon-1:30	Lunch

Afternoon Session

1:30-2:00	**Keynote Address**, Bill Kutash, Department of Environmental Regulation, Tampa, FL
2-2:20	James David and Frank Evans, St. Lucie County Mosquito Control, Inc., Ft. Pierce, FL **The Evolution of Marsh Management Practices in St. Lucie County Mosquito Control**

2:20-2:40	Paul R. Carlson, Laura A. Yarbro, William B. Sargent, and James R. David, Florida Department of Natural Resources, St. Petersburg, FL **Water Quality Problems and Solutions in Mosquito Control Impoundments of the Indian River Lagoon**
2:40-3:00	Arthur J. LaPerriere and Michelle Farmer, Army Corps of Engineers, Brooklyn, NY **Anatomy of a High Marsh Restoration Effort**
3:00-3:40	Break and Poster Session
3:40-4:00	Michael P. Bontje, TAMS Consultants, Inc., New York, NY **The Application of Science and Engineering to Restore a Salt Marsh, 1987**
4-4:20	Erich Mueller and Mary Sukup, Newfound Harbor Marine Institute, Big Pine Key, FL **Experimental Plots of Halodule wrightii in a Closed, Aerated Canal System (Little Torch Key, FL)**
4:20-4:40	Win Lindeman and James Wilt, Jr., Florida Department of Transportation, Tallahassee, FL **The Effectiveness of Mitigation Techniques at the Alafia River Crossing**
4:40-4:45	Announcements and Adjournment

Friday, May 20, Morning Session

7:00-8:30	Breakfast and Registration
8:30-8:50	David Boyer and Melvin Rector, Conservation Consultants, Inc., Palmetto, FL **A Study of Wetland Characteristics and Hydroperiod Simulations in Sarasota County, Florida**
8:50-9:10	Will Miller, Aurora Incorporated-South, Tampa, FL **Aquascaping Littoral Shelves**
9:10-9:30	Walter C. Holmes, Dick T. Stalling, and Gary Kiemnec, Northwestern State University Natchitoches, LA **Bank Stabilization and Shoreline Wildlife Habitat Improvement in a Large North Louisiana Reservoir (Toledo Bend)**
9:30-9:50	Lawrence Devroy, Biological Research Associates, Tampa, FL **Restoration of the Channelized Cypress Creek Swamp by Control Structure Installation (Sun City, FL)**

9:50-10:10 Joseph K. Shisler, Robert Jordan, Terry Schulze Environmental Connection, Inc., Perrineville, NJ, and Pat Buchinsky, Jersey Central Power and Light, Morristown, NJ
Impacts of Clear Cutting on Northeastern Palustrine Forested Wetlands

10:10-10:30 Break

10:30-10:50 Stephen B. Everett, Center for Wetlands, UF, Gainesville, FL
A Preliminary Report: The Comparison of Survival and Growth of Pondcypress and Baldcypress in Five Different Post-Mining Soils

10:50-11:10 Harvey A. Miller, University of Central Florida James G. Sampson, CF Industries, Wachula, FL, and Carol S. Lotspeich, Lotspeich and Associates, Inc., Winter Park, FL
Wetlands Reclamation Using Sand-Clay Mix from Phosphate Mines: Results After Three Years

11:10-11:30 William H. Hawkins and Kevin J. Ruesch, Gurr and Associates, Inc.,
Reclamation of Small Streams and Their Watersheds at Mobil's Central Florida Phosphate Mines

11:30-11:50 Betty T. Rushton, Center for Wetlands, UF, Gainesville, FL
Matching Tree Species to Site Conditions in Reclamation

11:50-Noon Announcements and adjournment

Afternoon - Field Trips

A. Saltwater Restoration Sites, Mangrove Systems, Inc.

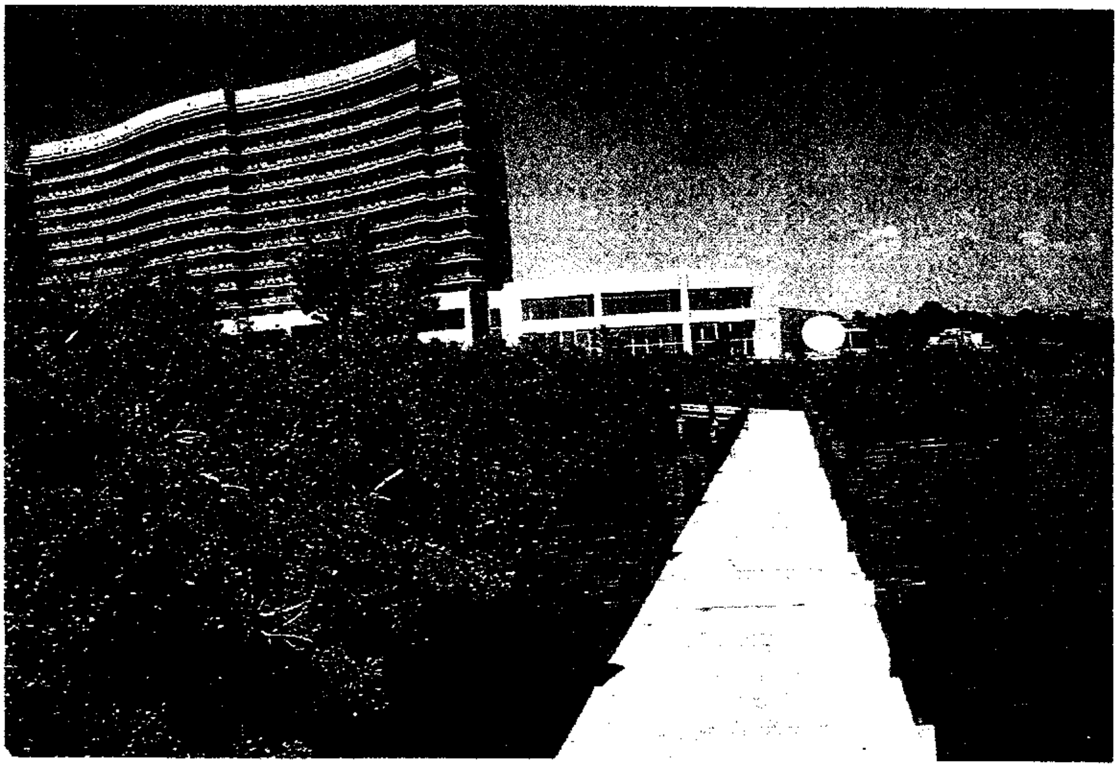
B. Freshwater Restoration Sites, Biological Research Associates

附錄四　照片

1.Tampa Bay 被毀之紅樹林地先種Spartina，爾後紅樹林自然入侵。
2.Tampa Bay 公寓建造後之濕地再造。
3.Tampa Bay 大旅館前之紅樹林及木棧道。
4.Tampa海灣公園之濕地再造。
5.Cypress Point 公寓之濕地再造。
6.Tampa Telecom公園之濕地再造。
7.Hunter's Green公司之濕地再造目前仍在施工中。
8.Cockroach Bay 之紅樹林。
9.Cockroach Bay 之解說木棧道。
10.Cockroach Bay 之水鳥。
11.Cockscrew Swamp Sanctuary。
12.Cockscrew Swamp Sanctuary沼澤林地。
13.Cockscrew Swamp之落羽松林與自導式解說木棧道。
14.Cockscrew Swamp之鱷魚。
15.Rookery Bay National Estuarine Sanctuary。
16.Collier-Seminole State Park之塩生草澤。
17.Collier-Seminole State Park塩生草澤火燒後之植物景觀。
18.Big Cypress Swamp之落羽松林，基部膨大，並長有膝根。
19.Big Cypress Swamp之濕草原(前)與落羽松林(後)。
20.Everglades之紅樹林(後)與草澤(前)。
21.Everglades之紅樹林入侵濕草原。
22.Florida Keys之紅樹林樹島。
23.Florida Keys紅樹林之支持根。
24.Lake Okeechobee景觀。

1.Tampa Bay被毀之紅樹林地先種Spartina爾後紅樹林自然入侵。

2.Tampa Bay公寓建造後之濕地再造。



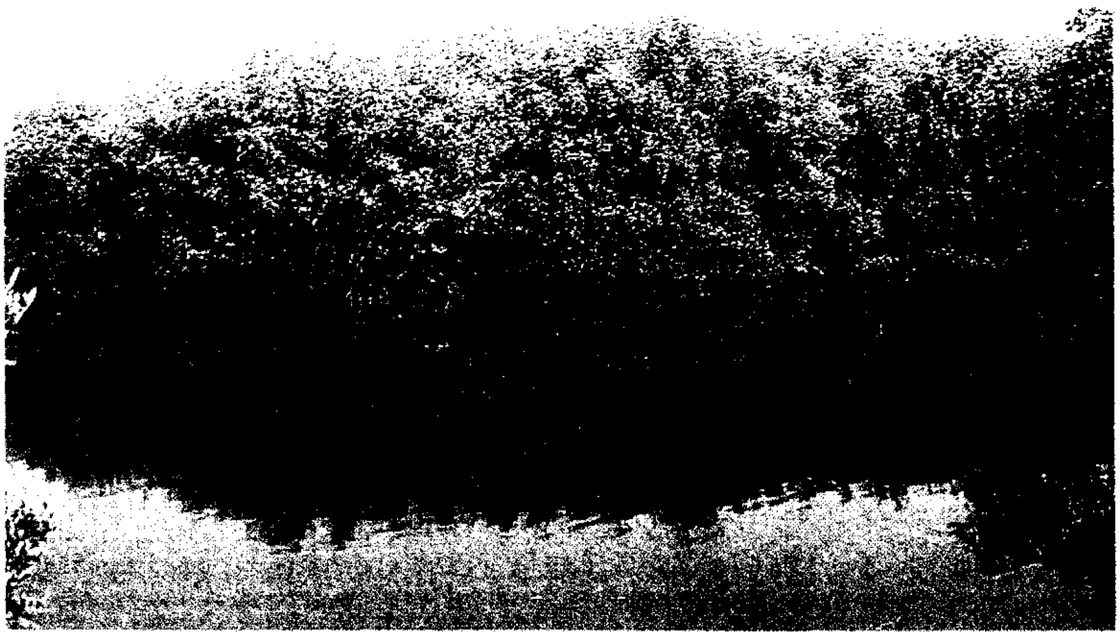
3.Tampa Bay大旅館前之紅樹林及木棧道。

4.Tampa海灣公園之濕地再造。

5.Cypress Point公寓之濕地再造。

6.Tampa Telecom公園之濕地再造。

7.Hunter's Green公司之濕地再造目前仍在施工中。



8.Cockroach Bay之紅樹林。

9.Cockroach Bay 之解說木棧道。

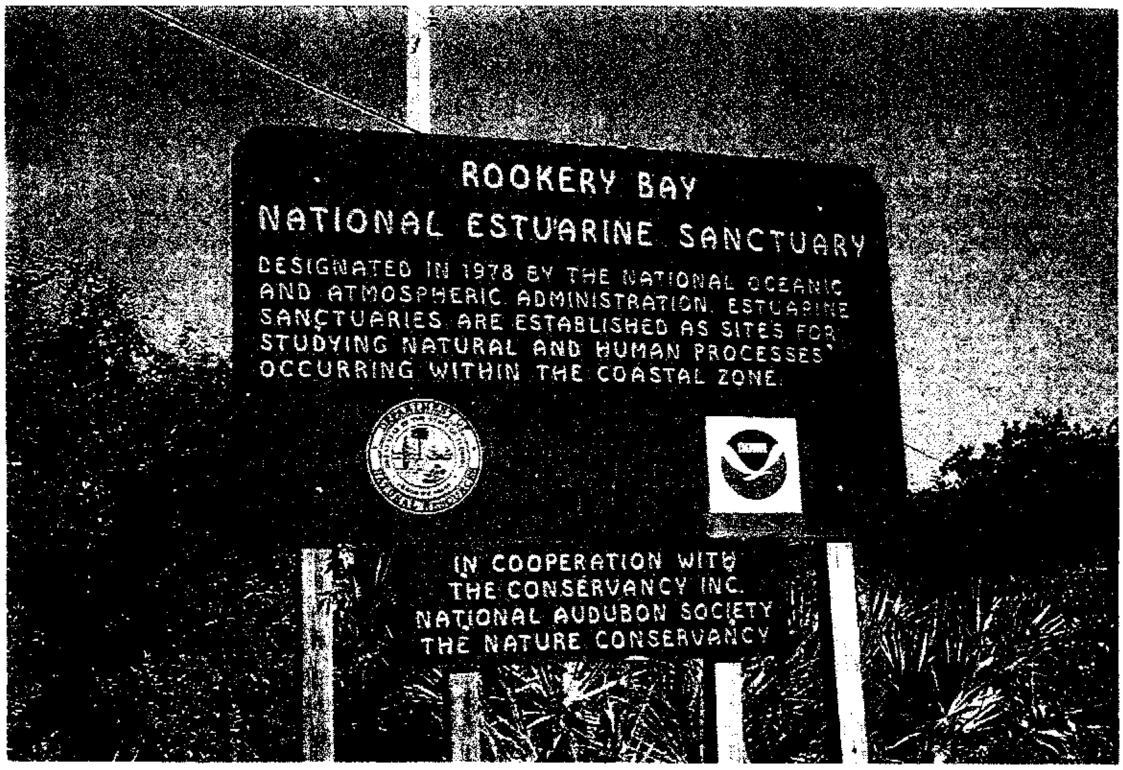
10.Cockroach Bay 之水鳥。

11.Cockscrew Swamp Sanctuary。

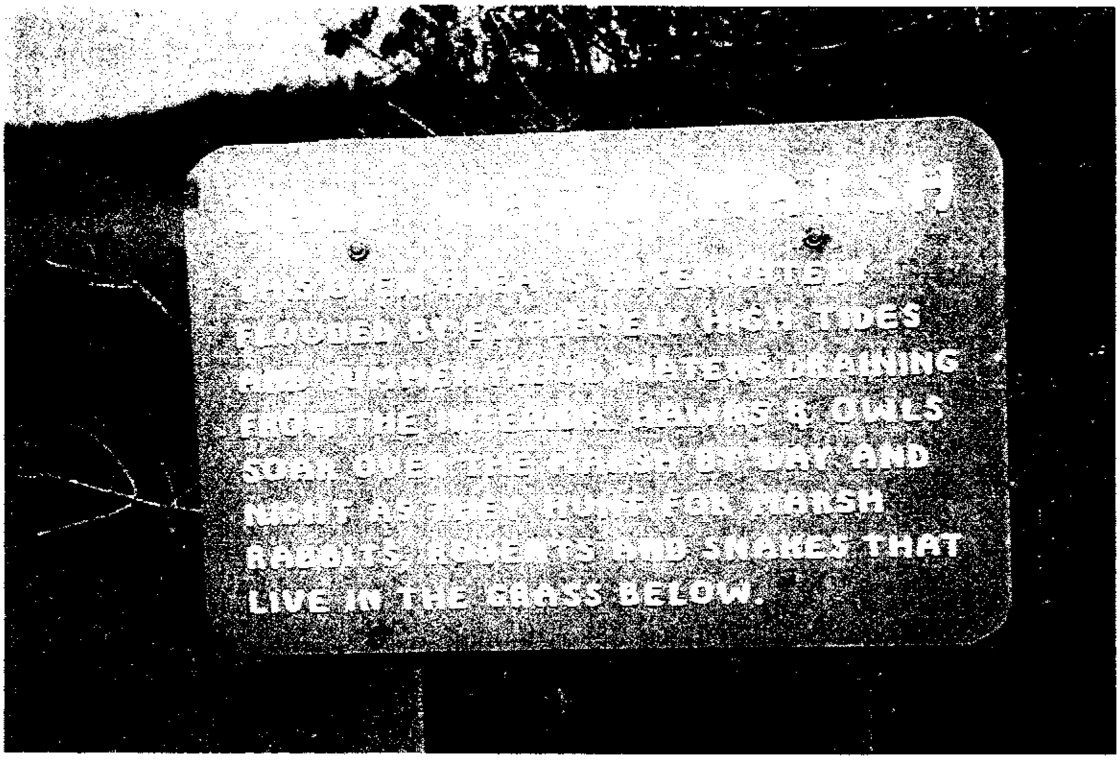
12.Cockscrew Swamp Sanctuary沼澤林地。

13.Cockscrew Swamp之落羽松林與自導式解說木棧道。

14.Cockscrew Swamp之鱷魚。



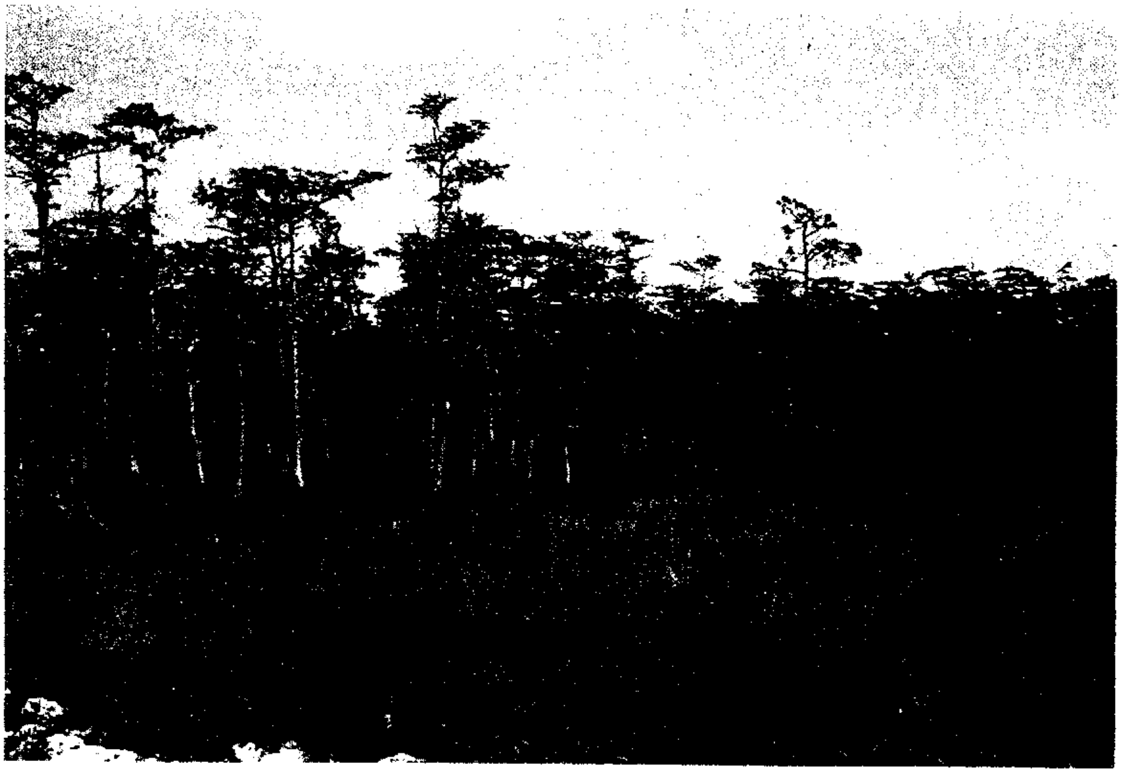
15.Rookery Bay National Estuarine Sanctuary。



16.Collier-Seminole State Park之塩生草澤。

17.Collier-Seminole State Park塩生草澤火燒後之植物景觀。

18.Big Cypress Swamp之落羽松林，基部膨大，並長有膝根。

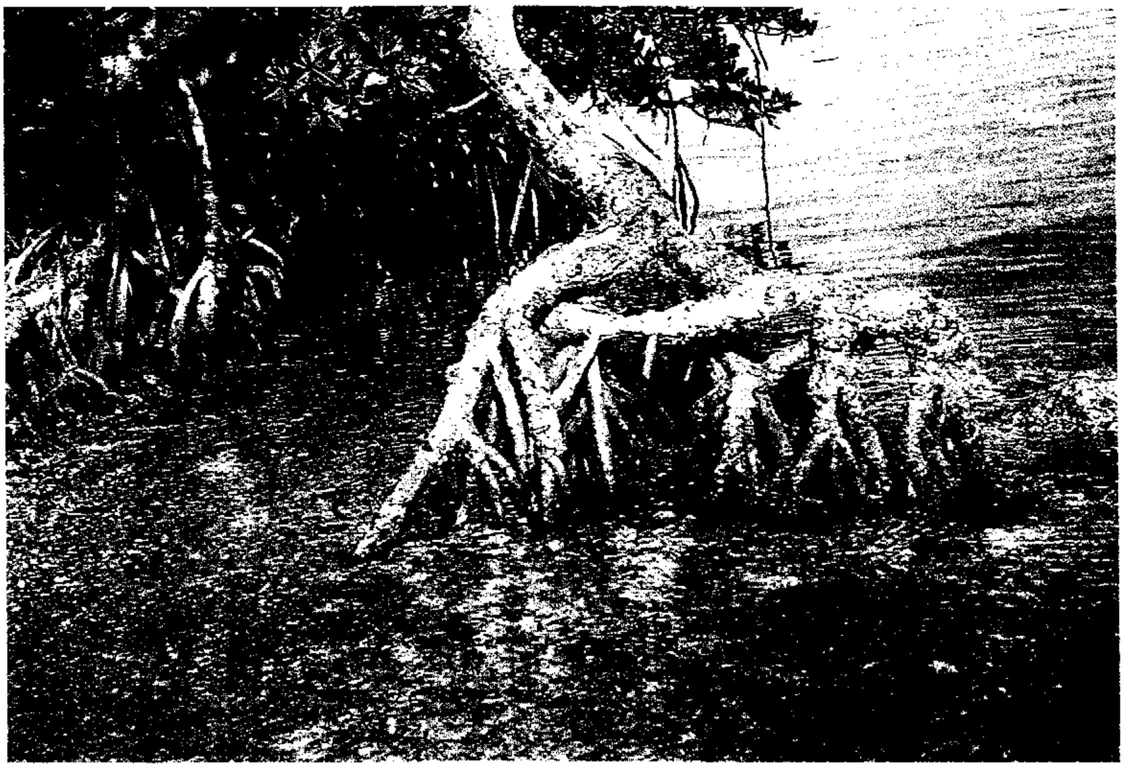


19.Big Cypress Swamp之濕草原(前)與落羽松林(後)。

20.Everglades之紅樹林(後)與草澤(前)。

21.Everglades之紅樹林入侵濕草原。

22.Florida Keys之紅樹林樹島。



23.Florida Keys紅樹林之支持根。

24.Lake Okeechobee景觀。

日本自然生態保育
及野鳥公園經營管理報告書

林錦宏　蔡阿鵬　靳其偉

台北市政府建設局

出國時間：77.2.21—77.2.27

出國地點：日本

一、前　　言

台灣工商業急遽發展與社會結構大幅改變，導致都市居民生活空間減少，而民衆對戶外活動與公園綠地之需求則相對地較往昔更爲殷切。因此如何妥善利用現有之有限空間，端視如何規劃確保良好環境品質，而自然生態保育工作是否紮實尤爲重要。

本市奉行政院指示依其頒布之「台灣沿海地區自然環境保護—淡水河口保護計畫」辦理自然生態保護工作後，本府卽於七十二年九月十七日公告關渡水鳥及中興橋、華江橋候鳥保育區保護管理措施，然因在國內尙屬首創性質，政府各機關之配合及法令之執行不免遭受舊有觀念的阻礙。本局基於主辦該項業務之立場，爲充分了解該地區生態體系和自然資源，以做合理的經營利用，乃積極委託學術界從事規劃，並經行政院於七十五年六月廿七日依文化資產保存法公告關渡自然保留區。又奉市府指示於該自然保留區北方籌設一面積達五〇公頃之關渡自然公園，以達到生態保育、休閒遊憩、自然教育、學術研究及提昇市民生活水準之功能。

由於鳥類保育區之設立需要極爲龐雜而專門的自然科學及工程知識輔助，然以目前國內有關這方面的知識與技術而言，仍有不足之憾，實有必要赴鄰近之日本，考察其既有之野鳥公園之規模，以做爲未來本市鳥類公園建設時，其中賞鳥館之安築、經營管理及鳥類棲息環境之是否合宜之參考。爰於七十七年二月廿一日起派本局林技正錦宏、蔡股長阿鵬、靳技士其偉赴日展開爲期一週之考察活動。

二、考察計畫

㈠考察重點：野鳥公園之經營管理技術。

㈡考察方式：實地參觀、訪問及蒐集資料。

㈢考察行程：此次考察於七十七年二月廿一日啓程，廿二日起訪問日本野鳥協會，並蒙該會事務局長市田則孝先生及保護部部長小河原孝生先生安排參觀東京港（大井）野鳥公園、横濱自然觀察森林、千葉縣行德野鳥觀察舍及國立科學博物館附屬目黑自然教育園等地，並由其安排解說人員陪同參觀，獲益匪淺。於同月廿七日上午搭機返國，結束考察活動。

三、考察紀要

㈠東京港（大井）野鳥公園（位於日本東京灣西岸，距離羽田機場約一〇公里，全年可見六十三種野鳥，最佳賞鳥季節爲四至五月及八至十月，適合半天賞鳥活動，每星期三至日開放）。

日本東京都政府於昭和四十六年（民國六〇年）起於東京灣西岸品川附近一帶塡土建造海埔新生地，預備做爲一大型批發市場之基地。後因其上低窪處雨後滯留之積水而漸有水草及其它水生植物孳生，並形成一小面積的沼澤地，而成爲適於許多野鳥棲息之處。大井新生地自然觀察會遂於昭和四十八年（民國六十二年）七月向政府請願要求保護這塊新生地的野鳥並設立野鳥保護區。其間經過六次開會檢討後，終於自昭和五十一年（民國六十五年）開始興建這一面積僅三・二公頃的迷你型鳥類公園，並於昭和五十三年（民國六十七年）四月正式開放啓用。昭和五十五年（民國六十九年）十二月由大井自然公園推進協議會發起，共六萬一千人聯合簽名向政府請願擴大該公園之範圍，直至昭和五十八年（民國七十二年）政府同意擴大，並將二六・六公頃土地撥交給日本野鳥協會，委託其從事細部規劃，現已規劃完成並進行施工。由於公園北、西側均爲公路，爲避免園內野鳥受到外界之干擾，在現已開放部分之園區周圍均栽植有濃密的樹木以與外界隔離。

爲滿足不同鳥類對其所適棲息環境之需求，園區內有泥濕地、砂礫地、樹林地、水生植物地、草地及水塘等多樣環境，入口處設有觀察廣場，內有一道約三公尺高的扇形觀察木牆，其上並設有長方形之觀察孔（長五〇公分、寬三〇公分）三十五個，前置有固定好的長筒望遠鏡，其旁則懸有鳥類圖鑑供人觀察及查閱辨識。該野鳥公園之管理係由東京都港灣局委託日本野鳥協會負責，兩位管理員長期駐于此地從事管理、解說及研究調查（包括野鳥繁殖生息分布、採食行動之調查、昆蟲調查、植物、魚類、水質及噪音調查、環境現狀調查及其它多種之生態調查）。

表一　東京港野鳥公園營運費（單位：千元日幣）

項　　目	摘　　要	費　　用
人件費	職員費　所長@ 350 × 17.5 = 6,125	6,125
	雇員@ 150 × 15.0 = 2,250	2,250
光熱水費	@ 500 × 12	6,000
備品、消耗品費	給人件費の約 5 ％	2,000
展示、教材費	一式	※ 4,070
印刷費	パンフレット、ＰＲ用パンフ	※ 18,630
通信、運搬費	@ 200 × 12	2,400
	小　　計	42,975

單位：千円

項　　目	摘　　要	費　　用
解說指導費	レンヅヤー　　@ 5,500 × 2 人	11,000
	アツスタント　@ 2,200 × 2 人	4,400
環境調查費	レンヅヤー　　@ 5,500 × 1 人	5,500
	（報告書印刷費）	1,000
環境管理費	レンヅヤー　　@ 5,500 × 1 人	5,500
	アツスタント　@ 2,200 × 2人	4,400
	@ 500 × 4　（ 50 丹／m^2）	2,000
	小　　計	33,800

項　　目	摘　　要	費　　用
人件費	料金徵收係　@ 1,500 × 2 人	3,000
植物管理費	樹林地　@ 500 × Bha（ 50 丹／m^2）	3,000
淸掃費	園路、便所、センター等	
	@ 40 × 100 日	4,000
施設管理補修費	一式	4,000
夜間警備費	一式	2,000
	小　　計	16,000
管　理　費　合　計		92,775

㈡橫濱自然觀察森林（位於橫濱市南部三浦丘陵基部，面積計四四・一公頃）：

由於本區地形的多樣性，有丘陵地、水域及樹林地等多種環境，造成多種動、植物生活其間，日本環境廳及神奈川縣政府爲提供多數平日少與自然環境接觸之都市居民有接近自然，瞭解認識其它生物之場所，特於昭和五十九年（民國七十三年）籌設此一自然觀察森林，並於昭和六十一年（民國七十五年）開放啓用，是日本第一處自然觀察森林（迄今全日本已有十處類似此地性質的森林）。

區內有自然觀察小路（路寬一・五公尺，長一、六四〇公尺）、觀察小屋（木造共二棟）、觀察廣場（七、五〇〇平方公尺）、誘鳥水域（六、八三〇平方公尺）、誘鳥樹林（六、二〇〇平方公尺）、停車場（二、五〇〇平方公尺），並有佔地四〇七平方公尺的木造一層建築——觀察中心，其內設有展示室（五十五平方公尺，依季節性將野鳥、昆蟲等小動物及植物等資料展示）、研習室（五六・七平方公尺，供放映影片、解說、講演、研習會之用，並可供學校野外教學之用，例如可藉由讓學生親手製做鳥窩等活動激發其親近自然，愛護動物之心）、觀察屋（三八・九平方公尺，藉由二面大型透明落地窗將室內觀察人員與外界之動植物分隔，再藉由肉眼及所設之大型望遠鏡觀察）、談話室（二四・三平方公尺，供交換觀察資料心得及休息）、日式客廳（一二・六平方公尺，供商討觀察路線及活動方式等）、資料研究室（一三平方公尺，供準備區內展示活動及整理調查資料之用）、服務處（一三平方公尺，提供各項諮詢及指導）及辦公室（二〇・二平方公尺），並由橫濱市政府委託日本野鳥協會派員常駐該地，負責管理、解說、調查研究等工作。

根據統計，在本園區內可見到一〇六科四六一種植物、六二科六五〇種昆蟲、三〇科九六種野鳥，建設總費用約爲三億四千三百六十一萬四千日圓，每年營運預算約爲四千二百萬日圓。

㈢行德野鳥觀察舍（位於千葉縣西北部，瀕臨東京灣），全年均可賞鳥，最佳賞鳥季節爲四至五月、九至十月，星期一及國定假日次日不開放）。

早在昭和四十三年（民國五十七年）時，日本千葉縣之行德至浦安間一帶仍爲廣大的沼澤地及潮間帶，有多種海鳥（包括雁鴨類）棲息其間。後因都市發展所伴生之多種建設威脅到該區鳥類的棲息並影響該區之存廢，經過愛鳥人士及保護自然團體之呼籲，千葉縣政府始於昭和五十四年（民國六十八年）在該縣行德南方瀕臨東京灣之海邊，設定一總面積八十三公頃之「行德近郊綠地特別保全地區」，包含新濱鴨場（二十九公頃，爲鳥類之自然繁殖地，禁止遊客入內，僅研究人員可入內進行調查，並照顧傷病鳥類）及行德鳥獸保護區（五四公頃，中有大面積之蘆葦地及水域區，因而吸引佔全日本鳥種二分之一，約二六〇種以上的鳥類前來棲息，是國際有名之鳥類棲息地，四周則以樹林、堤防及溝渠包圍，以避免外界之干擾）。

行德鳥獸保護區設有一棟三層樓之野鳥觀察舍，一樓設有展示室（一一〇・七平方公尺，展示圖片及模型，並備有參考資料供人查閱）及視聽室（五七・六平方公尺，供放映介紹影片，一次可容納四〇人）、二樓設有辦公室（四〇・五平方公尺）、圖書室（四四・一平方公尺，陳列參考圖書供人閱讀，一次可容納二〇人）及觀察室（窗外之前陽台上並置放麪包等食物，吸引部分鳥類前來取食，便利室內人員觀察），三樓爲觀察室（與二樓之觀察室共計二四五・七平方公尺，並設有固定型座椅及二五倍望遠鏡供觀察者使用，一次可容納五〇人），並由日本野鳥協會長期派遣四名人員駐于此地，負責管理、解說及研究調查之工作，建設總費用約爲十一億四千六百五十萬日圓，每年營運預算約爲九百七十萬日圓。

(四)國立科學博物館附屬目黑自然教育園（位於東京都港區目黑，佔地約二〇公頃）：

由於文明日進，該區已成爲東京地區碩果僅存尙能保持原有自然風貌的淨土，園內包括有丘陵、水塘、水渠及沼澤地。由於多年前即與外界環境隔離，園內的自然狀況即被完善地保持下來，而其中豐富多樣的動、植物構成了該地完整的生態體系。園內有許多年逾二百年樹齡的高大常青橡樹及松樹與濶落葉木組成的森林，配合其它共存之五百八十多種植物，爲鳥類、哺乳類、兩棲類、爬蟲類及昆蟲等動物提供了理想的生存環境。

國立自然教育園係於昭和二十四年（民國三十八年）開放，至昭和三十七年（民國五十一年）改爲國立科學博物館附屬自然教育園。該園主要功能係提供兒童、學生及一般民衆獲取自然知識之教育場所，園內分樹木園、水生植物教材園、路傍植物教材園、武藏野植物教材園、鳥區及濕地等區。除由園方定期舉辦自然觀察會（由中、小學生及其家長共同參與之野外活動）、野外生態實習、自然保護講座及生態學講座等各項活動外，並按月以解答題集之方式印製介紹當期的動、植物介紹資料。

自然教育園不同於一般公園或植物園，爲了保護自然的生態環境，規定較爲嚴格，入園者須購票並給予編號的入園證，同一時間內，入園者不得超過三百名，在園內不准吸煙或携帶飲料、收音機、樂器入園（但可以進入寫生）。

㈤日本野鳥協會：

該協會創立於昭和九年（民國二十三年），並於昭和四十五年（民國五十九年）十一月改組爲財團法人，成立迄今已有五十四年歷史，會員已有二萬人之多，創立時目的有：

1. 保護鳥類與其棲息環境。
2. 野鳥保護觀念之推廣教育並鼓勵民衆參與賞鳥活動。
3. 野鳥生態與狀態調查研究。

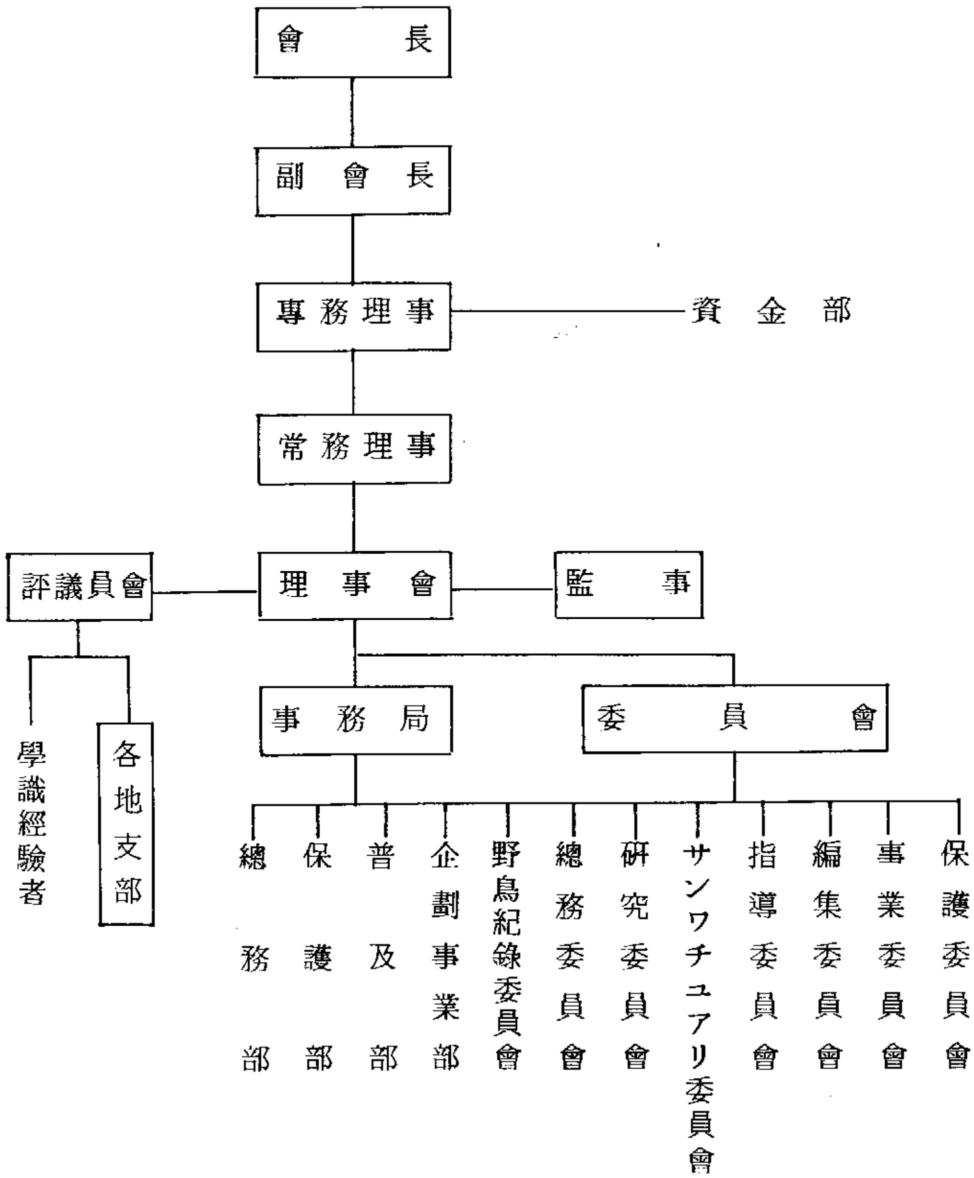
總會設於東京都涉谷區，全日本各地共有七十一個支部。內部組織由上而下依次爲會長、副會長、專務理事（下設資金部）、常務理事（下設監事、理事會及評議員會），其中評議員會下設各地支部，並有學者專家參與。理事會則分爲事務局（下設總務、保護、普及、企劃事業等四部）及委員會（包括野鳥紀錄、總務、研究、顧問、指導、編集、事業及保護等八個委員會）。

目前野鳥協會之主要工作可分爲：

1. 藉由多種展示會、演講、放映介紹影片等方式進行保護鳥類觀念之推廣。
2. 野鳥公園（BIRD SANCTUARY）設置計畫之推行（例如福島市、加賀市、清里、横濱市、姬路市等地，並受東京都港灣局委託辦理大井野鳥公園之管理作業）。
3. 保護活動（例如：配合日本全國各地自然保護團體調查並取締架網盜獵行爲，限制珍貴及瀕臨絕種之動、植物之輸出入及買賣）。
4. 調查研究（除自行調查全國鳥類外，並受日本環境廳委託做鳥類繁殖地圖調查及冬鳥分布調查等研究）。
5. 國際合作（如參加國際鳥類保護會議，並與中華民國等鳥類團體進行學術交流，交換彼此之經驗、技術與心得）。
6. 出版（「野鳥」月刊、野鳥圖鑑及有關資料多種）。

野鳥協會對促進日本賞鳥與鳥類保育工作貢獻良多，譬如促成日本政府將大雁與眞雁納入國家保護級的鳥類，使其免於遭受獵捕，並協助政府保護冲繩啄木鳥的棲息環境。以一私人機構而能與政府合作經營七處野鳥保護區，成功的推展野鳥生態保育活動，熱心公益的精神，令人感佩。

表三　財團法人、日本野鳥の會組織圖



四、考察心得

此次參觀日本國內二個野鳥公園，一個自然觀察林及一個自然教育園，另外也參觀了上野公園及日本皇宮前苑，深覺日本之保護野生動物及自然生態保育工作做得甚爲踏實，此可由下列兩點看出：

㈠學校教育重視自然生態保護觀念培養：日本之中、小學生在學期間即受過自然科學及野外生態教學之訓練，從小就對保護野生動物的觀念與作法耳濡目染且能身體力行。

㈡政府與民間對生態保護的共識：以東京港爲例，東京都政府原擬關建批發市場，後因民衆爲保護野鳥請願，遂決定擴大範圍，爲此使政府減少土地收入五十億台幣（原爲待售之市有地），並撥出近十億元台幣的建設費用，此外並將園區之規劃及管理工作完全委託由專家組成的日本野鳥協會辦理。另外在日本境內其他地方諸如野鳥公園及野生動物保護區之設施多達數十處，大多是由民間保護自然團體請願，由地方政府撥予經費委託學術界（如日本野鳥協會）規劃及管理，可見日本政府與民間對野生動物及自然生態保育工作之重視與推動之魄力了。

日本鳥類保護區除了保護野鳥之功能外，由其內之觀察設施及各項教育解說設備與媒體，即可達到觀賞遊憩及自然教育之目的。其設施無不配合鳥類生存所需，諸如種植各種野鳥喜好果實之樹木，維護原有的環境，設置小鳥棲息的小窩等，同時也顧慮到賞鳥的舒適，如望遠鏡的架設，休憩場所的安排，解說員的引導等，令人、鳥均能感受到和諧、共鳴的氣氛。

五、結論與建議

總而言之，一個理想的鳥類保護區應具有多項的利用功能，而爲充分發揮其應有的功能，至少須符合下列三項基本要求：

㈠可由人爲的方法改善局部的環境。

㈡其內必須具有多樣而複雜的環境。

㈢可提供自然教學、學術研究及賞鳥之活動。

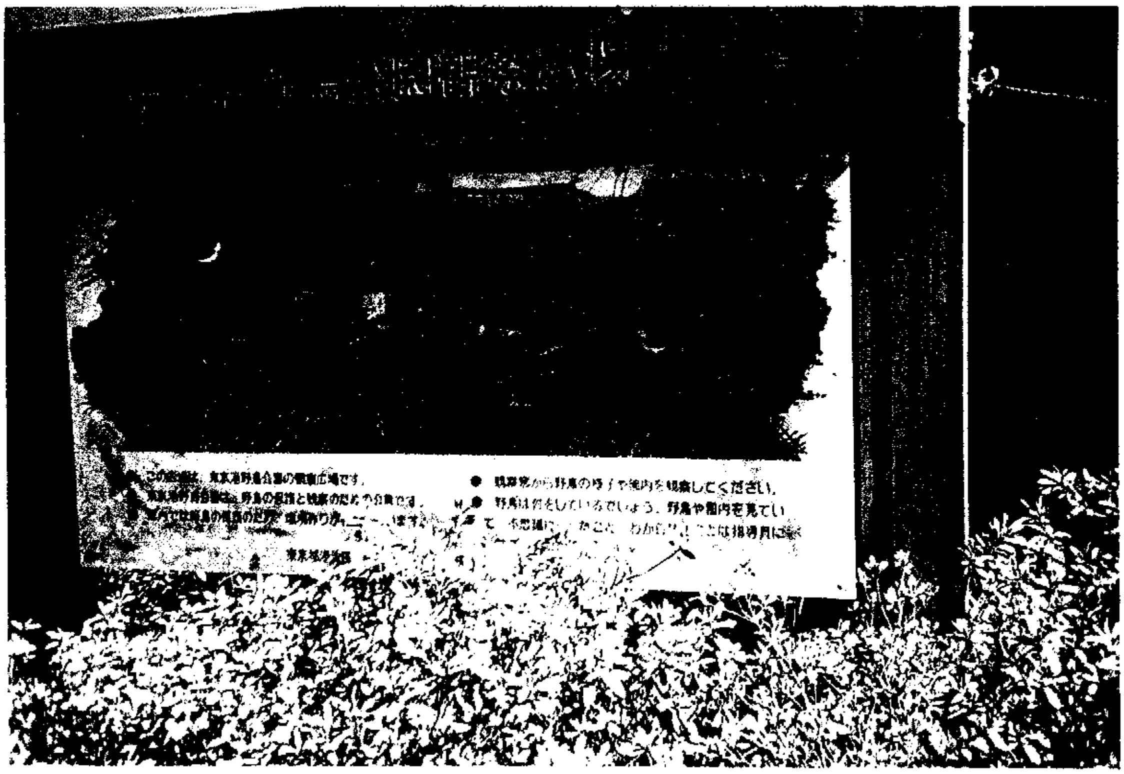
觀諸日本之野鳥公園（如大井及行德）多是利用海埔新生地或市區內土地經過人工改良而成，爲此常造成不貲之花費，反觀本市的關渡沼澤地區得天獨厚，有著優異的自然條件，如不能發展成爲自然公園殊爲憾事，在此不揣淺陋，提出以下管見：

(一)加强本國野鳥學會的功能：日本野鳥協會係一財團法人的私人機構，但其經費或由政府編列預算補助或接受民間捐贈或自覓財源（如出售鳥類電話卡、圖書、賞鳥設備），由於經費不虞匱乏，吸引許多生物、獸醫、園藝、法律方面的專才，使政府與民衆間多一溝通的橋樑，並減少政府在行政上的負擔。

(二)引進國外鳥類保護的經驗及經營管理技術，日本在民國六十九年以前並無介紹野外賞鳥活動的英文書籍，然而由於Mark Brazil博士的訪日，將全日本適合賞鳥的地方著書廣爲推介，對國際間的賞鳥活動助益匪淺，我國或可邀請著名的鳥類學家，就台灣境內適合賞鳥地點及交通狀況作一專輯以吸引國外愛鳥人士訪台，提供寶貴經驗，間接促進國際形象之提昇。

(三)加强民衆心理建設並加强宣導工作，讓國內民衆瞭解自然生態保育工作的重要性，以及生態保育對我們後代子孫的影響，切莫貪於近利，濫捕濫殺，影響生態循環，促使民衆投入生態保護工作的行列。

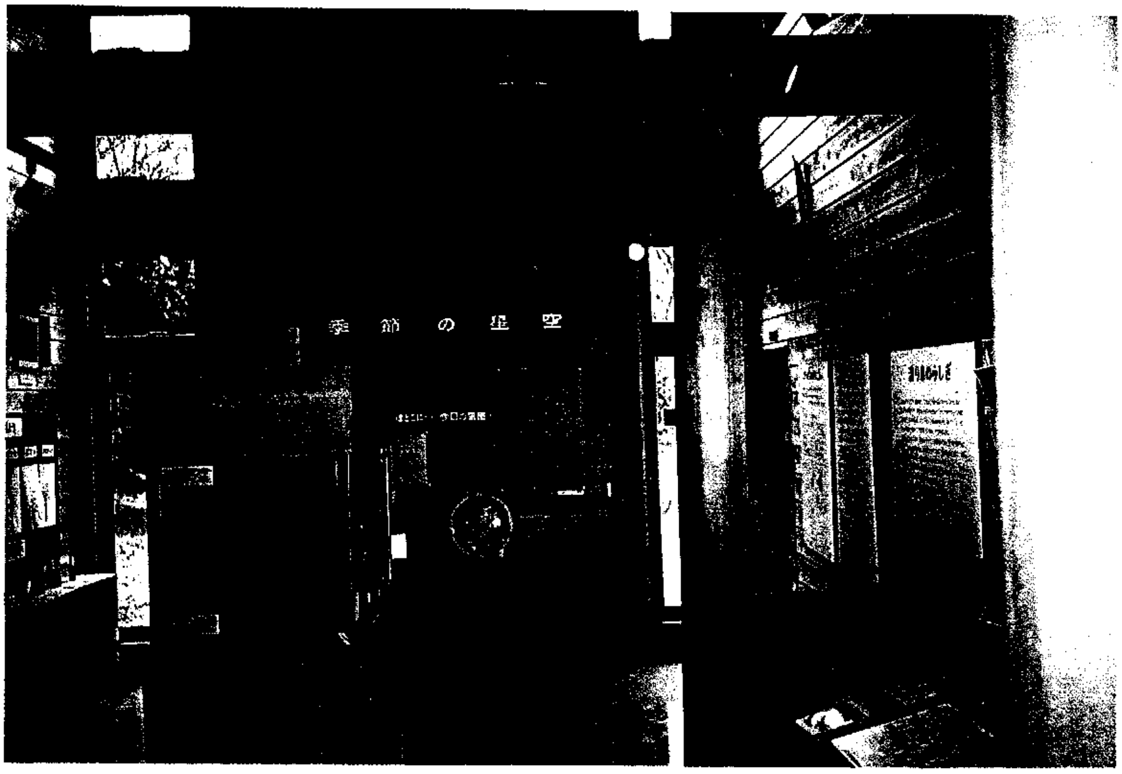
(四)積極籌設關渡自然公園：依據日本的經驗，第一處自然公園往往遭遇到的挫折愈多，但只要踏出第一步，人們很快就體會到自然公園的重要性與必要性，只要成立一處自然公園，其他地區即可模仿、學習，使自然保護的種子散播各處，因此對關渡自然公園的創設有必要加快脚步，以完成國內生態保護的紮根工作。



1. 東京港野鳥公園觀察廣場入口處。

2. 東京港野鳥公園觀察廣場之觀察孔。

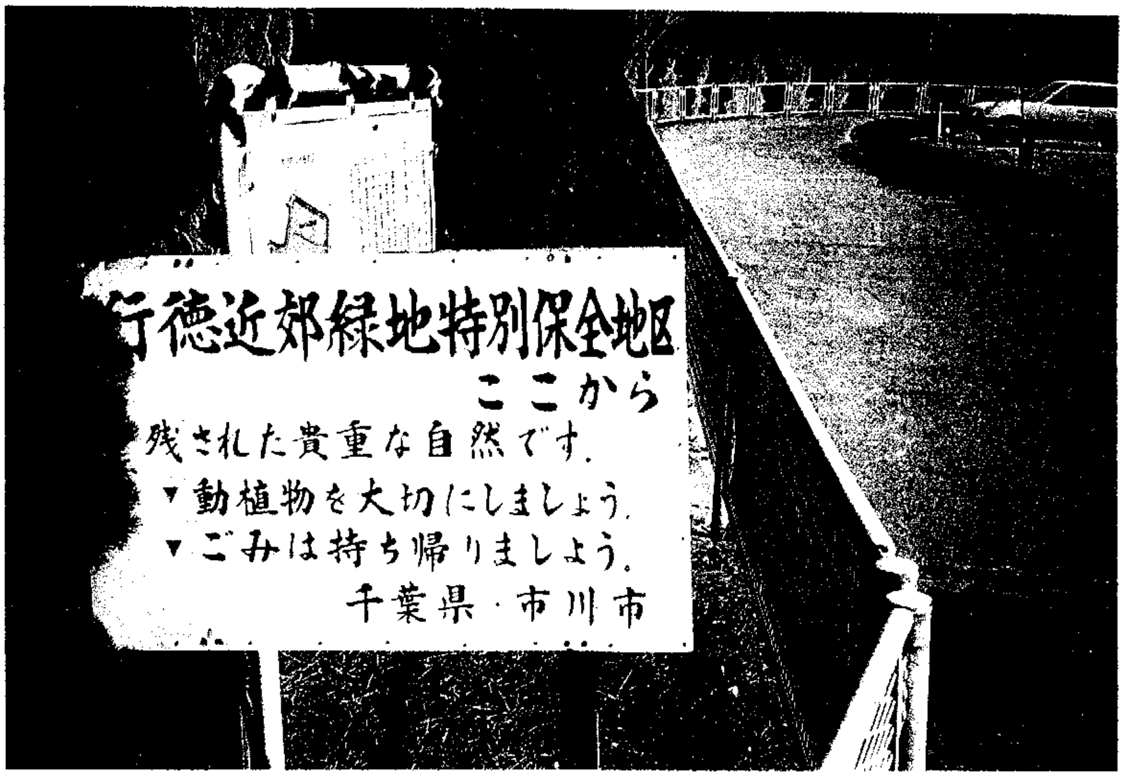
3.大井野鳥公園擴大工程之施工情形。



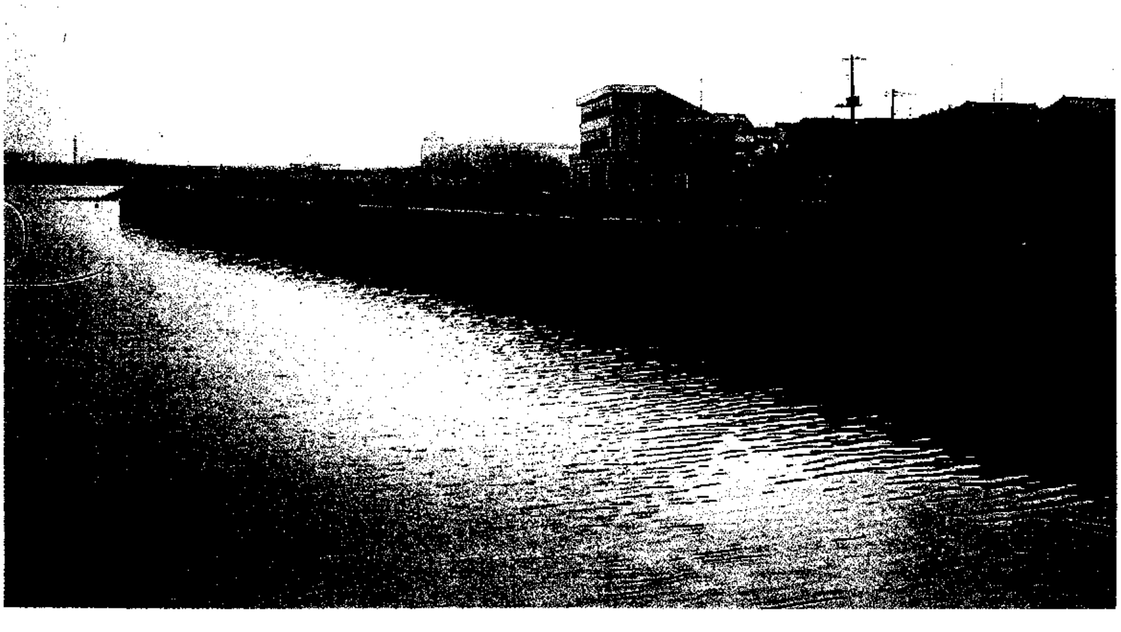
4.橫濱自然觀察森林之展示室一隅。

5. 橫濱自然觀察森林之觀察室一隅。

6. 橫濱自然觀察森林之戶外解說牌。



7. 行德近郊綠地特別保全地區入口處。



8. 行德野鳥觀察舍之外貌。

9. 行德野鳥觀察舍之二樓辦公室。

10. 目黑自然教育園內之標語牌。

11.目黑自然教育園之樹木園一隅。

12.目黑自然教育園園內禁煙標示。

赴南非考察自然保育工作報告書

柳　榗

林試所

出國時間：77.4.12—77.4.29

出國地點：南非

一、前　　言

自然保育乃爲在確保自然資源對人類及其環境之目前及將來的福祉之原則之下之保護、改進與利用。我國主管此項業務之機關除內政部營建署之國家公園組外則爲行政院農業委員會。在農業委員會中有一自然文化景觀審議小組，由經濟部、教育部、內政部、交通部、經建會、文建會及農委會等有關機構代表組成，在此一小組之下有一技術小組，由農委會聘請有關學科之專家組成，負責有關自然保育之學術研究及經營之諮詢工作，本人爲該小組成員之一。農委會爲自然保育工作之進行，每年編有預算遴選適當人員前往在此一方面有成就之國家考察研習，培養人才以供今後我國推行此項工作之借鏡及人力，而南非在這一方面不僅歷史悠久而且成績卓著，經農委會遴派本人前往，並徵得台灣省政府農林廳之同意，乃前往南非訪問。本次考察之主要目的爲了解該國自然保育工作之行政及業務組織系統，自然保育工作之現況及自然保育工作之績效。

本次訪問經農業委員會函請南非駐台北大使館代爲安排行程，南非大使館函復除表示歡迎並願代爲安排行程外並願負擔在該國訪問期間之一切食宿交通費用，並派員陪同，由於本次訪問由南非政府安排，故行程安排至爲詳盡充實，訪問至爲順利獲益良多，在此謹致對南非政府最高的謝意。由此亦可證實南非與我國政府間之關係之密切與良好。

二、行　　程

本次訪問之主要目的爲該國有關自然保育工作之行政組織系統、國家公園及自然保留區之經營現況，以及自然保育工作對國家社會經濟之貢獻。故其安排之行程除訪問有關機關外，則以國家公園及自然保留區現場實地之參觀與訪問爲主，全部訪問日程爲十八日，自四月十二日由台北出發至四月二十九日返回台北，全部行程如下：

日　期	地　點	訪　問　內　容
77. 4. 12.～13.	台北一約堡一普利多利亞	行程及訪問南非外交部。
77. 4. 14.	普利多利亞地區	由春斯旺省自然保育局副局長巴黎先生陪同參觀蘇克堡斯蘭特自然保留區及工作站之各項教育推廣設施及聽取

		業務簡報。晚應我國駐南非大使館洪照雄公使晚宴。
77.4.15.	普利多利亞—納爾斯普瑞特	上午拜訪南非國防部生態學官員格斯夏克少校後轉往約堡機場搭機飛往納爾斯普瑞特轉車至海斯未幽。
77.4.16.—17.	克魯格國家公園	上午至克魯格國家公園由新聞官林德先生陪同參觀該園之斯庫庫沙工作站各項設施及附近園區，當晚宿於該站，第二日往沙他拉工作站及附近園區參觀，晚返斯庫庫沙工作站。
77.4.18.	克魯格國家公園—康瓜尼	上午拜訪克魯格國家公園管理處主任研究員赫登巴赫先生及參觀該園之研究設施，圖書館、博物館，下午轉往康瓜尼。
77.4.19.	康瓜尼地區	上午由康瓜尼自治區公園委員會克魯格先生陪同參觀該區正在設立之三處自然保留區，並說明設置此等保留區之社會經濟效益。
77.4.20.	納爾斯普瑞特—德爾本—彼德馬立茲堡	晨由康瓜尼往納爾斯普瑞特參觀該地之國家植物園後搭機飛往德爾本轉車至彼德馬立茲堡，下午拜訪納他耳省公園委員會副主任休斯博士，聽取該會之工作簡報。
77.4.21.—23.	彼德馬立茲堡、聖路西亞、翁福路枝及呼魯伊自然保留區等地	21.日晨由納他爾公園委員會蓋斯福特先生陪同前往聖路西亞自然保留區工作站及轄區內參觀，並訪問該站研究員泰勒先生。下午至翁福路枝自然保留區工作站及轄區參觀。22.日晨由翁福路枝轉往呼魯伊自然保留區工作站及轄區參觀並拜訪該區管理員康威及哈威二位先生。23.日上午由呼魯伊工作站返回彼德馬立茲堡，下午參觀該地歷史文物村。
77.4.24.	彼德馬立茲—德爾本—開普市—斯特林布希	由新聞局彼德馬立茲堡分處主任根特先生陪同參觀德爾本海岸地區之海岸遊憩設施後由德爾本搭機飛往開普市後轉往斯特林布希，晚應該校森林系唐納教授晚宴。
77.4.25.	斯特林布希—鍾克爾夏克	上午參觀斯特林布希大學並拜訪該校森林系自然保育學教授畢卜克博士，下午往鍾克爾夏克林業試驗場水文研

		究站拜訪班德主任並會見將於六月間來台訪問之布希先生，後往現場參觀水文試驗站。
77.4.26.	斯特林布希附近地區	由開普省林區管理處安瑞格先生陪同參觀該處之三處自然保留區。
77.4.27.	開普市—約堡—普利多利亞	晨由斯特林布希至開普市拜訪開普省自然及環境保育局局長拉魯先生並聽取該局工作簡報後參觀開普市之克爾斯登國家植物園後搭機飛返約堡，轉車至普利多利亞，晚應南非國家公園委員會研究組主任范維克先生晚宴。
77.4.28.—29.	普利多利亞—約堡—台北	晨往南非外交部拜會致謝，後至約堡搭機於二十九日上午九時返台北。

三、訪問心得及感想

㈠訪問心得：

1. 南非簡介：南非位於非洲南端約介於南緯廿二度至卅五度之間，總面積約一、二二五、一〇〇平方公里，約爲本省之卅三倍，全國人口約二、六〇〇萬。行政區則包括四省、六自治區及四獨立邦。氣候介於熱帶及亞熱帶之間，唯雨量較少，全國平均年雨量約五〇〇公厘，東南部雨量較多，最多處可達一、六〇〇公厘，但全國百分之六十五的土地少於五〇〇公厘，西南則屬於冬雨夏乾型氣候，農業及工業可稱發達，全國交通尤爲發達。雖爲開發中國家，但開發程度極高。

2. 南非自然保育工作之行政系統及業務概況。

⑴南非之自然保育工作，中央政府主由環境部、國家公園委員會及農林部負責，其他尚有國防部及科技工業研究委員會，但僅作政策性之決定。實際業務及經費則由各省及自治區等地方政府自行負責。

⑵由於各地方政府之自然情況及歷史傳統之不同，故各地方政府之自然保育機構之名稱及組織皆有所不同，但其組織架構則大致相同，主要可分爲行政、業務、研究及推廣四部門，其下所設之自然保留區各有工作站負責管理及業務工作。

⑶中央政府國家公園組主管之國家公園各設有管理處負責行政、業務、研究及推廣工作，較大之國家公園管理處則分設有工作站。

(4)各國家公園及自然保留區之主要業務爲提供戶外遊憩、資源經營、技術研究、教育推廣以及珍稀生物種類及特殊生育地之保護等。

(5)南非之國家公園及自然保留區皆訂有詳細管理辦法，管理機構皆有執行取締與處罰之權利。

3. 南非自然保育工作現況：

(1)南非早在一八九七年即開始設置自然保留區以保護自然，如四七、七五三公頃之翁福路枝自然保留區及二三、〇六七公頃之呼魯伊自然保留區即成立於一八九七年，翌年一八九八又設立了沙比自然保留區（克魯格國家公園之前身）。

(2)南非目前有國家公園十七處約三〇〇萬公頃，自然保留區一四〇餘處，約二六〇萬公頃。

(3)南非之國家公園及自然保留區保留之對象雖以野生動物聞名世界，但對於森林、植物、集水區及特殊地質、地形亦極爲重視。且大部分國家公園及自然保留區除少數爲物種保存或特殊脆弱之環境而予以保護不對外開放，僅供研究之用外，皆予以合理的經營利用，如提供戶外遊憩、資源經營及教育之用。

(4)各國家公園及自然保留區爲發揮其遊憩教育之功能皆有良好之設施，如道路、營地、遊客服務中心、博物館、視聽教育設施及推廣刊物之發行等。

(5)國防部爲配合自然保育工作、環境之保護，對於軍事訓練基地及演習場地等對自然之衝擊已開始注意避免。

4. 南非自然保育工作之成就：

(1)國家公園吸引大量國際觀光客。

(2)提供國民戶外遊憩之環境與場所。

(3)提供自然及環境教育與科學研究之材料與場所。

(4)厚殖國家生物及水土資源，安定自然環境。

(5)物種之保護與復育，使一些有危機之種之族群恢復。如白犀牛在一八九五年生存者不到五十隻，經保護後至一九四七年時增加至三百隻，目前已供應世界各地動物園有三千六百隻。

(6)除國家公園及自然保留區可保存當地生物種外，並設有七處國家植物園以保存當地之植物成效卓著且極具經濟價值。

(二)訪問後之感想：

1. 南非由於早期受殖民國家對當地自然資源之掠取，以致在十九世紀即深感自然資源之貧匱與環境之惡化而興起對自然之保育，開始設置自然保留區，繼續由南非政府之經營，深感自然保育之重要而獲得今日的成果。

2. 由南非之經驗可確定自然保育乃爲發揮自然資源對現代人最佳的永續利用價值，並可保持其供應後代人生存所需之最大潛力對自然資源之經營方式。

3. 自然保育工作步驟包括初期的對自然資源的保留維護與復育及後期的保持其永續的生產與功能的經營利用。

四、建　議

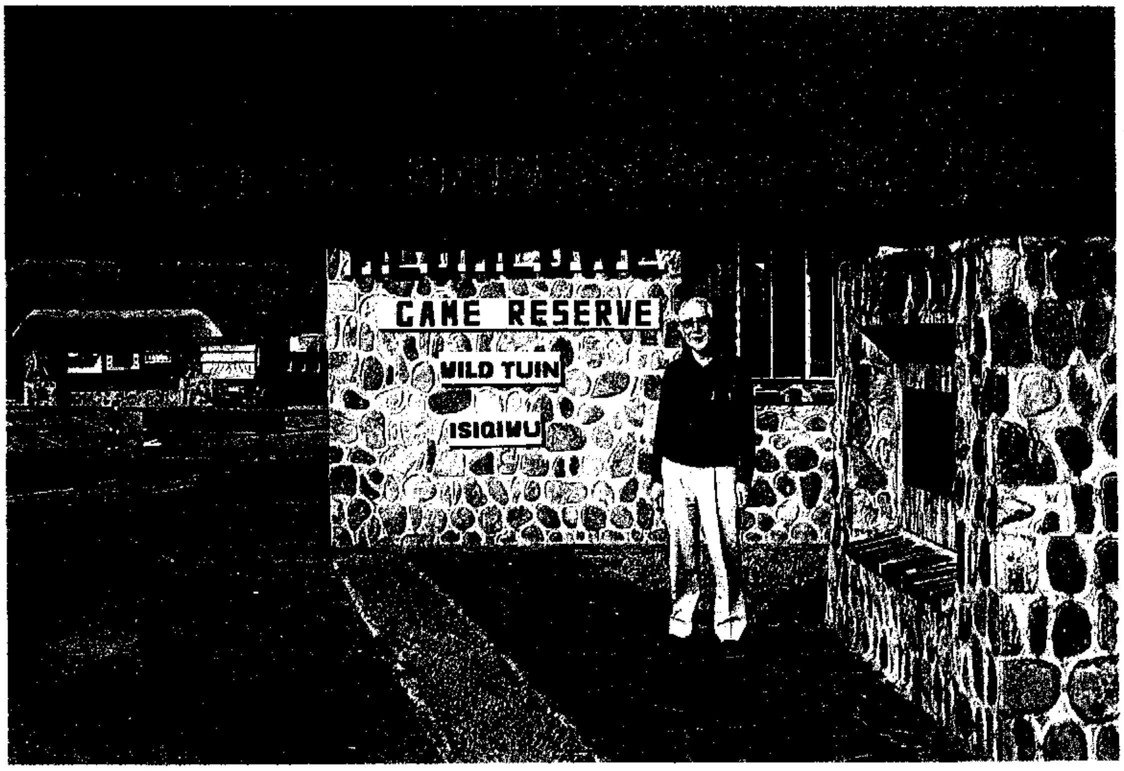
(一)本省之自然保育工作尚在初期的保育與維護階段，應加速研究以供今後保育之參考以發揮其最大的永續的社會經濟效益。

(二)建議除本省已開發及區域計畫預定開發之地區及已設立爲國家公園地區以外之地區，尙保持爲自然狀況者，由單一自然保育機構從事整體的保育，以發揮本省自然資源整體的多方面社會經濟效益，如生物及水土資源的經營、戶外遊憩及自然教育環境之提供以及自然環境之調節等功能。

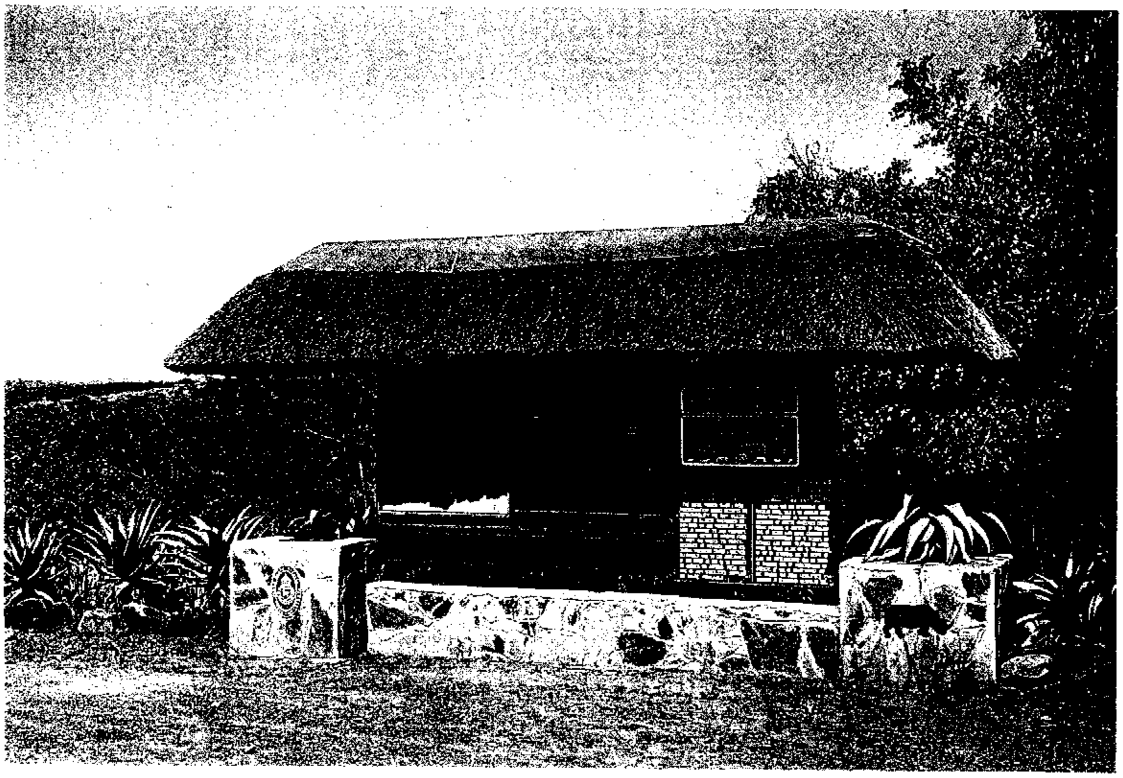
1. 自然保護區內之天然林，主要樹種爲羅漢松。

2. 自然保護區之入口。

3. 人工林林相（松樹造林）。



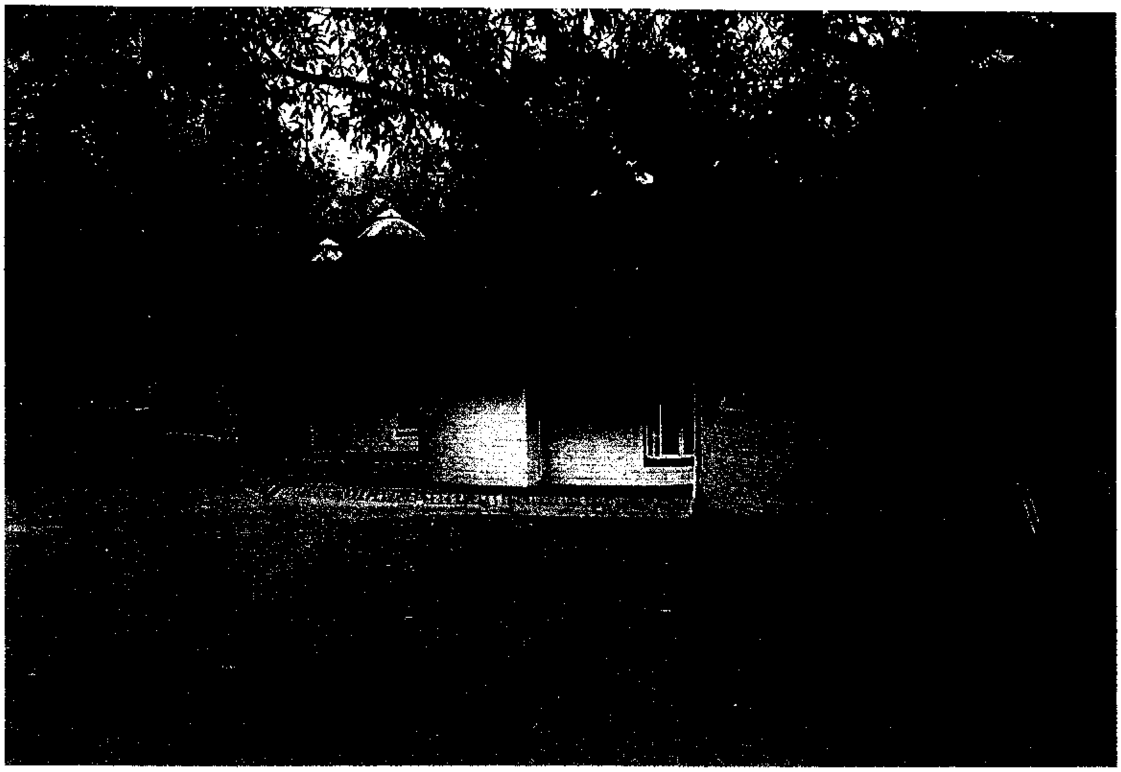
4. Hluhlume 野生動物保護區之入口。



5. 保護區內之解說牌。

6. Natal 省公園委員會管理人員與研究人員。

7. Umfolozi 野生動物保護區之入口。



8. 遊客住宿小屋。

9. 自然保護區之入口處。

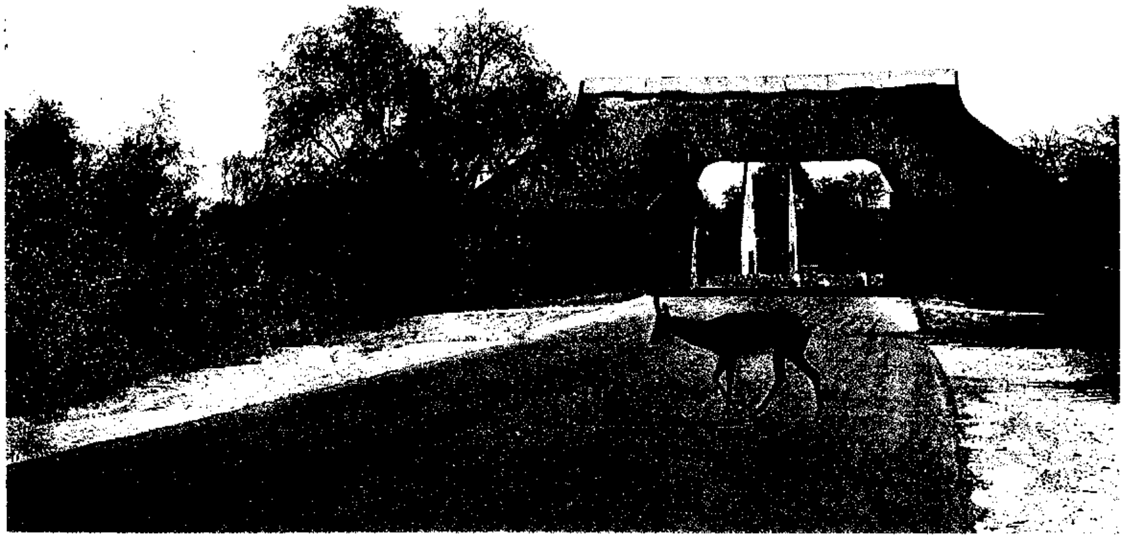
10.南非國家植物園。

11.保留區內之植被。

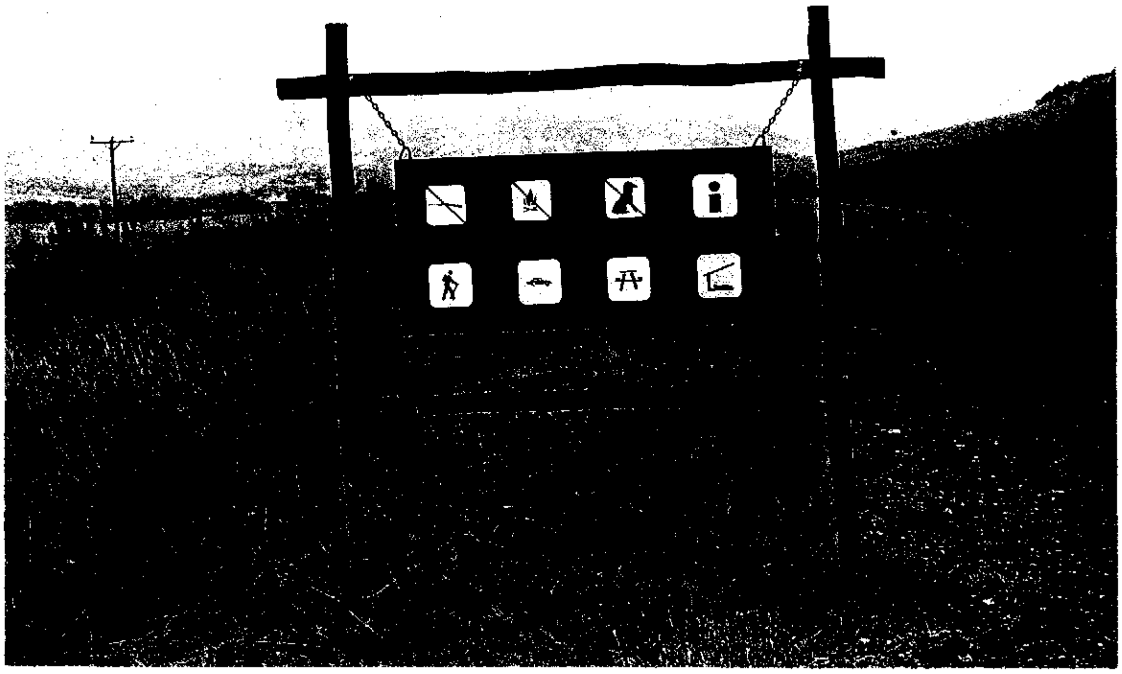
12.保護區內之野生動物—— 斑馬。

13.保護區內之羚羊。

14.保護區內之長頸鹿。



15.野生動物保護區之入口。



16.保護區內之各種解說符號。

參加國際野生動物及魚類保育協會年會報告

劉小如

中央研究院動物研究所副研究員

出國時間：77.9.9—77.9.14

出國地點：加拿大多倫多市

一、簡介國際野生動物及魚類保育協會

此協會爲非官方組織，成立於一九〇二年，成員除中華民國外，皆是北美洲各政府主管野生動物及魚類資源的機關，出席會議的各機關代表也都是各機關之首長或副首長。會員之中，以美國各州政府之魚類及野生動物主管機關佔絕大多數，共五十四個單位（因美國各州中有三州之魚類與野生動物分由不同單位負責，而佛羅里達州除魚類及野生動物廳外，另有一個自然資源處也是會員），聯邦政府中也有五個相關單位是會員。加拿大共有十一個省級單位及一個中央級單位，另有大英國協在北美洲的三個國家、墨西哥，及中華民國，共七十六個會員。

此協會之組成，實乃爲提供各野生動物與魚類經營管理機構一個溝通、協調、以達成互相配合與合作的管道，使得各機關能在野生動物及魚類之經營管理措施上取得一致性，以免因各自爲政而事倍功半，甚或互相妨害而導致完全失敗。

此協會內部之運作及對外工作之推動，除在華盛頓市設立一負責聯繫與執行的工作單位（僅執行副會長及五名職員），並聘有一名法律顧問，一名會議記錄編輯外，幾乎全由會員分別組成各種工作小組分擔工作。大會領導階層有會長及二名副會長（由各機關代表推選，任期一年），秘書兼會計，及一位大會顧問。理事會有副理事長及六位理事，均是由各機關代表中選出的。工作小組則五花八門共有三十一個（各工作小組名稱見附錄一），負責研討各種與野生動物及魚類經營管理有關的問題，再於大會中提出進一步討論與決定，大會的決定，各機關均切實執行。

二、會議內容及心得

此次年會的議程（附錄二）排得十分緊湊，上午與下午各討論三小時，中間並不休息。此外，每小時的議程均多有數項報告與討論，但是報告人員與參與討論者可能因爲都是行政主管，均很能掌握時間，使得會議進行絕無冗長、拖延時間的現象。

會議內容多是各小組研究問題的工作報告，雖然筆者因爲對北美地區許多問題過去研討狀況不清楚，又加上是第一次出席此類行政人員的會議不甚習慣，而有時覺得不能十分掌握討論範圍或主題，但仍有許多收穫與心得，僅在此列出，以爲我國資源主管單位之參考。

㈠有關協會部份：

1.此協會之基本精神，爲對各機關主管之資源負責，各地民衆之需求，絕不能危害

到資源本身之健全與延續。

2. 雖北美洲各地之需要與問題各不相同，此協會之存在代表各地共同之目標及共同之利益。實是北美洲最强有力之自然資源經營管理單位，對資源負最直接之法律責任；透過各州政府，也與全國各地之民衆有最密切之聯繫，實是多年來影響並建立北美洲資源經營管理態度與方法的組織。

3. 因北美洲不直接消費野生動物及魚類的民衆（不打獵或釣魚的人）數量日增，此協會已開始擴展此方面的活動與服務，例如推動瀕臨絕種動物之保育等。

(二)特殊計畫或活動部份：

1. 北美洲至今仍有許多地區有狂犬病，美國主要在德州與加州，而加拿大安大略地區之病例却高於上兩州之和。主要帶病動物是蝙蝠、紅狐及鼴鼠，安大略因此積極推動預防注射。由獵人配合進行之研究發現狂犬病之存在與否與一地區之土壤、土壤排水、及農業狀況與方式均有關，而一棲地之面積若小於四千平方公里，狂犬病也會自然消失。

2. 協會推動的獵人教育計畫中原似有全國槍枝協會介入，協會決定要與槍枝協會劃清界線。

3. 北美各國因主要是基督教背景，至今在美國仍只有三十五州允許獵人在星期天狩獵，四州部份地區開放狩獵，二州今年將允許星期天獵捕特定動物或於特定地區狩獵，五州則除少數特殊地區或種類外，原則上禁止星期天狩獵，另有四州是全面禁止。加拿大極北部地區外，均禁止星期天狩獵，北部地區不但不禁止愛斯基摩人星期天打獵，對一般獵人也同樣開放。某些地區之民衆正在寫信給政府，呼籲開放星期天狩獵，光是歐亥俄州卽收到一萬四千封信。

4. 北美野生雁鴨計畫，是美國與加拿大各機關間的合作計畫。顯然去年大會時決定兩國各募集兩百萬美元，共同來推動計畫第一步的工作。其後美國共有十二州的主管機關，由其經費中匀出一部份移做此計畫之經費，共得一百萬美元，但加拿大政府一直到最近才同意將政府經費中之部份移來做配合款，推動此項合作計畫。今年年會中所討論的是計畫的第二步，美國聯邦政府、各州政府，及民間團體將各籌二百萬美元來推動工作，包括以二百萬美元在美國境內購買重要雁鴨棲地，另外四百萬則將送至加拿大使用。加拿大的配合款還未決定是一百三十三萬（１：３比例）或四百萬（１：１），但整體經費將用於已審核通過之計畫上。

5. 北美大湖區的魚類資源經營管理，由大湖區魚類資源管理委員會負責。此委員會由兩國共十三個州、省、聯邦政府及印第安人組織組成，負責從事Sea Lamprey災害防治、魚苗生產養殖、漁撈量管理、水質改善，及以生態系統觀念爲基礎來

經營管理大湖區魚類資源。目前在大湖區釣魚者每年有一千四百萬人，對地方經濟影響在二十億元以上。在一九四〇及五〇年代大湖區魚類資源因Sea Lamprey爲害、過度撈捕，及棲地破壞而崩潰之後，能有目前的成功誠屬不易，而其中最令大湖區魚類資源管理委員會引以爲榮的就是民衆對大湖區資源的重視與愛護，這種態度的改變使得當地資源不會再面臨過去那種災難。

6.「野外」計劃推動的原因如下：

(1)美國的幼稚教育中普遍不重視環境教育，老師需要特別鼓勵與支持來傳導有關野生動物及棲地的知識，以便日後能有對環境負責任的行爲及正確的決定。

(2)一般老師對野生動物之基本知識有限，此方面之教育背景很弱，需由參加活動來獲得知識與信心。

(3)受過訓練的老師可協助整個學校或學區中的相關課程。

因此這是一個針對美國各地幼稚班及中小學教師的需要而推動的工作，到目前已進行了五年。工作方式是爲各地老師們舉辦「野外」營，至今已有十四萬位老師及行政人員參加過這種活動。後續調查結果發現75％參加過此種活動的老師，會把所得資料轉借給其他老師，提高野外營的功效。美國已有四十一個州政府及六個全國或國際組織參與推動野外營的活動，去年一年卽有約四萬人參加過野外營，共約有一百一十五萬名學生因此受惠。在加拿大舉辦的野外營也正在各省有關單位的合作下積極展開。今年年會中，計劃報告人提出給參與過活動的老師進一步資料，或新資料、或復習課程的構想，使他們能有興趣地繼續傳授正確的觀念。已推動的後續行爲包括：

(1)各州內印製通訊，協助參加過野外營的老師間之聯繫與溝通。

(2)印製通訊使各州老師與帶領野外營的義工老師們保持聯繫。

(3)舉辦特殊訓練營，就特定主題做更深入的探討，例如淡水生態、野生動物保育、爬蟲類、羚羊，或猛禽等。

(4)針對各地野外營之內容編印補充資料。

(5)提供經費鼓勵老師帶領學生，根據野外營的訓練經驗從事小型野生棲地改善計畫。

(6)鼓勵全校課程中均能融入野外營的觀念與活動。

(7)提供進一步活動指南，鼓勵相關活動。

此計畫之經費有限，平均各州只能聘用一位專職人員，各州用於書籍、材料、交通等方面的經費約是每年一萬五千美元，計畫推動小組希望經費能逐漸增加，以便能增加人手與資料。

7. 美國全國海洋漁業署向聯邦政府提出海洋漁業需要申請執照的建議。協會的海洋與河口小組研究此議案後，向立法小組提出意見，並在大會中提出討論。往年聯邦政府相似的建議均受到協會的反對，今年決議案中更明確指出頒發漁獵執照及收執照費是各州政府的權責，聯邦政府若規定在領海中捕魚要申請執照，則漁人（業餘或執業性海釣者）必須付雙重執照費，會破壞各州現存制度及費用徵收計畫，因此再度決議反對。這種情形使聯邦政府即使能獲得國會的支持，通過需有海洋捕魚執照的規定，在執行上若不得各州合作仍是不能成功，因漁人及捕魚活動是分散在各州轄區內的。

8. 此協會主要人員對我國十分友好，始終以中華民國相稱，殷勤詢問國內有關野生動物及魚類保育活動，現任執行副會長並鼓勵我國多參與國際會議以提高知名度。

三、執行副會長之退休

現任執行副會長Mr. Berryman 將於年底退休，本屆年會中每位上台報告或致辭的代表都向他致意，感謝他多年的努力，讚揚他的成績，並表示思念之意，許多單位也贈送紀念品，美國雷根總統也寫信讚揚Mr. Berryman 的成就。我代表中華民國對Mr. Berryman 四年來給予我國的支持表示感謝，轉達農委會及保育人士歡迎他隨時到台灣來的心意，並贈送紀念品。即將接任之執行副會長也要轉達他對中華民國的好感。

四、建議事項

(一)農委會應每年派員參加此協會之年會，同時儘可能派同一人參加，以建立對會議程序及討論內容之熟悉，不但可增加有關野生動物及魚類管理之行政經驗，並可提高與其他會員代表之友誼。民國七十八年之年會將於九月初在Nebraska 舉辦。

(二)積極聯繫其他野生動物及魚類資源保育或經營管理團體並參與活動。已對我表示有興趣聯繫之單位包括美國森林署野生動物部門及美國的野生動物學會。

(三)與「野外」計畫負責人聯繫，洽商派員參與學習，以便回國後推展類似之活動及輔助計畫。

(四)今年美國魚類學會之年會與國際野生動物及魚類保育協會同時同地召開，此學會是北美最高魚類學術研究組織。今年之報告中有數篇菲律賓學者提出的研究成果，我國學者也應積極爭取與學機會。明年之魚類學會大會將於九月初在阿拉斯加舉辦。

附錄一　國際野生動物及魚類保育協會工作小組名單

1. 行船問題臨時小組
2. 北美野生雁鴨科經營管理計畫臨時執行小組
3. 財務小組
4. 動物災害防治小組
5. 動物福利小組
6. 審計小組
7. 獎賞小組
8. 溝通與教育小組
9. 電腦使用小組
10. 教育經費小組
11. 聯邦政府預算小組
12. 魚及野生動物健康小組
13. 皮草資源小組
14. 研究經費輔助小組
15. 棲地保護小組
16. 內陸魚類小組
17. 國際事務小組
18. 土地資源小組
19. 法令與執行小組
20. 法規小組
21. 立法小組
22. 海洋及河口小組
23. 遷徙動物小組
24. 印第安人事務小組
25. 選舉小組
26. 非狩獵性及瀕臨絕種野生動物小組
27. 計畫與活動小組
28. 決議小組
29. 獵人及漁人教育小組
30. 時間地點小組
31. 水資源小組

附錄二　國際野生動物及魚類保育協會1988年年會議程

9月9日：報到

10日：執行小組會議

8：30　(1)點名、報告事項，靜默一分鐘紀念Richard Cronin。

(2)審查與通過一九八八年三月執行小組會議紀錄。

9：30　(1)有關棲地管理協調之報告。

(2)有關本協會參與最高法院評審第九區環境保護署之事項。

(3)協會之財務狀況及下年度預算。

10：30　執行小組：

(1)薪資之訂定與討論。

(2)財務小組報告。

(3)執行副會長退休與交接事項。

(4)野生動物經營管理機構發言。

1：30　(1)美國聯邦政府魚類及野生動物署發言。

(2)加拿大野生動物署發言。

2：30　(1)研討印第安人是否符合申請聯邦政府輔助之條件。

(2)研討是否允許各州管理船隻通行權之單位重新加入本協會之事項。

3：30　(1)研討本協會是否加入國際自然資源保育聯盟等國際保育組織。

(2)界定各工作小組之職責。

(3)決定十二月之執行小組會議會期。

11日：執行小組會議

1：30　(1)點名、報告事項

(2)加拿大野生動物保育聯盟等三個團體代表報告與致辭。

2：00　(1)研究經費輔助小組報告。

(2)淡水資源教育訓練班報告。

(3)研討有關世界魚類大會之建議事項。

(4)魚類棲地保護聯合陣線之現況。

(5)有關一九九一年大會時間與地點之選擇。

(6)教育經費小組報告與建議。

3：00 (1)有關本協會在執行北美野生雁鴨科經營管理計畫中之角色，及各種合作計畫之現況。

(2)北美野生雁鴨科經營管理計畫臨時執行小組報告。

(3)有關之立法事項。

4：00 休息。

4：15 「警覺」負責小組會議

(1)會計報告。

(2)其他業務。

12日：業務會議

8：30 (1)點名及報告事項，靜默一分鐘紀念Richard Cronin。

(2)會長報告。

(3)大會顧問報告。

(4)會計秘書報告。

(5)執行副會長報告。

(6)立法顧問報告。

(7)資源專家報告。

(8)法律顧問報告。

(8)審核及通過三月之業務會議紀錄。

1：30 (1)一九八八年預算。

(2)財務小組報告，建議提高一九八九年會費。

(3)修改章程，以便提高會費。

(4)「野外」計畫報告。

(5)十月舉行新主管研習班之進展狀況。

2：30 (1)各小組之分工界定。

(2)棲地管理協調小組報告。

(3)北美野生雁鴨科經營管理計畫報告。

3：30 (1)本協會在雁鴨計畫中之角色及各種合作計畫之現況。

(2)各小組報告：

水資源組、電腦使用組、內陸魚類組、動物災害防治組、獵人暨漁人教育組，魚類及野生動物健康組。

13日：業務會議

8：00 多倫多市政要致歡迎辭

8：30　國際野生動物及魚類保育協會及美國魚類學會會長致辭。

8：45　美國與加拿大在野生動物與魚類經營管理上共有之問題與努力。

9：40　北美野生雁鴨科經營管理計畫之報告。

10：00　休息

10：30　跨國界跨行業之魚類保育問題

1：30　(1)點名及報告事項。

(2)美國森林署報告。

(3)動物福利小組報告及討論有關動物福利事項。

(4)北美野生雁鴨科經營管理計畫臨時執行小組報告。

2：30　(1)研究經費輔助小組報告。

(2)印第安人事務。

3：00　(1)土地資源。

(2)遷徙性野生動物。

(3)非供狩獵性野生動物及瀕臨絕種動物。

(4)國際合作事項。

(5)棲地保護。

(6)海域及河口之經營管理。

(7)船隻通行權及相關事項。

14日：業務會議

8：30　(1)點名與報告事項

(2)安大略地區之相關問題。

9：30　(1)法令與執行。

(2)教育與溝通。

(3)立法。

(4)大會決議事項。

10：30　(1)提名與選舉。

(2)新選負責人員接任。

(3)新會長致辭。

11：00　大會結束。

11：05　執行小組工作會議

中德技術合作計畫研修報告
主題：環境與生態保護

吳冠聰

農委會林業處

出國時間：77.10

出國地點：德國

一、前　　言

本項國際性訓練課程，係由德國國際合作基金（DSE）所舉辦。由該基金提供獎學金予十四國二十名學員，在爲期一個月左右的訓練期間，分別由該基金糧農中心（ZEL）及西德聯邦農林生物研究中心生物防治所、果類植物保護所研究人員及講座提供有關以生態方法爲主的植物保護之理論及實作課程。

筆者及服務於台灣省農藥及毒物試驗所之郭克忠君（Kuo, Ker-Chung）分別由服務單位推薦，透過經濟部主辦之中德技術合作計畫參與此項訓練，因專業背景及單位不同，郭君之研修報告將另案提出。

二、課程簡介

(一)宗旨：

植物保護之宗旨，並非單純地追求最大產量，而是在於尋求適當的經濟性、生態性之關係，俾使在生產之餘仍然能夠提供其餘生物生存的空間，扮演其在整個生態體系自然調節的角色。現今及未來之植物保護，應該審愼地評估作物之種類、氣候、地理環境及社會情況，以綜合性之措施來防治病害及蟲害、鼠害等。

本項課程，透過植物保護策劃及評估主管、生物防治研究人員擔任講座，提供參與學員有關之資訊，俾使其具有下列諸項能力：

1. 瞭解作物生產體系內生態性及經濟性諸元素之關聯性，以策劃適當之植物保護計畫。
2. 在綜合性的植物保護範疇內，側重生物防治方法之使用。
3. 瞭解生物防治方法之準備措施及實施流程。
4. 在資源保育之前提下，尋求新的植物保護方法，並做適當之調整，以適應學員不同國別之實況。
5. 學成後能將習得之知識技能傳授予本國之其他專業人員。

(二)內容（詳如附件）。

三、研修心得

(一)植物保護專業心得：

1. 來自菲律賓及泰國等國家之學員均主動提到亞蔬中心（AVRDC ）及亞太糧肥中心（FFTC ），足見透過類似之財團法人機構能夠有效而迅速提供相關國家必要之協助，並增進雙方瞭解及增加官方或非官方之合作機會。

2. 農林生產體系內以生物方法進行的植物保護（或稱植物病蟲害防治），不僅包括減少病蟲害之族群、減低其致病或爲害能力，也應考量以植物免疫（Immunization）或植物藥方（Phytomedicine），誘發增强植物之抵抗力。

3. 生物方法之植物保護是農業生態體系（Agroecosystem）內重要一環，但爲確保長期性食物、能源及綠資源之穩定供應及農村經濟之復興，必須將其與經濟性、生態性（包括農藝方法、植物生長與營養需求、合成農藥之使用等）諸元素做整體性之考量，以尋求其最佳組合（Maximum harmony）。

4. 醫生以其執業對象而言，約略可區分爲人醫、獸醫及植保醫師，因此有關農業藥物之使用，宜參酌人醫獸醫之法規有所限制或規範。農藥使用地區之人醫應有良好之急救訓練及擁有充分之資訊解毒藥物等。

5. 禾本科穀物栽作區雜草之去除需要特別謹愼，雜草量在經濟臨界值（Economic threshold）以下時，貿然予以去除，除了增加生產成本外，更造成表土裸露及土壤之流失；而殺草劑之使用，可能使作物對病毒性、眞菌性及線蟲等病原感染抵抗力之降低，同時亦極易殺滅病蟲害之天敵。

(二)一般心得：

1. 每天之報紙以訂書針裝訂，避免閱讀時散失，以保持其完整。
2. 森林計畫性地經營及採收，林木密集材積量大林相優美。
3. 江山雖美非吾土。
4. 大英國協國家（包括非洲多數國家及印度、斯里蘭卡等）之領導階層，多在英國受高等教育取得學位，深受其影響。
5. 赴德研修前主辦單位經濟部提供之德語密集訓練，有助於研修效果之提升及生活之適應。
6. 西德之漢堡（面積 755 km^2，人口 1.61 百萬，所得 25,431 美元，資料時間31 12 1985）、不來梅、西柏林等三大都會區（stadt）與組織聯邦國家（Bundes Staadt）之其餘八個邦，具有同等之地位，此種政治結構値得吾人建設中華民國台灣都會區之參考。
7. 台灣區與位於中歐之西德及美國加州，在全球之時區中各相隔約略 7 ～ 9 小時而呈鼎立之勢，且位於民主制度之前哨（Ecotone），具有經濟發展或戰略之意義。

Deutsche Stiftung für internationale Entwicklung

DSE

Federal Biological Research Centre for Agriculture and Forestry

CERTIFICATE

It is hereby certified that

~~Ms~~/Mr. Gwan-tsong Wu / Republic of China

has successfully completed the international training course on

ECOLOGY-ORIENTED PLANT PROTECTION

held in Feldafing, Darmstadt and Dossenheim,
Federal Republic of Germany,
from August 25 to September 27, 1988
organized and conducted by the
Food and Agriculture Development Centre of DSE
in cooperation with the
Federal Biological Research Centre for Agriculture and Forestry (BBA).

This programme was sponsored by the Federal Minister for Economic Cooperation on behalf of the Government of the Federal Republic of Germany.

Berlin, 26.9.88	Feldafing, 26.9.88	Braunschweig, 26.9.88
Director General, German Foundation for International Development	Director, DSE-Food and Agriculture Development Centre	President, Federal Biological Research Centre for Agriculture and Forestry
Hemmer	[illegible]	Klingauf

Deutsche Stiftung für internationale Entwicklung

German Foundation for International Development

Fondation Allemande pour le Développement International

Fundación Alemana para el Desarrollo Internacional

in cooperation with the

Federal Biological Research Centre for Agriculture and Forestry (BBA)

Institute for Biological Control, Darmstadt,

Institute for Plant Protection in Fruit Crops, Dossenheim

(附件)

International Training Course

on

ECOLOGY-ORIENTED PLANT PROTECTION

August 25 - September 27, 1988

at

Feldafing, Darmstadt and Dossenheim

Federal Republic of Germany

P R O G R A M M E

TK-77-282-88

DSE

1. Course Organization and Coordination

Course Organization and Coordination:	Dr. Bruno SCHULER
Programme Assistant:	Ms. Erika DIETZ
Secretary	Mr. Graf von KOSPOTH Ms. Augustine MEHR
Food and Agriculture Development Centre of German Foundation for International Development	Zentralstelle für Ernährung und Landwirtschaft (ZEL) der Deutschen Stiftung für internationale Entwicklung (DSE) Wielinger Str. 52 D-8133 Feldafing Federal Republic of Germany
Chairman (during programme at Feldafing):	Mr. Norbert WEIS International rodent control consultant Ulmenstr. 1 6000 Frankfurt 1
Course Assistant:	Mr. Vincent NEUSSL Agricultural engineer Limburger Str. 13 5000 Köln 1
Basic German:	Ms. Ute EBERHARDT Magister Artium Pöltnerstr. 11 8120 Weilheim i. OB

2. Institutions Concerned and Resource Persons (in chronological order)

Commonwealth Institute of Biological Control (CIBS) European Station Switzerland	Commonwealth Institut für biologische Bekämpfung (CIBS) Europäische Station 1, Chemin Des Grillons CH-2800 Delémont Switzerland

Dr. K. P. CARL (Director)

Gießen University
Institute for plant pathology and applied zoology

Universität Gießen
Institut für Phytopathologie und angewandte Zoologie
Ludwigstr. 23
6300 Gießen

Prof. Dr. H. SCHMUTTERER (Director)

Hannover University
Institute for plant diseases and plant protection

Universität Hannover
Institut für Pflanzenkrankheiten und Pflanzenschutz
Herrenhäuser Str. 2
3000 Hannover 21

Mr. A. FALKHOF (with Prof. Dr. F. SCHÖNBECK)

Wageningen University
Department of Entomology
The Netherlands

Universität Wageningen
Abteilung für Entomologie
P.O.Box 8031 (Binnenhaven 9)
NL-6700 eh Wageningen
Niederlande

Dr. A. van HUIS

Hohenheim University
Institute for rural socio-economics in the tropics and subtropics

Universität Hohenheim
Institut für Agrar- und Sozialökonomie in den Tropen und Subtropen
Postfach 70 05 62
7000 Stuttgart 70

Dr. U. MÄRZ (with Prof. Dr. W. DOPPLER)

Göttingen University
Institute for plant pathology and plant protection

Universität Göttingen
Institut für Pflanzenpathologie und Pflanzenschutz
Griesebachstr. 6
3400 Göttingen-Weende

Prof. Dr. R. HEITEFUSS (Director)

Plant protection office of Baden-Württemberg

Landesanstalt für Pflanzenschutz
Reinsburgstr. 107
7000 Stuttgart 1

Dr. R. ALBERT (with Dr. G. MEINERT)

Federal Biological Research Centre for Agriculture and Forestry (BBA)

Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA)
Messeweg 11/12
3300 Braunschweig

Prof. Dr. F. KLINGAUF (President)

Institute for Biological Pest Control (BBA)	Institut für biologische Schädlingsbekämpfung (BBA) Heinrichstr. 243 6100 Darmstadt

Dr. G. LANGENBRUCH
Dr. H. BATHON
Dr. G. ZIMMERMANN
Dr. A. HUGER
Dr. J. HUBER
Dr. S. HASSAN

Institute for Plant Protection in Fruit Crops (BBA)	Institut für Pflanzenschutz im Obstbau (BBA) Schwabenheimer Str. 101 6915 Dossenheim

Prof. Dr. E. DICKLER (Director)
Dr. W. ZELLER
Dr. H. KRCZAL
Dr. L. KUNZE
Ms Dr. Vogt
Dr. E. SEEMÜLLER

BASF Company Agricultural Research Station	BASF AG Landwirtschaftliche Versuchs-station Postfach 220 6703 Limburgerhof

Prof. Dr. H. BOHLE
Dr. V. HARRIES

German Agency for Technical Cooperation (GTZ) Plant and Postharvest Protection Section	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH Pflanzen- und Vorratsschutz FB 152 Dag-Hammarskjöld Weg 1-2 6236 Eschborn

Mr. R. KASKE (Head)

3. Tentative Programme

Thursday, August 25, 1988	Arrival of participants in Feldafing via München airport
	Registration
6.30 p.m.	Dinner

Lodging and Programme at the Food and Agriculture Development Centre of DSE, Feldafing

Time table:

Working hours:	Meals:
1st session: 09.00 . 10.30	Breakfast: 08.00 - 09.00
2nd session: 11.00 - 12.30	(Weekend: 08.00 - 09.30)
3rd session: 14.00 - 15.30	Lunch: 12.45
4th session: 16.00 - 17.30	Dinner: 18.30

Friday, August 26

09.00 a.m.	Opening address Dr. v. MYLIUS, Deputy Director DSE/ZEL
	Introduction to the course programme Dr. SCHULER
	Administrative affairs Ms. DIETZ
	General information for guests of the Conference Centre Mr. von KOSPOTH
	Presentation of participants and staff
0.45 p.m.	Lunch
2.00 p.m.	Introduction to the centre's library Mr. CUSHNER
	Introduction to participatory visualization Mr. WEIS
3.30 p.m.	Feldafing city tour
6.30 p.m.	Dinner and get-together evening

Saturday, August 27

9.00 a.m.	Travel to Munich (S-Bahn)
	Lunch
2.00 p.m.	Munich city tour and travel back to Feldafing

Sunday, August 28	
9.30 a.m.	Information and discussion on the Federal Republic of Germany Ms. EBERHARDT
12.00 ~~0.30~~ p.m.	Lunch
	free
Monday, August 29	
9.00 a.m. 國情報告	Country reports Situation analysis Discussion of requirements The PARTICIPANTS
Tuesday, August 30	
9.00 a.m.	Continued
Wednesday, August 31	
9.00 a.m. 1. 引進天敵之生物防治	Classical biological control by introduced parasites and predators and the need for international cooperation Dr. CARL (英籍，瑞士工作)
7.30 p.m.	Basic German (1) Ms. EBERHARDT
Thursday, September 1	
9.00 a.m. 2. 由植物萃取殺蟲劑	Production of insecticidal extracts from neem tree and examples for the application under tropical conditions Prof. SCHMUTTERER
7.30 p.m.	Basic German (2) Ms. EBERHARDT
Friday, September 2	
9.00 a.m. 3. 以疫苗實施預防接種 （植物免疫）	Use of the natural potential of resistance to preserve and increase plant health Mr. FALKHOF
Saturday, September 3	Free
Sunday, September 4	Sightseeing programme

Monday, September 5

9.00 a.m. 4. 間(雜)作體系的病害防治	Pest management in intercropping systems Dr. van HUIS

Tuesday, September 6

9.00 a.m. 5. 植物保護的經濟分析	Economy of plant protection measures and in particular of biological pest control Dr. MÄRZ
7.30 p.m.	Basic German (3) Ms. EBERHARDT

Wednesday, September 7

9.00 a.m. 6. 整合性的農業生產體系	☆ Cultivated land as agro-ecological system and the conception of integrated plant production with regard to the prevention of diseases, pests and weeds Prof. HEITEFUSS
7.30 p.m.	Basic German (4) Ms. EBERHARDT

Thursday, September 8

9.00 a.m. 7. (1)西德植物保護簡介 (2)生物防治在農村的推展	Tasks and organisation of the plant protection service considering the case of Baden-Württemberg Introduction of biological pest control at farmer's level in the framework of integrated pest management with special emphasis on extension and implementation Dr. ALBERT

Friday, September 9

9.00 a.m.	Elaboration of conclusions for the participants' own working place or of country strategies, in working groups Presentation of the results The PARTICIPANTS
7.30 p.m. 8. 德國國際合作基金糧食及農業中心的植保工作	Activities of DSE/ZEL in plant protection Dr. B. SCHULER

Saturday, September 10 Free

Sunday, September 11 Departure from Feldafing to Darmstadt by train

Lodging for 4 nights at
Hotel Müller
Adelungstr. 34
6100 Darmstadt
Tel.: 06151 / 26721

Programme at the Institute for Biological Pest Control of BBA, Darmstadt

Time Table

Morning session including break: 8.30 a.m. - 12.00
Lunch at 12.30 p.m
Afternoon session including break: 1.30 p.m. - 5.00 p.m.

Monday, September 12

8.30 a.m. 9.益蟲的保護		Introduction: Goals and objectives of the Federal Biological Research Centre for Agriculture and Forestry (BBA) including the Information Centre for Plant Protection in the Tropics (INTROP) Protection and enhancement of beneficial organisms Prof. KLINGAUF
1.30 p.m. 10.以Bt細菌控制昆蟲族群		*Bacillus thuringiensis*: Introduction and execution of a biotest Dr. LANGENBRUCH

Tuesday, September 13

8.30 a.m.	cf. 2	Plant extracts and their use in plant protection: Collection, storage, extraction and screening Prof. KLINGAUF
1.30 p.m.	cf. 14	Entomophageous nematodes: Introduction and practical training Dr. BATHON, Dr. ZIMMERMANN

Wednesday, September 14

8.30 p.m. 11.昆蟲及節肢動物疾病診斷		Introduction into insect pathology Diagnosis of arthropod diseases (with microscopical demonstrations) Coconut palm rhinoceros beetle (*Oryctes rhinoceros*): Integrated control Dr. HUGER

1.30 p.m. 12.昆蟲的病毒性疾病	Maintenance of biotest Dr. LANGENBRUCH
(Dinner)	Entomopathogenic viruses: Introduction, mass production and use in biological control. Dr. HUBER

Thursday, September 15

8.30 a.m. 13.昆蟲的眞菌性疾病	Entomopathogenic fungi: Introduction, demonstrations, and practical training (isolation, determination, mass production) Dr. ZIMMERMANN
1.30 p.m. 14.昆蟲的綫蟲性疾病	Evaluation of experiments with nematodes Dr. BATHON
	Evaluation of biotest with B.t. Dr. LANGENBRUCH, Dr. HUBER
5.15 p.m.	Travel from Darmstadt to Dossenheim (near Heidelberg)

Lodging for 3 nights at Hotel "Zum Bären"
Daimlerstr. 6
6915 Dossenheim
Tel.: 06221/85029

Hotel "Goldener Hirsch"
Hauptstr. 59
6915 Dossenheim
Tel.: 06221/85119

Programme at the Institute for Plant Protection in Fruit Crops of BBA, Dossenheim

Time Table

Morning session including break:	8.30 a.m. - 12.00
Lunch at the Institute:	12.00
Afternoon session including break:	1.00 p.m. - 4.30 p.m.

Friday, September 16

8.30 a.m. 15.蘋果園病害防治	Introduction to the agro-ecosystem apple. Visit of 2 commercial apple farms Prof. DICKLER
1.00 p.m. (1)病毒的應用 (2)費洛蒙的應用	Codling moth (Cydia pomonella) -control with granulosis virus-implementation in IPM (Integrated plant management)
	Apple clearwing moth (Synanthedon myopaeformis) -control with mating disruption

(3)蛾生殖器解剖

Determination of Oriental fruit moth (Grapholita molesta) and plum fruit moth (Cydia funebrana)
- dissection of male genitalia

Determination of fertilized clear-wing moth. Dissection of spermatophorous
Prof. DICKLER

<u>Saturday, September 17</u>

Free or cultural programme

<u>Sunday, September 18</u>

Heidelberg city tour
Lodging for 4 nights at:
Hotel "Goldene Rose"
St. Annagasse 7
6900 Heidelberg
Tel.: 06221/160078

<u>Monday, September 19</u>

8.30 a.m.
16. 果樹的細菌性疾病

Isolation of bacteria from leaves and other plant parts

Diagnostic tests and serological techniques

Crown gall (Agrobacterium), Fireblight (Erwinia amylovora), development of biological control techniques
Dr. ZELLER

1.00 p.m.
17. 果樹的病毒性疾病

Virus diseases of fruit crops. Introduction. Experimental virus transmission by vectors (aphids), grafting and mechanical inoculation. Serological tests by enzyme-linked immunosorbent assay (ELISA)
Dr. KRCZAL, Dr. KUNZE

<u>Tuesday, September 20</u>

8.30 a.m.
18. 果樹蟎蚕等蟲害

Methods for the evaluation of mite population densities (European red mite: Panonychus ulmi and apple rust mite: Aculus schlechtendali)
Ms Dr. VOGT

1.00 p.m.

cf. 17 Evaluation of ELISA and discussion of the results
Dr. KUNZE

<u>Wednesday, September 21</u>

8.30 a.m.
19. 果樹類菌體疾病

Plant pathogenic Mycoplasmas. Detection by fluorescence microscopy; dodder transmission, control by the use of resistant rootstocks. Demonstration of instruments to monitor weather and spore dissemination
Dr. SEEMÜLLER

1.00 p.m.	cf. 16	Bacteriology, evaluation of the serological tests Dr. ZELLER

Thursday, September 22

8.30 a.m.	Travel to BASF AG, Limburgerhof
20.現代農業藥物的發展及使用	Visit of the Limburgerhof experimental station. Mating disruption technique, development of modern pesticides, use of pesticides in developing countries. Prof. BOHLE, Dr. HARRIES
p.m.	Travel to Darmstadt

Lodging for 5 nights at Hotel Müller
Adelungstr. 34
6100 Darmstadt
Tel.: 06151/26721

Hotel "Bockshaut"
Kirchstr. 7-9
6100 Darmstadt
Tel.: 06151/24258

Programme at the Institute for Biological Pest Control of BBA, Darmstadt

Friday, September 23

8.30 a.m. 21.益蟲的增殖	Beneficial arthropods: Mass rearing, use in biological control and side-effects of pesticides
1.30 p.m. 22.國際性的合作	International cooperation (IOBC etc.) Dr. HASSAN
6.30 p.m.	Dinner and farewell party
Saturday, September 24	Frankfurt city tour
Sunday, September 25	Free or cultural programme

Monday, September 26

9.00 a.m.	Evaluation of the training course The PARTICIPANTS and Dr. SCHULER Administrative affairs Ms DIETZ Closing session Dr. SCHULER
12.00	Travel to GTZ, Deutsche Gesellschaft für Technische Zusammenarbeit

1.00 p.m.	Lunch at restaurant
2.00 p.m.	Welcome address (Room 1101) General presentation of GTZ Mr. KASKE
2.30 p.m.	Projects and programmes of GTZ in the field of biological pest control, various GTZ STAFF MEMBERS
3.15 p.m.	Discussion
3.45 p.m.	Individual contacts between participants and various desk officers
4.30 p.m.	Travel back to Darmstadt
Tuesday, September 27	Departure of participants according to the individual flight schedule via Frankfurt airport

4. List of Participants

Bangladesh

RASHID, A.K. Rashid Uddin Ahmed	Subject matter specialist in agricultural extension Dept. of Agricultural Extension Office of the Assistant Director of Agriculture Brahmanbaria

Bolivia

BEL PAIRE DE MORALES, Cécile, Mrs.	Research worker in ecology Instituto de Ecología Universidad Mayor de San Andrés Casilla 20127 La Paz

China, Republic

KUO, Ker-chung (郭克忠)	Research assistant in plant pathology Taiwan Agricultural Chemicals and Toxic Substances Research Institute 189, Chung Cheng Rd. Wufeng Taichung Hsien, Taiwan
WU, Gwan-tsong (吳冠聰)	Zoologist in wildlife conservation Council of Agriculture Executive Yuan (Cabinet) 37, Nanhai Rd. Taipei, Taiwan 10728

Ecuador

TANDAZO, Armando	Regional leader of plant protection Ministerio de Agricultura y Ganadería Sanidad Vegetal Loja

Libanon

BOUEIZ, Marleine, Miss	Supervising and consultant engineer Georges Farès Saadê Zouk Mikael Kesrouan Im. Saadê P.O.Box 1686 Jounieh

Malawi

CHIRWA, Linley Stella, Mrs. (cf. 薛　鈴)	Senior agricultural extension officer Secretary for Agriculture Ngabu A.D.D. Private Bag Ngabu

Malawi (continued)

GADABU, Afete, Dr. (cf. 葛大木)	Senior agricultural research officer in entomology Dept. of Agricultural Research Lunyangwa Research Station P.O.Box 59 Mzuzu

Philippines

LEYSA, Pepito # 53	Plant entomologist II Dept. of Agriculture Regional Crop Protection Center Takurong, Sultan Kudarat
PAN, Nena, Miss	Plant pest control technologist Ministry of Agriculture and Food San Augustin, Pili, Camarines Sur
SAN JUAN, Nemesia, Miss	Science research specialist Philippine Coconut Authority Davao Research Center Bago-Oshiro Davao City, Mindanao

Sri Lanka

DE ZOYSA, Indra Jinadarie, Dr., Mrs.	Research officer in plant pathology Dept. of Agriculture Pathology Division Agricultural Research Station Maha Illuppallama

Thailand

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世界鮭鱒魚類會議及考察報告

張崑雄

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林曜松

台大動物系

出國時間：77.10.2—77.10.14

出國地點：日本

一、引　　言

鮭、鱒魚類主要分布於北半球的高緯度地帶，自學術或經濟的觀點而言，它們均是世界上極為重要的魚類，因此鮭、鱒魚類的世界會議，便備受矚目。該會議，每四年召開一次，今年剛好是鮭、鱒魚國際會議的第三屆，由日本京都大學著名的魚類生態學川那部浩哉教授所負責籌辦。川那部浩哉博士曾訪問過台灣的武陵農場，觀察櫻花鉤吻鮭的棲息情形。民國七十四年時，他在獲知我國開始積極保護櫻花鉤吻鮭後，便邀請我國人員日後能出席該項會議。

此次承行政院農委會的推薦，筆者等於十月二日前往日本出席該鮭、鱒魚類會議。其行程如下：

十月二日：自台北赴日本東京。

十月三日：自日本東京赴札幌市。

十月四日至九日：參加會議及發表研究報告。

十月十日至十一日：自札幌至函館，沿途參觀鮭鱒魚的孵化設施以及栽培漁業。

十月十二日：張崑雄在北海道大學水產學部講演"臺灣的人工魚礁研究"。

十月十三日：張崑雄自東京返台北。

十月十四日：林曜松參觀羽田機場附近的河川及野鳥公園，並自東京返回台北。

二、研討會內容

在札幌召開的鮭、鱒魚國際會議，共有十五個國家，約一百五十餘人出席，發表論文多達九十八篇，其內容涵蓋洄游陸封性鮭鱒魚類的分類學、生態學、生活史，種內與種間的競爭、族群、遺傳變異、生理與生殖、發生學、成長、魚病、治療、族群生態、保育與經營管理及鮭魚與人類文化關係等主題（附錄一）。我國出席代表發表的論文為「櫻花鉤吻鮭的保育史」（附錄二）。大會並特別安排於閉幕典禮前放映由農委會錄製的"臺灣櫻花鉤吻鮭的復育"錄影帶，獲全體出席人員之讚賞。

三、櫻花鉤吻鮭保育報告

臺灣擁有櫻花鉤吻鮭的情形，頗讓部份北歐或北美人士大感驚訝，他們認為在如此低緯度的高山地區，居然還能出現櫻花鉤吻鮭，實在難得。我國代表在大會用幻燈片的

方式，介紹了該魚種分布的地理位置、形態、七家灣溪的周圍環境、半世紀以來該族群縮減的狀況，以及我國近來的保育措施等。此外，我方代表也在會場分發農委會編的中英文「櫻花鉤吻鮭保育簡介」，並且播放十五分鐘英文解說的錄影帶，與會各國對我方的解說內容以及政府的努力，甚爲推崇，甚至有多位外國人士，在現場索取我國所放映的錄影片及幻燈片作爲教學的用途。大會結束前頒發了一連串「…最…」的遊戲獎中，我國獲得報告內容「印象最爲深刻獎」。而第二屆大會主席 Lionel Johnson 博士於大會結論中，對我國的努力更是推崇道：「臺灣櫻花鉤吻鮭的學術性的地位可與世界活化石魚「腔鰭魚」相提並論，世界各國對鮭、鱒魚類的保育，若能像臺灣對櫻花鉤吻鮭一樣努力的話，那麼世界上鮭鱒魚的保育便會有更好的明天」。本屆大會主席對我國的努力及停止櫻花鉤吻鮭的孵化工作也極爲推崇，他除設晚宴款待我國代表外，還建議我國若加强櫻花鉤吻鮭棲地改善工作，那麼保育櫻花鉤吻鮭的前景將會更美好。

四、日本鮭、鱒魚類的孵化場

會議期間，與會人員參觀北海道、千歲及熊石之鮭鱒魚孵化場。日本每年約放養二十億尾鮭、鱒魚幼苗至河川，洄游至大海成長供漁民捕撈，然後約有 3 %的放養魚回歸內陸供人們垂釣。在日本，人們雖然大量捕捉鮭鱒魚，但由於已從事大規模的魚類孵化與放流工作，所以鮭鱒魚的資源並無匱乏之虞。

五、日本的栽培漁業

日本除了對鮭、鱒魚從事大規模的孵化外，也對鯛、比目魚、蟹、蝦、九孔、貝、海膽、昆布、海參等從事孵化與放養於大海的工作。近年來，日本天然生產的魚、蝦數量在減產中，但是透過栽培漁業的漁獲量，却與日俱增，由此可知日本人是相當重視栽培魚類的培育研究。

六、豐平川鮭鱒魚科學展示館

爲了讓民衆能瞭解鮭、鱒魚類的生態，札幌市政府於一九八四年，在札幌市南部眞駒內公園，設置了一座鮭、鱒魚的科學館。該科學館面積 750 m^2，耗資日幣一億九千萬圓，每年來此參觀人數約有三十萬人。

館內設有各種鮭魚類的展示牌，說明鮭、鱒魚的分布、形態、分類、行爲、生活史

、魚類孵化、成長、放流等知識。此外，並有人工繁殖的示範區，當場可讓人們實際參加當地重要鮭、鱒魚類的採卵、受精及標識放流的工作。他們每年均邀請札幌市中小學生、市民、市長及美、加等鄰國人，於豐平川畔舉行盛大的放流大典。利用這種機會使在場的每一位小學生均能親手把魚苗放流到河川去。該館每年大約放流數百萬尾的魚苗，過了一段時間，當人們看到標識成魚一一地回歸到豐平川，都會雀躍不已。在館外，還設有模擬天然的魚類孵化場，場旁另置有遮光牆，使造成陰影，當人們在附近走動時，也不會驚動魚類，豐平川上尚有一個具解說功效的魚道。此外，館內也設有一小型的演講廳針對不同程度的對象，提供不同的解說材料。雖小小的一間屋子，其所扮演環境解說功能却頗大。

七、建議事項

㈠加強櫻花鉤吻鮭的族群與分類研究

這幾十年來，國外學者雖曾就我國櫻花鉤吻鮭的分類問題，做過一些研究，但多以形態測定爲主，且樣本數偏低，故櫻花鉤吻鮭與日本陸封性鮭魚間的類緣關係，迄今仍未有明確的認定，這一方面倒是值得我國學者做更深入的探討。在本屆的國際會議，我國只針對櫻花鉤吻鮭的現況與保育措施作報告，在未來的第四屆鮭、鱒魚類國際會議，我國便應該進一步發表櫻花鉤吻鮭的生長繁殖行爲、族群量與分布等生物知識，以提高我國的學術研究水準。過去，由於魚類族群量偏低，是項生物資料，不便採樣研究，目前族群量已顯著增加，有關其生物知識，當不難探知。

㈡收回鄰近七家灣溪的農耕地

半世紀以來，櫻花鉤吻鮭自從被發現後，其棲息地已損失了95％以上，目前只生存於七家灣溪旁。而七家灣溪旁，目前種有大規模的蔬菜及果園，由於大量施肥，以及嚴重的水土保持不良，已經對櫻花鉤吻鮭的生存造成了相當不良的影響。爲了能讓櫻花鉤吻鮭能繼續生存及不浪費過去農委會在櫻花鉤吻鮭上的重大投資，緊鄰七家灣溪旁約二十八公頃的農業用地，由政府出面收購並從事造林，以避免人爲的干擾，應是刻不容緩的事。

㈢籌辦中、日淡水魚類研討會議

目前在農委會的領導下，臺灣地區溪水魚的經營管理，雖已開始受到各有關單位的重視，但因人才缺乏及技術欠缺，進展頗爲緩慢，反觀日本，他們對於淡水魚類的研究，却已有頗長一段時日。兩地的地理環境其實是很相近的，河川短、水流急，可觀摩之處是甚多的。爲了提昇我國在淡水魚類的學術水準。以及獲取改善淡

水魚棲息地方面的管理技術，建議農委會在國內舉辦中、日淡水魚類的生態與棲地改善會議，其中鮭、鱒魚類的研究尤其可列為討論的主題。

附錄一. 會議議程

Monday, October 3

15:00-17:00 Registration at Hotel KKR Sapporo
18:00-20:00 Welcome party at KKR Sapporo
Opening address

Tuesday, October 4

9:00- **Section 1. Review of charr problem**
Chairman: H. Nordeng
H. Kawanabe (Japan) Japanese charr and masu salmon problem
L. Nyman (Sweden) One view point on char problem

Tea break

Section 2. Review of masu salmon propagation
Chairman: A. Klemetsen and F. Yamazaki

T. Kubo (Japan) Anadromous masu salmon in Japan; its biology and propagation
S. Kimura (Japan) Yamame, land-locked masu salmon in Kyushu Island

Section 3. Taxonomy and systematics including cytogenetics
Chairman: R. J. Behnke and S. Kimura

13:00-13:30 I. A. Chereshnev and M. B. Skopetz (USSR) The morphological, ecological and evolutional peculiarities of charrs from the El' gigitgin lake (Central chukotka)
13:30-14:00 R. J. Behnke (U.S.A.) Synthesis of information for phylogenetic interpretation of *Salvelinus*
14:00-14:20 K. Nagasawa (Japan) Color variation of spots in *Salvelinus leucomaenis* in northern Honshu, Japan
14:20-14:50 S. Kimura (Japan) Some notes on the taxonomical status of *Salvelinus leucomaenis* complex found in Japan
14:50-15:10 T. M. Cavender (U.S.A.) and S. Kimura (Japan) Cytogenetic and morphological comparisons between eastern and western Pacific *Salvelinus*
15:10-15:30 L. Nyman (Sweden) Genetic and ecological interaction in two sympatric taxa of Arctic char

15:30-16:00 Tea break

16:00- General discussion

Wednesday, October 5

Section 4. Migration and land-locking
Chairman: E. K. Balon and M. Azuma

8:30- 8:50 K. Tsukamoto (Japan) Application of otolith to migration study of salmonids

8:50- 9:10 H. Nordeng (Norway) Migratory systems in anadromous salmonids

9:10- 9:30 N. Jonsson, B. Jonsson (Norway) and J. Ruud-Hansen (Denmark) Downstream displacement and life history variables of Arctic charr, *Salvelinus alpinus*, in a Norwegian river

9:30- 9:50 I. Priede (U.K.) Observations on land-locked and migratory charr in Arctic north east Greenland

9:50-10:20 J. Hammar, R. Porter, E. Sköld and E. Verspoor (Canada) Mixed or reversed anadromy-life history strategies of Arctic char in southern Labrador ?

10:20-10:40 Tea break

10:40-11:00 M. A. Svenning and P. Grotnes (Norway) Stationarity and homing of landlocked Arctic charr. A prerequisite for ecological segregation ?

11:00-11:20 H. Kawamura (Japan) The growth and smolting patterns of juvenile masu salmon, *Oncorhynchus masou*, in some streams in Hokkaido, Japan

11:20-11:40 H. Kojima and K. Sugiwaka (Japan) Effects of summer flood on residuary rate and productivity of an underyearling masu salmon population in a stream

11:40-12:00 T. Hirata, A. Goto, F. Yamazaki and K. Hamada (Japan) Growth and smoltification of juvenile masu salmon *Oncorhynchus masou* Breboort

12:00-12:20 M. Nagata (Japan) The effects of growth and density on bimodality in the length frequency distribution of juvenile masu salmon in a Hokkaido stream

12:20-13:00 General discussion

14:30- **Excursion to Hokkaido Salmon Hatchery and Hokkaido Fish Hatchery, Garden party at Eniwa.**

Thursday, October 6

Section 5. Spawning ecology and life history
Chairman: B. Jonsson and K. Maekawa

8:30- 9:00 E. K. Balon (Canada) Comparative ontogeny of the relict Aurora charr; Life history interpretation

9:00- 9:20 D.L.G. Noakes (Canada) Early life history and behaviour of Canadian charr species

9:20- 9:50 L. Johnson (Canada) Life-history of the anadromous arctic charr *Salvelinus alpinus*, of Nauyuk Lake, N.W.T., Canada

9:50-10:20 A. Klemetsen (Norway) Life cycle coupled habitat shifts in a dense, resident Arctic charr population

10:20-10:40 Tea break

10:40-11:00 J. B. Reynolds and L.S. Gregory (U.S.A.) Dolly Varden and their habitat, Tiekel river, Copper river basin, Alaska

11:00-11:20 A. L. DeCicco (U.S.A.) Movements and spawning of adult Dolly Varden charr in Northwestern Alaska; Evidence for summer and fall spawning populations

11:20-11:40 T. Hino, K. Maekawa (Japan) and J. Reynolds (U.S.A.) Reproductive success in males of the land-locked Dolly Varden (*Salvelinus malma*) in south-central Alaska

11:40-12:00 H. Takayama and T. Watanabe (Japan) Age and size at maturity of transplanted Biwa salmon in Lake Kizaki, Nagano Pref., Japan

12:00- General discussion

Section 6. Intra and inter specific interaction
Chairman: K. Fausch and T. Furukawa-Tanaka

13:30-13:50 N. J. Adams, G. Power and D. R. Barton (Canada) Comparison of field methods for estimating daily ration of Arctic charr (*Salvelinus alpinus*)

13:50-14:10 K. Tanida, T. Maruyama and Y. Saito (Japan) Feeding ecology of Japanese Charr (*Salvelinus leucomaenis*) in a high moor and adjacent streams in central Japan

14:10-14:30 T. Furukawa-Tanaka (Japan) Social interaction between Japanese and Dolly Varden charrs, *Salvelinus leucomaenis* and *S. malma*, in Hokkaido Is., Japan

14:30-14:50 S. Nakano (Japan) Interspecific social interaction of Japanese charr (*Salvelinus leucomaenis*) and masu salmon (*Oncorhynchus masou masou*) in a mountain stream, Japan

14:50-15:20 K. Fausch (U.S.A.) Interspecific competition between *Salvelinus fontinalis* and other salmonids in streams

15:20-15:40 Tea break

15:40-16:00 R. S. Rempel and T. G. Northcote (Canada) The winter feeding habits of sympatric and experimentally allopatric populations of Dolly Varden charr (*Salvelinus malma*) and cutthroat trout (*Salmo clarki*)

16:00-16:20 P. Magnan (Canada) Interactions between brook charr and non-salmonid species in eastern Canadian lakes: ecological shift, morphological shift and their impact on zooplankton communities

16:20-16:40 J. Hammar (Sweden) Landlocked Arctic char in southern Sweden: ecology, prerequisites and present status of a glacial relict in multispecies fish communities

16:40-17:00 N.-A. Nilsson (Sweden) On the influence of the invasion of Arctic charr into lakes with allopatric brown trout

17:00- General discussion

Friday, October 7

Section 7. Population and genetic variability
Chairman: F. M. Utter and K. Numachi

8:30- 8:50 T. Okazaki (Japan) Population structure of masu salmon during their wintering migration along the coastal waters of northern Japan

8:50- 9:10 K. Numachi and T. Kobayashi (Japan) Variability and sequence divergence of mitochondrial DNA in masu salmon, *Oncorhynchus masou*

9:10- 9:30 C. A. Mills (UK) The charr populations of Windermere

9:30- 9:50 O. T. Sandlund (Norway), P. M. Jónasson (Denmark), B. Jonsson (Norway), H. J. Malmquist (Denmark), S. Skúlason (Iceland) and S. S. Snorrason (Iceland) Biology of polymorphic Arctic charr of lake Thingvallavatn, Iceland

9:50-10:10 S. S. Snorrason, S. Skúlasonn (Iceland), O. T. Sandlund (Norway), H. J. Malmquist (Denmark), B. Jonnson (Norway) and P. M. Jónasson (Denmark) On development of sympatric polymorphism in Arctic charr, *Salvelinus alpinus*

10:10-10:30 Tea break

10:30-10:50 J. D. Reist (Canada) Life history types and genetic structuring of Arctic charr, *Salvelinus alpinus* / *malma*, in the western Arctic, Canada

10:50-11:10 A. Goto, M. Takahashi and F. Yamazaki (Japan) White and red spotted morphs of the Japanese charr *Salvelinus leucomaenis* in the river of southern Hokkaido, as a phenotypic variation

11:10-11:40 R. B. Phillips (U.S.A.) Evolution of nucleolar organizer regions (NORs) and ribosomal RNA genes in the genus *Salvelinus*

11:40-12:00 N. Okada, M. Aono, K. Matsumoto, Y. Kido, R. Koishi and M. Saneyoshi (Japan) Shaping and reshaping of the salmonidae genome during evolution

12:00-12:30 General discussion

Section 8. Physiology and reproduction
Chairman: W. C. Clarke and Y. Honma

13:00-13:20 A. Chiba and Y. Honma (Japan) Innervation and vascularization of the hypothalamo-hypophysial system of the Japanese charr, in relation to its reproduction

13:20-13:40 T. Miura, K. Yamauchi and Y. Nagahama (Japan) Endocrine control of spermiation in the masu salmon *Oncorhynchus masou*

13:40-14:00 M. Nakamura and Y. Nagahama (Japan) Sex differentiation in the amago salmon, *Oncorhynchus rhodurus*

14:00-14:20 J. Delabbio, M. Sweeney and B. D. Glele (Canada) Maturation and spawning of Arctic char (*Salvelinus alpinus* L.) at different salinities

14:20-14:40 Ya.-H. Lou, K. Yamauchi and H. Takahashi (Japan) Isolation and partial characterization of the sperm plasma membrane of the Masu Salmon, Oncorhynchus masou

14:40-15:00 E. Ringø (Norway) Gut content composition and intestinal microflora in Arctic charr, Salvelinus alpinus (L.), I. Effects of linoleic acid (18:2 N-6)

15:00-15:20 Tea break

15:20-15:40 T. J. Hara, T. Sveinsson, R. E. Evans and D. A. Klaprat (Canada) Morphological and functional characteristics of the chemosensory organs of Canadian char species

15:40-16:00 K. Yamamori (Japan) Sensation of taste in Japanese charr and masu salmon

16:00-16:20 H. Nordeng (Norway) Pattern of smolt transformation in the resident fraction of anadromous char Salvelinus alpinus; Genetic and environmental influence

16:20-16:40 Y. Fujioka and S. Fushiki (Japan) Physiological studies on parr-smolt transformation in Biwa salmon

16:40-17:00 H. Yamada, R. Horiuchi, H. Ohta and K. Yamauchi (Japan) Changes in circulating hormones and its production during smoltification in masu salmon, Oncorhynchus masou

17:00-17:20 W. C. Clarke (Canada) Photoperiod controll of smoltification

17:20- General discussion

Saturday, October 8

Section 9. Developmental genetics and growth
Chairman: W. W. Smoker and H. Onozato

8:30- 8:50 H. Onozato (Japan) Androgenesis of masu salmon

8:50- 9:10 K. Arai, K. Fujino and M. Kawamura (Japan) Chromosome set manipulation in the Salvelinus species

9:10- 9:30 F. Yamazaki, J. Goodier and K. Yamano (Japan) Chromosomal aberration by aging and hybridization in charr, masu salmon and related salmonids

9:30- 9:50 A. Berg and J. C. Holm (Norway) Growth rates in different Norwegian populations of Arctic char (Salvelinus alpinus) held in intensive culture

9:50-10:10 J. C. Holm (Norway) Growth rate gain in Arctic char (Salvelinus alpinus) when held in duoculture with Atlantic salmon (Salmo salar)

10:10-10:30 O. Skilbrei and J. C. Holm (Norway) Growth, sexual maturation and anadromous potential in three Norwegian strains of Arctic char (Salvelinus alpinus)

10:30-11:00 General discussion

Section 10. Disease and control
Chairman: H. P. Arai and K. Nagasawa

12:00-12:20 K. Nagasawa (Japan) Disease problems in charrs, masu and amago salmon cultured in Japan

12:20-12:40 M. Yoshimizu, T. Nomura, T. Awakura and T. Kimura (Japan) Incidence of fish pathogenic viruses among anadromous masu salmon (Oncorhynchus masou) in northern part of Japan, 1976-1987

12:40-13:00 M. Sakai, S. Atsuta and M. Kobayashi (Japan) Prevalence of bacterial kidney disease (BKD) infection among populations of masu salmon, Oncorhynchus masou

13:00-13:20 S. Atsuta (Japan) Observation on myxosporidian in kidney of masu salmon, Oncorhynchus masou

13:20-13:40 S. Urawa (Japan) Seasonal changes of Microsporidian infection in masu salmon, Oncorhynchus masou, from the Chitose River

13:40-14:10 General discussion

14:10-14:40 Tea break

Section 11. Population ecology, conservation, management and fisheries
Chairman: J. Hammar and T. Maruyama

14:40-15:10 F. W. Kircheis (U.S.A.) History of landlocked Arctic charr management in Maine, U.S.A.

15:10-15:30 T. Maruyama, T. Nakamura and K. Tanida (Japan) The growth and the maturation of Iwana, a fluvial form of Salvelinus leucomaenis (Pallas) in the headwaters of Tedori river, central Japan

15:30-15:50 T. Nakamura, T. Maruyama and E. Nozaki (Japan) The efficiency of the newly introduced fishing inhibition on Iwana, a fleuvial form of Salvelinus leucomaenis (Pallas) in the headwaters of Tedori river, central Japan

15:50-16:10 T. Maruyama, E. Nozaki and A. Mizuno (Japan) The conservation of charr in Jadani River, central Japan

16:10-16:30 M. Bohl, E. Leuner, R.-D. Negele and E. Bohl (West Germany) Reduced growth of Arctic charr (Salvelinus apinus L.) in the lake "Königssee" Bavarian National Park

16:30-16:50 Y-S. Lin, K-H. Chang, and P-S. Yan (Taiwan) The status and conservation of masu salmon (Oncorhynchus masou formasanus) in Taiwan

16:50-17:10 T. G. Boivin, G. Power and D. R. Barton (Canada) Biological and social aspects of an inuit winter fishery for Arctic char

Sunday, October 9

(continued)

8:30- 8:50 P.-A. Amundsen (Norway) Effects of intensive fishing on feeding in a stunted population of Arctic charr (*Salvelinus alpinus* L.) in Takvatn, northern Norway

8:50- 9:10 H. Mayama (Japan) Smolt production and release for rehabilitating reduced masu salmon stocks in Japan

9:10- 9:30 E. Teskeredžić, Z. Teskeredžić, L. Malnar, M. Tomec, Ž. Štancl and Z. Modrušan (Yugoslavia) Controlled rearing of amago salmon (*Oncorhynchus rhodurus*) in floating cages of the Adriatic Sea

9:30- 9:50 J. Delabbio and B. D. Glebe(Canada) The potential of Canadian Arctic charr (*Salvelinus alpinus* L.) as a commercial sea culture species

9:50-10:20 G. Takahashi (Japan) Circumstances around charr and masu salmon on their management and protection in Japan

10:20-10:30 E. Kimura (Japan) Protection of Kirikuchi (*Salvelinus leucomaenis japonicus*)

10:30-11:30 General discussion

14:00- **Section12. Salmon and Human being**
This section will be held at Tsukisamu Hall of the World Food Festival

H. Kawanabe (Japan) Introduction

D. Garza (U.S.A.) Historic and present uses of salmon by south east Alaska natives

S. Yoshizaki (Japan) Salmon and culture in human society

L. Johnson (Canada) Closing remarks

General discussion

16:30- **Farewell party at Tsukisamu Hall**

Poster Session

M. Saneyoshi (Japan) Effect of recombinant chum salmon growth hormone (rSGH) on the juvenile masu salmon growth

T. Awakura (Japan) Parasitology of the masu salmon, *Oncorhynchus masou* in northern Japan

M. Kaeriyama (Japan) Aspects of salmon ranching in Japan

M. Schmitz (Sweden) Annual variations in seawater adaptability and rheotactic behaviour in Arctic charr (*Salvelinus alpinus* L.)

R. Dumas (Canada) Stream enhancement in northern Quebec (Canada): a test project to improve the quality of Arctic char (*Salvelinus alpinus*) migratory passages

附錄二．台灣櫻花鉤吻鮭之保育史

Conservation of the Formosan Landlocked Salmon <u>Oncorhynchus</u> <u>masou</u> <u>formsoanus</u> in Taiwan, a Historical Review

Yao-Sung Lin [1] **Kun-Hsiung Chang** [1]

Abstract

The Formosan landlocked salmon (<u>Oncorhynchus</u> <u>masou</u> <u>formosanus</u>), first discovered in 1916, has always been considered a rare species in Taiwan. Despite this, angling and habitat destruction has led to a continuous decline of the salmon population until recently. In 1984, the salmon was classified as an endangered species and was given strict protection based on the Cultural Assets Preservation Act. For the last six ~~five~~ years, nearly two million US dollars has been provided to establish a hatchery , to recruit a patrol team, and to fund programs of habitat improvement of the Chichiawan Stream, the last habitat of the salmon. In addition, a sewage treatment plant has been planned , and a study of future land use along the Chichiawan Stream is underway in order to decrease the impact of agriculture on habitat of the fish. Today, the salmon population has reached a size of nearly 2,000 individuals along a 5-km section of the stream , and 250 tagged fish have also been released into both the Chichiawan and Hsuehshan Streams.

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The natural environment of Taiwan

Taiwan island is located in the Pacific Ocean, crossing the latitudes 21°45'S to 25°26'N and longitudes 119°18'W to 124°34'E (China Year Book, 1980). It is situated 150 km off the southeast coast of the Chinese mainland, between cold-temperate Japan in the north, subtropical south China in the west, and tropical Philippines and Indo-Malayan islands in the south. The island is dominated by forested mountains, of which over two hundred reach over 3,000 m. Almost three fourths of Taiwan is slopeland (land above 100 m with 5% slope), and nearly half of the total area of the island has an altitude of more than 1,000 m. Taiwan supports a diverse flora of over 4,000 vascular plant species and various forest types, which in turn supports a rich fauna: 61 species of mammals, 420 species of birds, 140 species of freshwater fish, 30 species of amphibians, 92 species of reptiles and over 50,000 species of insects.

The rivers of Taiwan are short, the longest being 170 km. Most ot them run rapidly , and heavy rain in the typhoon season often cause floods. Due to hydrologic, geologic and physiographic conditions, erosion problems may be very serious in Taiwan. A watershed with good vegetative cover may still have 5 to 10 mm of surface soil washed away from the entire watershed annually. On a watershed with poor cover conditions, a loss of 25 mm or more may occur (Lee, 1987). The most serious types of erosion are stream bank cuttings and landslides. As a result of erosion , the streams transport tremendous amount of sediments from the upper reaches to down-stream areas. To reduce this transport of sediments, one of the most common measures used in Taiwan is the construction of check dams. Usually, a series of step-like check dams are built in an area of serious erosion. Before 1984 , over 1,500 check dams had been established in almost all the streams in Taiwan.

Systematic position of the Formosan landlocked salmon

The Formosan landlocked salmon, a glacial relict in the world (Kano,1940), was discovered by Aoki (Aoki,1917) in 1916. Jordan and Oshima (1919) named the fish as <u>Salmo formosanus</u>. Since then, several scientific names have been given to the species and its systematic position has been controversial (Jordan and Oshima, 1919; Oshima, 1920, 1934, 1936; Behnke et al., 1962). From 1945 to 1973, only one Chinese scholar (Teng, 1959) ever studied the systematic position of the masu salmon in Taiwan. After comparing with specimens collected by Behnke et al. (1962) and the Standford holotype, and the meristic characters of other subspecies of Oncorhynchus masou, Watanabe and Lin (1985) suggested that the Taiwan salmonid should be designated as Oncorhynchus masou formosanus.

Habitat of the Formosan landlocked salmon

Kano(1940) reported that the masu salmon widely distributed in six upper streams of the Tachia River which flows westwardly in Taichung County (Fig. 1). The upper Tachia River is unique for its high altitude combined with gentle inclination of the river bed, a large production of aquatic insects known to be important as fish food, and a stable sand and pebble substrate which is suitable as spawning ground for salmon. However, due to angling and ecological disturbance, the salmon is seen only in the Chichiawan Stream in recent years (Fig. 2). This region is located at an elevation of 1,740 m, where water temperature ranges between 8 and 17°C , the average being 12°C. The annual rainfall is between 1,000 mm and 1,500 mm.

Destruction history of the salmon

Taiwan is a relatively small island with an area of 35,570 square kilometers, and is one of the most densely-populated regions in the world. Two-thirds of the island is covered by mountains which force most people to live in the congested narrow plains on the western part of the island. Because of this, there has been a great environmental stress on developed lands.

Between 1950 and 1980, the first-priority goal of the government was to achieve national economic prosperity through industrialization and utilization of natural resources. However, this caused a general destruction of natural environment including fresh water fish habitats.

To facilitate communication and transportation between east and west Taiwan, the East-West Cross-Island Highway (Fig.1) was built in the mid-1950's. Road construction

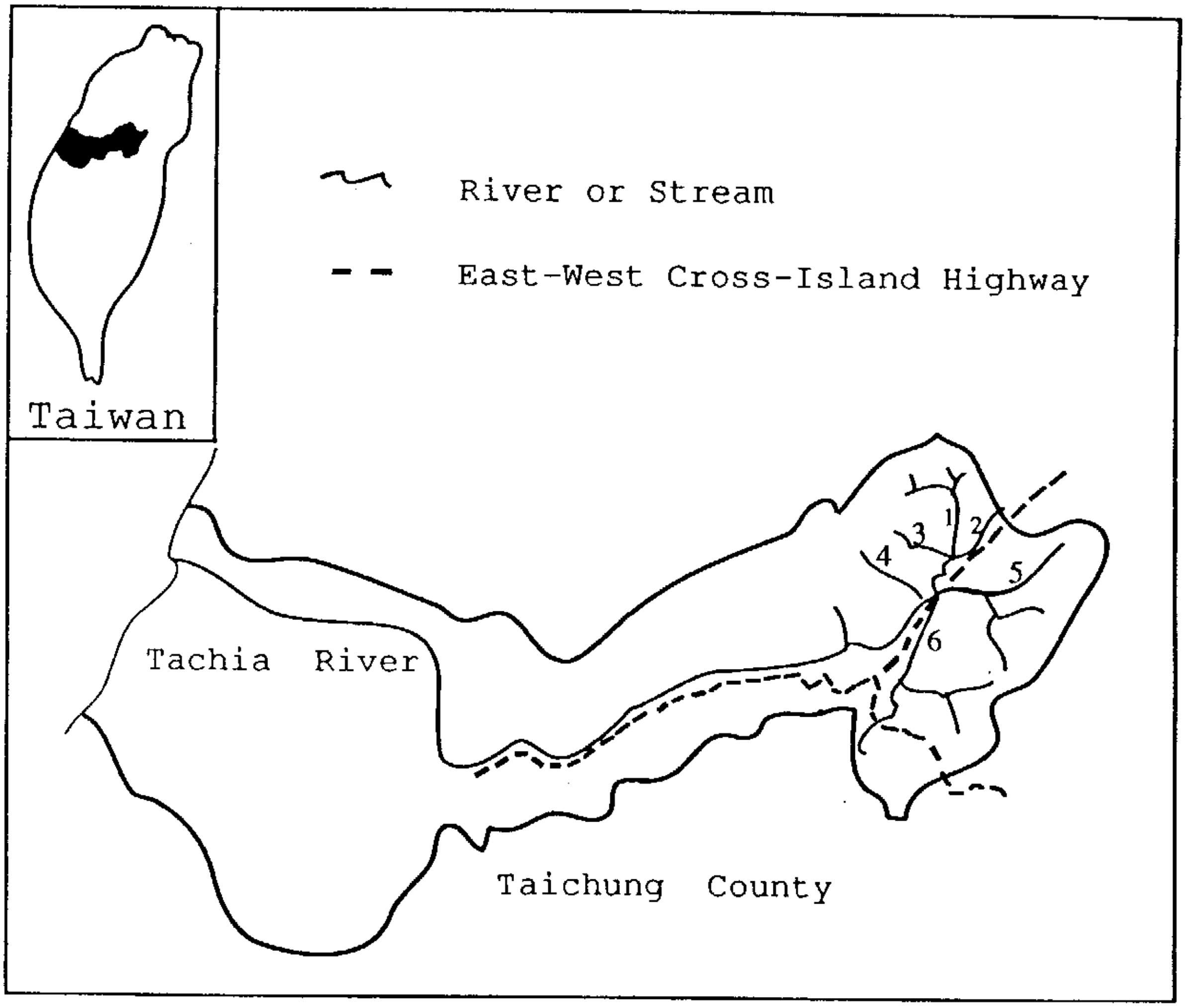

Fig. 1. The river-course of the Tachia River. The streams in which salmon was spotted in 1940 were denoted by numerical numbers : (1) Chichiawan Stream ; (2) Yousheng Stream ; (3) Hsuehshan Stream ; (4) Sukaran Stream ; (5) Nanhu Stream ; (6) Hohuan Stream (modified from Kano, 194Q)

in mountainous areas accelerated not only the process of erosion, but also the development of agriculture and tourism, which increased the pollution of streams and the degradation of fish habitats.

After the East-West Cross-Island Highway had been opened in 1960 (Fig. 1) , many forests in the upper Tachia River watershed were converted into agricultural land for temperate orchards (Fig. 2). The success of the pioneer orchard at Wuling Farm and Fusoushan Farm attracted a great number of people to upper Tachia River watershed to cultivate more fruit around 1970. The population increased from 6,184 persons in 1969 to nearly 49,246 persons in 1974, and the total area of orchards increased from 2,554 ha to 4,710 ha. In 1980, the total area of cultivated land reached nearly 5,000 ha (Chang ,1985). Many of the orchards were located in areas which are very steep and close to the stream where the salmon had survived . The convertion of forest into orchards at upper Tachia River watershed caused serious erosion. Even worse, the success of growing vegetables in the last ten years at the upper Tachia River watershed caused more soil erosion and eutrophication problems in the streams. In order to prevent the transport of silt down the river, streams of the upper Tachia River watershed were separated into segments by over 70 check dams.

Wong (1983) reported that 16 kinds of pesticides were used at the Wuling orchards and vegetable gardens. The frequency of application was 12 to 18 times a year. About 30 kg active ingredients were applied to each hectare of land per year. Among these agrochemicals, 97.5% were fungicides and 2.5% were insecticides and acaricides. Most of the pesticides except sodium pentachlorophenate (PCN-Na) were of low toxicity to fishes. Only recently, the use of PCN-Na was banned by the government.

The Wuling Farm is not only profitable in producing fruit and vegetables, but is also a popular tourist site, receiving more than 200,000 visitors a year, which causes eutrophication of the Chichiawan Stream. The bi-weekly observation of water quality from 1985 to 1987 indicated that both the phosphate and nitrate concentrations at Chichiawan Stream were higher than the upper limit of non-polluted streams (Lin et al., 1987).

Kano (1940) indicated that the Formosan landlocked salmon were restricted to areas where the water temperature was below 17°C . However, due to forest cutting, over 90% of the streams inhabited by salmon in the past have a summer water temperature

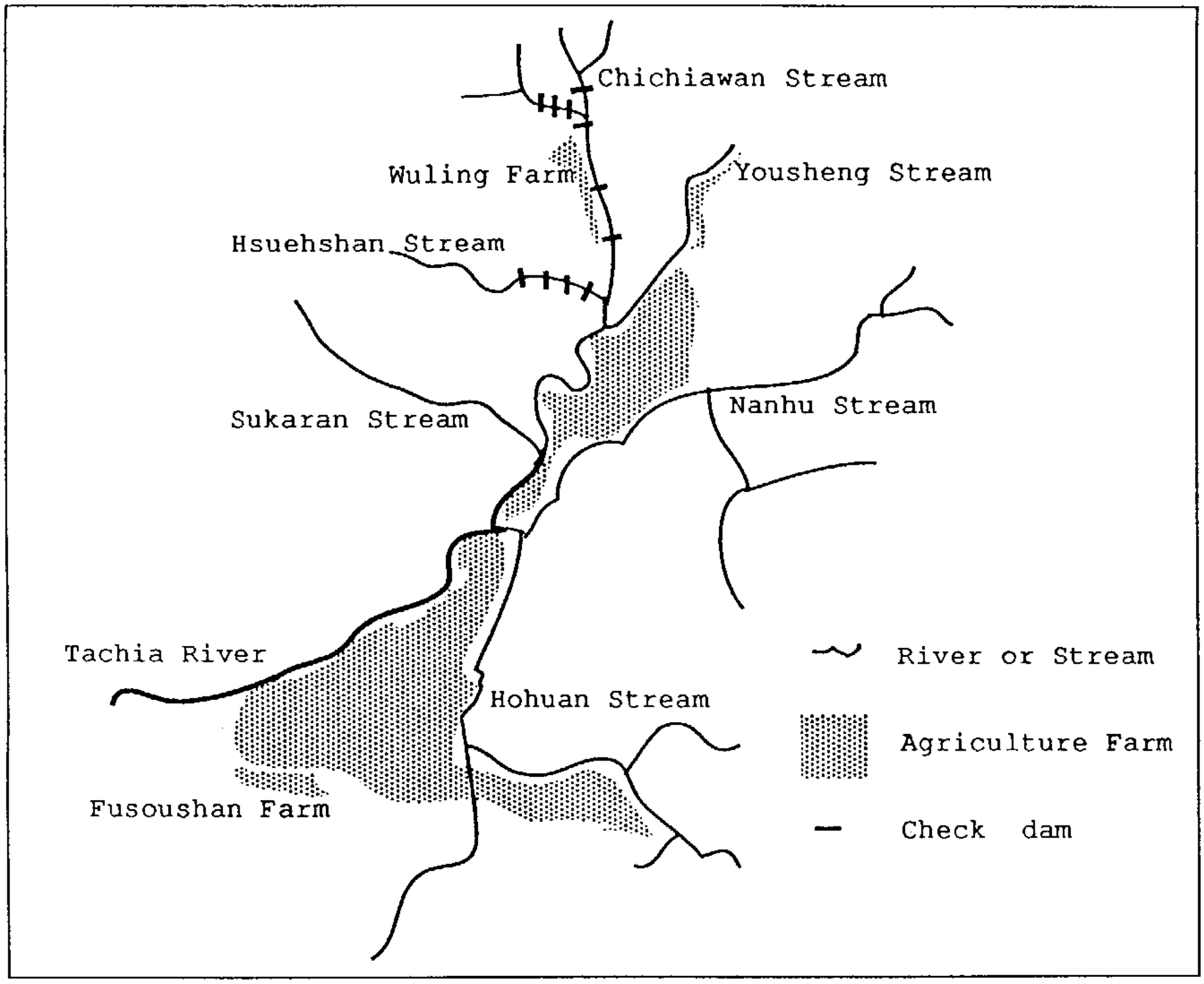

Fig. 2. Land use around upper section of the Tachia River including present habitat of the Formosan landlocked salmon at Chichiawan Stream and Hsuehshan Stream.

of over 18°C . Eutrophication, pesticides pollution and elevation of the water temperature in the streams all contribute significantly to the decline of the salmon.

Conservation of the salmon

Since the landlocked salmon has attracted anglers, the population has been heavily exploited and thus reached a state close to extinction in the recent past. In 1938, the colonial Japanese Government designated the Formosan landlocked salmon as a Natural Monument and gave it strict protection (Nakamura and Koshigi, 1938). At that time, fishing either near the spawning ground or during the breeding period was prohibited. Furthermore, a buffer zone of 300 m in width along the streams where the salmon existed were completly protected from logging. However, these conservation measures have been neglected for almost 40 years after the retrocession of Taiwan from colonial Japanese Government in 1945. Except in 1974, an attempt to propagate the salmon artifcially was taken by the Forest Bureau, but it failed.

In 1984, the government announced that nature and ecological conservation work would be one of the "Fourteen Major Projects" for the next six-year, and by 1988, four national parks and a big nature reserve occupying about 7.8% of Taiwan's total area have been established. In addition, the Division of Conservation under the Council of Agriculture (COA) were also established in 1984. Since than the COA has been very active in promoting nature conservation.

In 1984, the Cultural Assets Preservation Act provided legal protection for rare and endangered species of plants and animals including the Formosan landlocked salmon. The penalty for violation of this law is more severe than that of the Hunting Law. Between 1984 and 1989, COA has spent over two million US dollars to protect O. m. formosanus and funded many projects for the conservation of the salmon. To prevent illegal fishing, COA provides funding to the Wuling Farm to patrol the stream. In the last three years, illegal fishing was nearly eliminated. As a result, the number of salmon has increased rapidly. The population size was estimated to be 700 in 1985 , and reached around 2,000 in 1987 (Lin, et al., 1987).

To avoid extinction of the salmon in Taiwan, a hatchery was established in October 1985. Each year several thousand eggs were obtained from spawning fish to stock the hatchery from which nearly a thousand fry emerged. By March 1988, 306 juveniles ranging in sizes from 146 to 285 mm were alive in the hatchery. In late March 1988, 250 tagged salmon were released into natural streams at three sites; two at the middle and upper parts of Chichiawan Stream, and one in Hsuehshan Stream. It is encouraging that the tagged fish still spotted several months later during scuba diving surveys.

To reduce nutrient input into Chichiawan Stream from the agricultural land nearby, a 8-km sewage canal and a sewage plant at the lowest part of Chichiawan Stream will be built. In addition, studies on the population, habitat preference and pathogens of the salmon were also carried out in the last couple of years. Furthermore, detailed plans on future land use is undertaken to decrease agricultural land near the stream at Wuling Farm. Given a couple of years, it is believed that the natural environment of Chichiawan Stream will be much improved.

Future problems to be faced

Although COA has made great efforts to protect the Formosan landlocked salmon, the fish is still endangered due to the following reasons:

(1) The total population size of the salmon is still small, probably less than 2,000.

(2) The individuals restricted to Chichiawan Stream, are still facing a major threat of extinction. Furthermore, these fish are separated into subpopulations by check dams (Fig. 2).

(3) There are still some vegetable farms and orchards exposing the stream to eutrophication which may even increase in the future.

(4) As the human population increases in Taiwan, the Wuling scenic site may attract more tourists, and thus increasing the impact on the stream.

(5) There are few fishery biologists in Taiwan who are involved in stream fish research and management

In the past, plans of improving the natural environment of the upper Tachia River watershed failed because of social and economical problems. The current conservation strategy is thus to protect Chichiawan Stream from pollution and to expand the landlocked salmon territory to the Hsuehshan Stream.

Conclusion

In the past, we have ignored our freshwater fish, including the Formosan landlocked salmon, as natural resourses. Today government actions include measures taken against the negative environmental impact of development, as well as program in freshwater fish research and conservation. In addition there are now five non-governmental conservation associations concerned with the protection of local stream fishes.

A committee for the conservation of freshwater fish in forest regions was formed in June, 1988 under COA. In July, COA sponsored a research program of game fish ecology , and will hold the first National Symposium of Freshwater Fish Conservation in April 1989. To develope the freshwater fish management techniques, a cooperative project between COA and the United States Department of Agriculture is in progress. Therefore, rapid development of freshwater fish research and conservation in Taiwan are anticipated.

The tragedy of losing major portions of the habitat of the Formosan landlocked salmon is illustrative and the lesson of this tragedy should be learned by the people of Taiwan. Large scale agricultural development in the mountain regions without considering conservation of the ecosystem as a whole will lead to irreversible damage to the watershed environment, and even to the extinction of valuable fish species .

Ten years ago economic development was emphasized more than nature conservation in Taiwan. Today this is no longer the case. With current prosperity , we hope we as well as the freshwater fish will all have a better environment in the future.

Acknowledgments.

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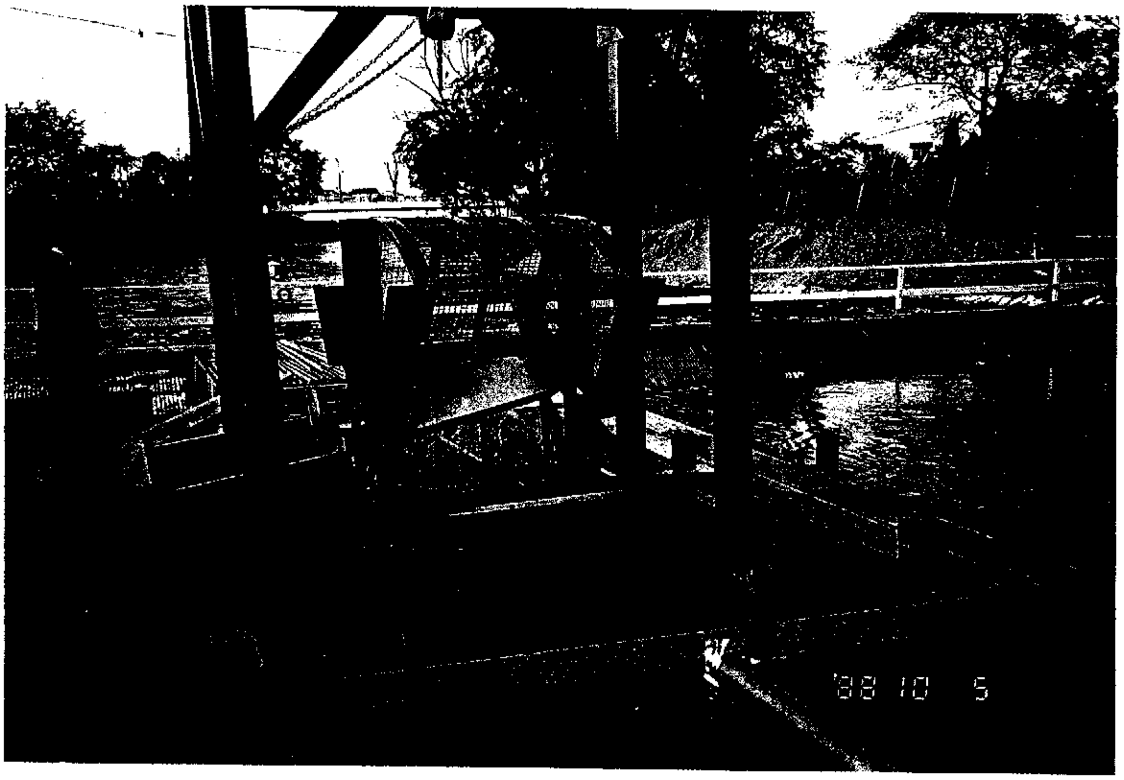

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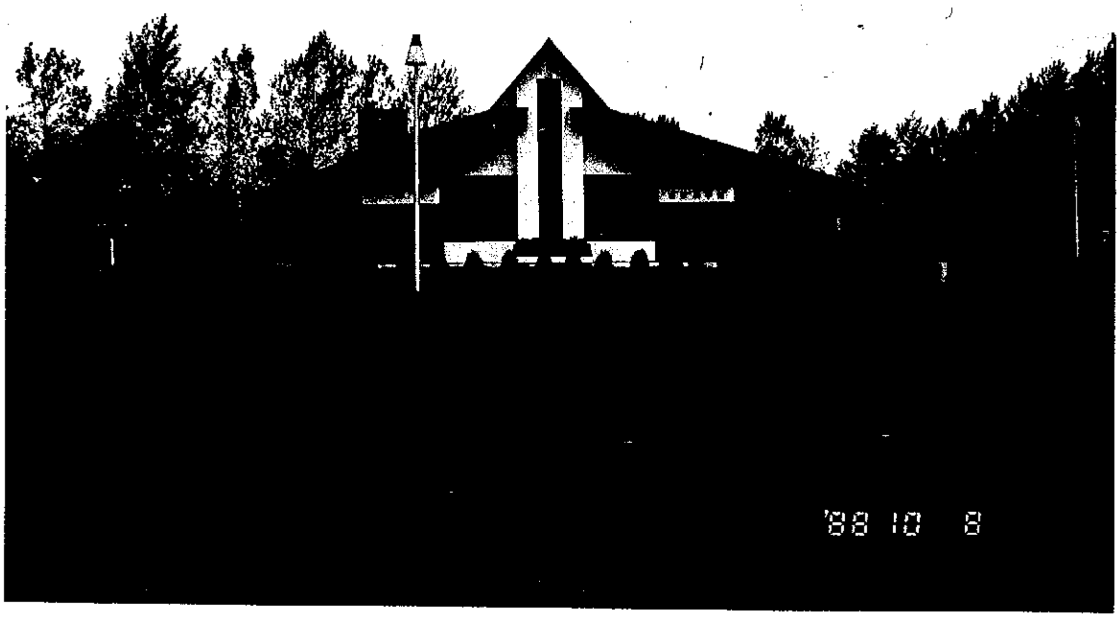

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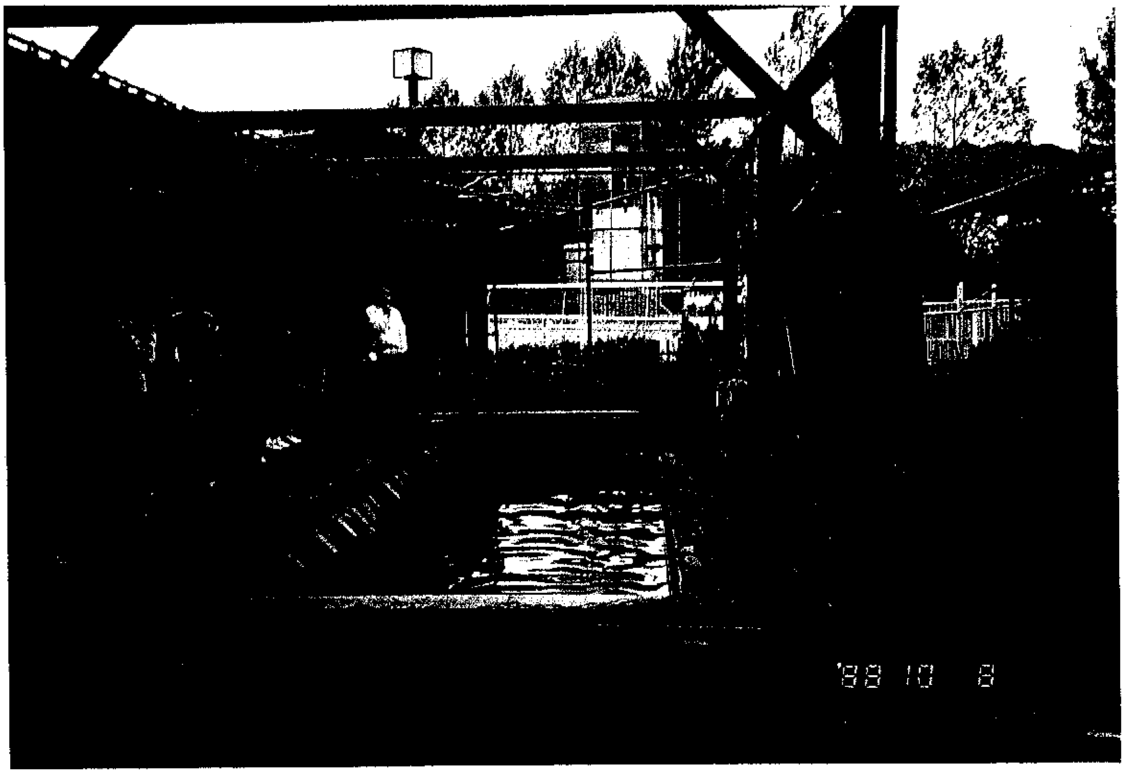
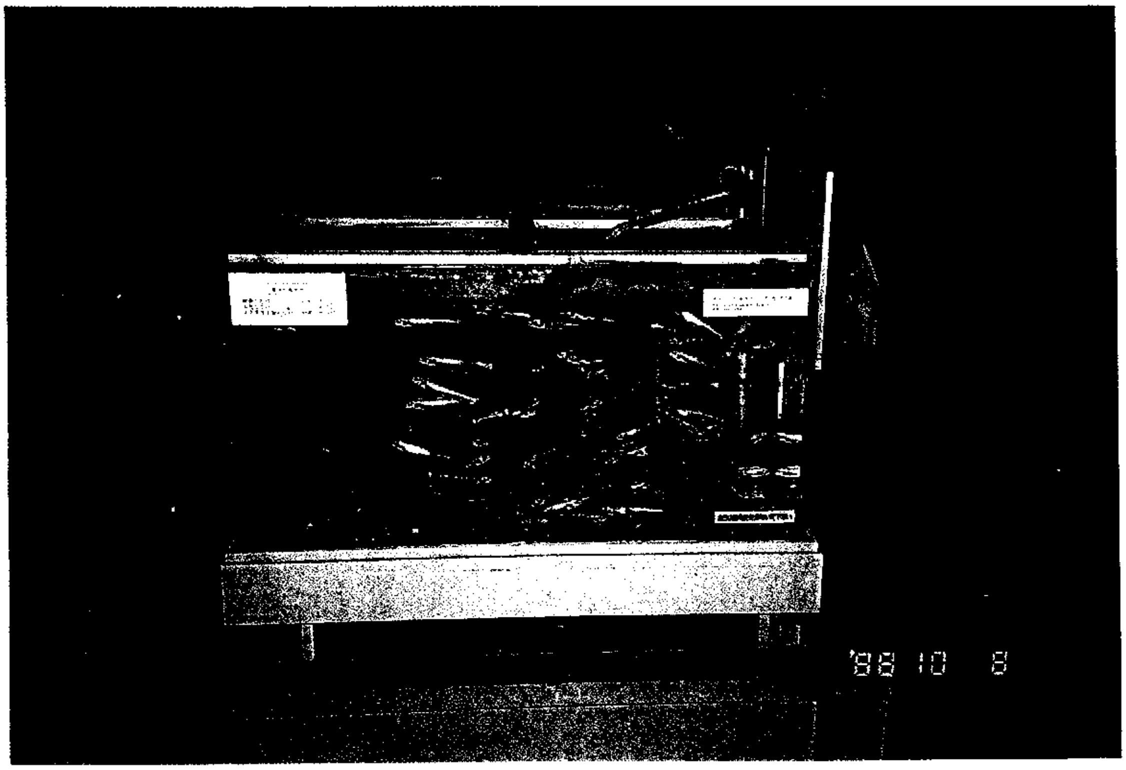
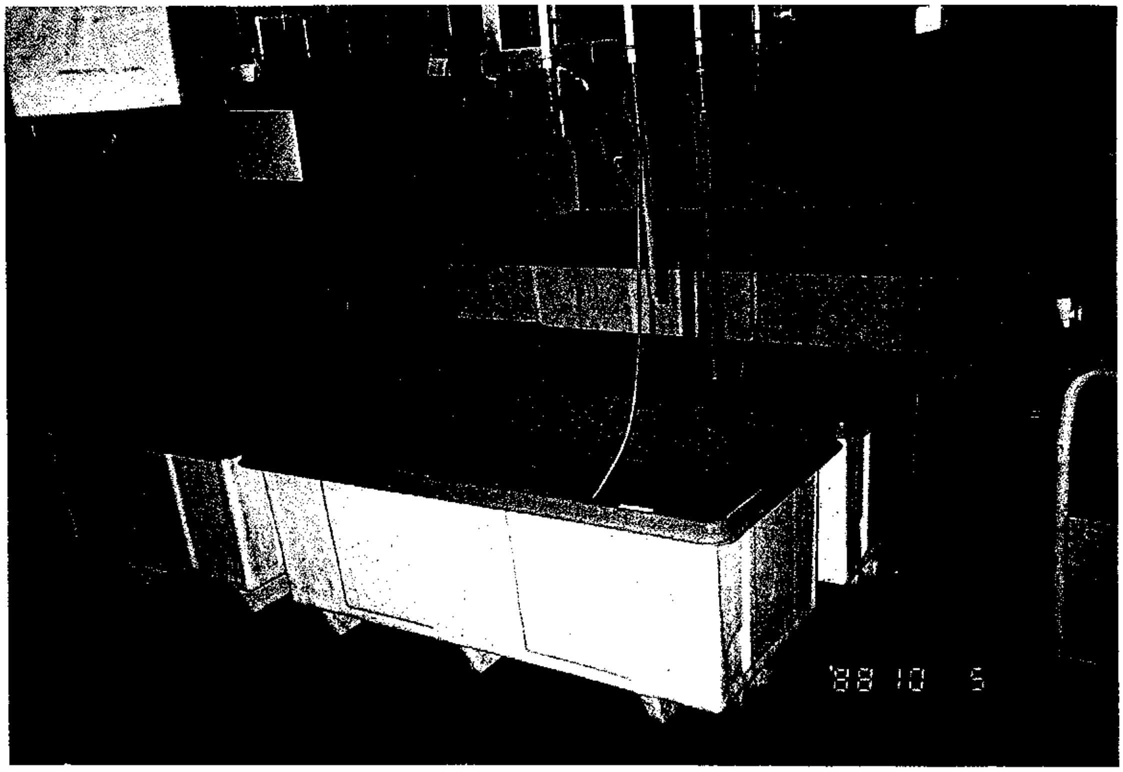


3. 鱒魚生殖行爲展示場。



4. 室內仔魚養殖展示水箱。

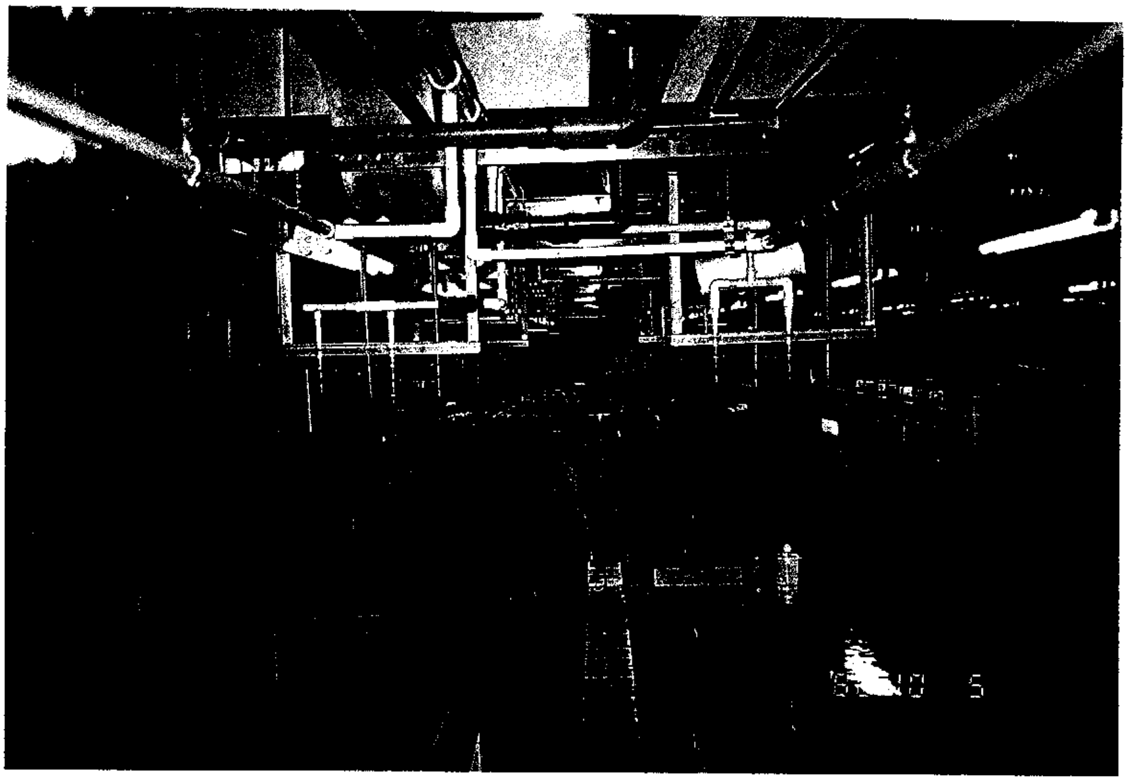


5. 室內鮭魚孵化槽。

6. 孵卵水槽。

7. 鮭鱒魚科學展示館內之解說圖片。

8. 鮭鱒魚科學展示館內之解說圖片。



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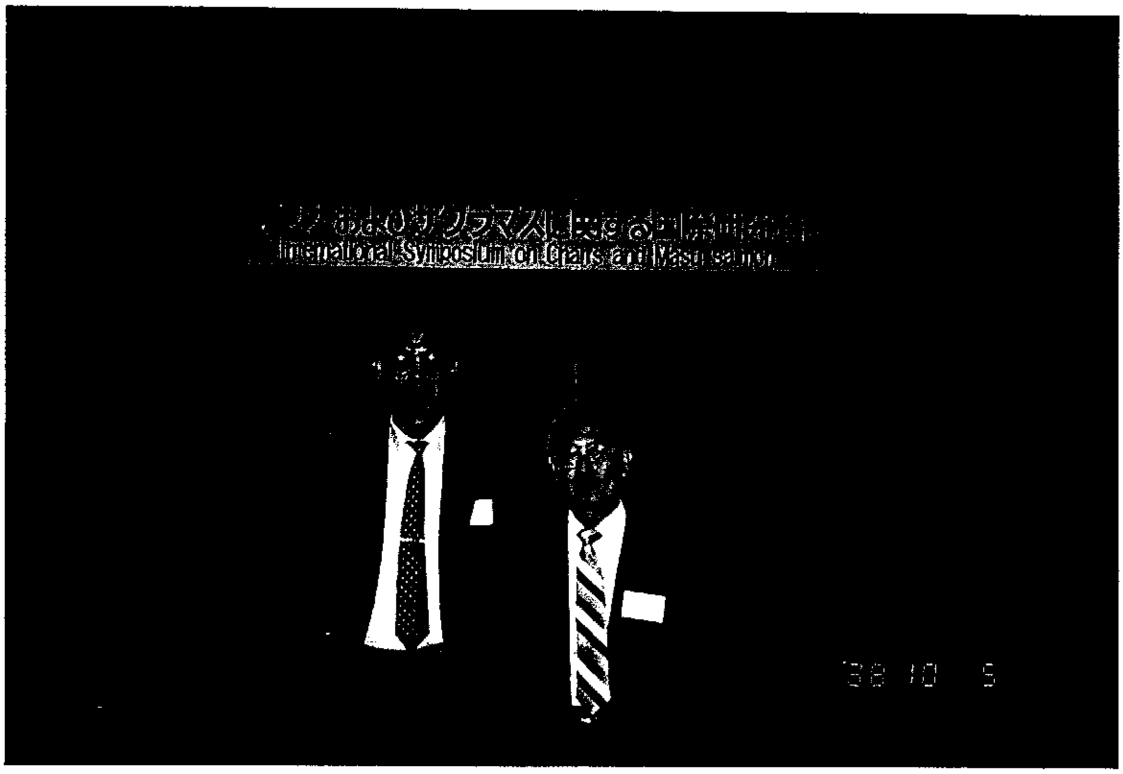

10.參加世界鮭魚類會議之中華民國代表。