

出國報告（出國類別：考察）

2010 年「中美環境保護技術合作協定
—海洋污染預防與緊急應變管理」
出國考察報告書

服務機關：行政院環境保護署

姓名職稱：許處長永興，宋欣真科長，
張志偉高級環境技術師

派赴國家：美國

出國期間：99 年 9 月 26 日至 10 月 2 日

報告日期：99 年 12 月 16 日

出國報告摘要

報告名稱：

2010 年「中美環境保護技術合作協定－海洋污染預防與緊急應變管理」出國考察規劃

出國人員/服務機關/職稱：許處長永興，宋欣真科長，張志偉高級環境技術師

出國類別：參訪

出國地區：美國

出國期間：99 年 9 月 26 日至 10 月 2 日

報告日期：99 年 12 月 14 日

分類：海洋污染/環境保護

內容摘要：

今年 4 月 22 日美國墨西哥灣發生的 Deepwater Horizon 溢油案，迄今共外洩 85 萬噸原油，為史上最嚴重的海洋油污染事件。美國政府為了因應本案特別成立了聯合應變中心，並以 USCG 及 NOAA 為聯邦的應變主力，其中 USCG 負責油污攔阻與清除，而 NOAA 負責所有的科技諮詢工作。NOAA 以下轄的海洋污染應變與復育中心為主，負責提供聯合應變中心包含空中及水體的油污監測、溢油模擬軟體、海岸敏感地圖、海上焚燒規範、及網路即時緊急應變指揮系統等相關科學資訊。而 NOAA 的研發合作單位，華盛頓州立大學城市水污染中心及舊金山灣基金會，則分別協助監測海灣水質與建置網路資源管理平台，並提供中立的學術調查，消除民眾對散油劑對環境威脅等議題的疑慮。

目錄

壹、目的	2
貳、行程簡介	4
一、參訪美國國家海洋暨大氣總署海洋污染應變與復育中心.....	5
二、參訪 Puget Sound Partnership 暨華盛頓大學城市水污染中心.....	16
三、參訪舊金山灣基金會.....	20
參、心得與建議.....	23
肆、附件	
一、拜會名單	24
二、美國國家海洋暨大氣總署海洋污染應變與復育中心簡報(NOAA, OR&R).....	25
三、美國國家海洋暨大氣總署環境敏感指標地圖製作教學大綱(NOAA, OR&R)	41

壹、目的

今年 4 月 22 日美國墨西哥灣發生的 Deepwater Horizon 溢油案，迄今共外洩 85 萬噸原油，為史上最嚴重的海洋油污染事件。美國政府為了因應本案特別成立了聯合應變中心，中心的成員涵蓋了肇事者、聯邦政府、州政府、學術研究機關、非營利的基金會、及相關業界專家。聯邦政府成員包含美國國土安全部(Department of Homeland Security, DHS)、國防部(Department of Defense, DOD)、環保署(Environmental Protection Agency, EPA)、海洋暨大氣總署(National Oceanic and Atmospheric Administration, NOAA)、海岸巡防隊(United State Coast Guard, USCG)及州政府。並以 USCG 及 NOAA 為應變主力，其中 USCG 負責油污攔阻與清除，而 NOAA 負責所有科技諮詢工作。

NOAA 以下轄的海洋污染應變與復育中心為應變主力，負責提供聯合應變中心包含空中及水體的油污監測、溢油模擬軟體 (General NOAA Operational Modeling Environment, GNOME)、海岸敏感地圖 (Environmental Sensitivity Index Maps, ESI)、海上焚燒規範、及網路即時緊急應變指揮系統 (Environmental Response Management Application, ERMA) 等相關科學資訊。而 NOAA 的研發合作單位，華盛頓州立大學城市水污染中心 (University of Washington, Center for Urban Waters) 及舊金山灣基金會 (San Francisco Estuary Foundation, SFEI) 則分別協助監測海灣水質與建置網路資源管理平台。

藉由本次參訪，希期增進臺美雙方在海洋污染應變科技部分的交流，了解美國各級單位對於環保事務的運作模式，同時環保署也將吸取美國在緊急應變時科技部會的支援模式，來增進對海洋污染緊急應變的管理作法與技術，以減少台灣與臨近海域船舶意外造成海洋污染的危害，進而保護太平洋岸的居民、海洋生物免受台灣海面漏油及化學物質的影響。

貳、 行程簡介

9 月 26 日	桃園國際機場飛往西雅圖
9 月 27 日至 28 日	拜會 NOAA 海洋污染應變與復育中心
9 月 29 日	拜會 Puget Sound Partnership 暨華盛頓大學城市 水污染中心
9 月 30 日	拜會舊金山灣基金會
10 月 1 日至 2 日	舊金山返回台灣

一. 參訪美國國家海洋暨大氣總署海洋污染應變及復育中心 (NOAA, Office Response and Restoration)

(一) 前言

美國發生重大海洋與海岸污染事件時，USCG 的 Strike Force 負責海上及海岸的油污及化學品清除（武），而 NOAA 的海洋污染應變與復育中心(Office of Response and Restoration, OR&R)則負責提供應變相關的科技支援與後續的復育工作（文）。如本次墨西哥灣溢油事件，聯合應變中心的政府部門便是由 USCG 及 NOAA 為主，其他單位為輔。

NOAA 的海污應變依據為有三，分別是：

1. National Oil and Hazardous Substances Contingency Plan
2. National Response Framework (ESF-10)
3. Emergency Planning and Community Right to Know Act (SARA Title III Amendment)

(二) NOAA 的組織架構

NOAA 為美國商業部下轄之單位，總部位於 Silver Spring, Maryland，NOAA 下轄 5 大中心，分別是大氣暨海洋研究中心、國家氣象中心、國家海洋中心、國家海洋漁業中心、及國家環境衛星資訊中心。本次參訪對象是海洋污染應變與復育中心，但是亦有以電話與電子郵件與位於 Virginia 的 NOAA 國家環境衛星資訊中心進行相關會議。

其中海洋污染應變與復育中心隸屬於國家海洋中心，行政總部位於

Silver Spring, Maryland，科技應變部門則位於 Seattle, Washington。海洋污染應變與復育中心下編 134 名員工，包含緊急應變部 45 人，海洋垃圾部 10 人，環境復育部 45 人，及秘書部 26 人，另外該中心超過半數員工擁有博士學位。緊急應變部於 1970 年初成立時只有 5 名人員，1990 年 Exxon Valdez 案後擴編至 45 人，為因應墨西哥灣溢油案，該中心暫時擴編至 150 人。近 10 年來，NOAA 平均每年處理 150 件海洋油、化學及其他污染事件。

(三) NOAA 的海污應變工作事項

NOAA 的海洋污染應變與復育中心日常工作項目共有 3 大項：

1. 海污應變：

於海洋污染事件發生時（至少需要達到第 2 級），提供如空中海污觀測、油污軌跡模擬、網路應變資源整合系統、應變方式評估及建議（如海上焚燒）、海上（岸）化學品應變建議、海氣象觀測及預報、生態復育等建議與資訊。

2. 日常準備工作：

繪製環境敏感指標地圖(ESI)、研發應變軟體、及辦理相關的訓練。

3. 協調整合：

於應變時協調整合海岸巡防署(USCG)、聯邦現場專家小組(FOSC)、州政府、及相關的學者專家。該中心設有海洋科技人才資料庫，鑒於海洋專家，如海洋生物專家，往往僅對海洋生物本身，但對油

或化學品對生物的影響不清楚。所以該中心便設立科學家協調小組，小組成員具有海洋污染對生物、水質影響的通用知識。於事件發生時，可迅速與其他專家溝通協調，擬定出對當地環境的應變策略。

目前該中心每年亦固定開設 30 人 3-5 天的科技應變研習營，課程內容包含油污軌跡模擬，ESI 製作與判讀，及化學品應變等課程，及不定期開設單項科技應變項目的線上或實體課程。

而 NOAA 的國家環境衛星資訊中心則於海洋油污污染事件發生時，提供相關的衛星觀測報告。該中心為全時運作，可動用一般可見光衛星及包含不受天候及於夜間運作的雷達衛星(SAR)。且與歐洲等其他國家的衛星公司簽有合約，其可動用的衛星數量遠大於台灣。若軌道適宜，該中心可於 3 小時內完成衛星的油污面積分析報告，而目前國內中央大學太空遙測中心，分析可見光的衛星照片需時約 7 小時。

(四) NOAA 海洋污染應變與復育中心的海污應變工具

NOAA 的海洋污染應變與復育中心的應變工具共有 3 大類：

1. 應變統整工具：

如環境敏感指標地圖 (ESI) 及網路應變整合系統 (ERMA)。

2. 油污應變工具：

油污軌跡模擬軟體 (GNOME)，溢油諮詢資料庫 (ADIOS2)，及溢油單位換算軟體 (NUCOS)。

3. 化學應變工具：

化學品空氣警戒區模擬軟體 (ALPHA)，化學品反應資料庫 (CAMEO)，及海洋生物毒性模擬軟體 (CAFÉ)。

建置環境敏感指標地圖 (ESI) 是海洋污染應變與復育中心最重要的日常工作，其以 30 公尺為間隔，涵蓋了美國沿岸所有的環境敏感資訊。與其他國家的 ESI 地圖相比較，美國的環境敏感指標地圖並沒有包含應變資源庫的位置及應變路徑建議，因為該中心認為環境敏感指標地圖內容應專注於自然資源，若包含應變資訊可能會誤導現場應變指揮官的決策。並且該中心的环境敏感指標地圖除了海岸地質與使用特性外，尚包含了豐富的生物資訊。鑒於當地生物的成長與棲聚會隨季節而變化，該中心的生物指標細分至每月並標示生物的幼生期、成長期及成熟期。該中心並建議，所有的 ESI 地圖應有紙本(每一頁均需外包塑膠膜)、電子地圖及地理資訊系統(GIS)等 3 種版本，因為在緊急狀況時，很有可能喪失電力，所以該中心所有資料均有紙本備份。

ERMA 是 NOAA 於 2010 年剛剛研發完成，提供指揮中心與前進指揮所的即時網路諮詢系統，該系統可同時提供應變資源、海氣象預測、溢油軌跡模擬、海面船隻資訊、及環境敏感指標地圖 (ESI) 等資訊，同時依指揮官的需求顯示不同的圖資。

GNOME 是海洋污染應變與復育中心自行開發的免費油污軌跡預測軟體，其以商用軟體 Oil Map 為研發骨架，所以操作介面與原理非常相

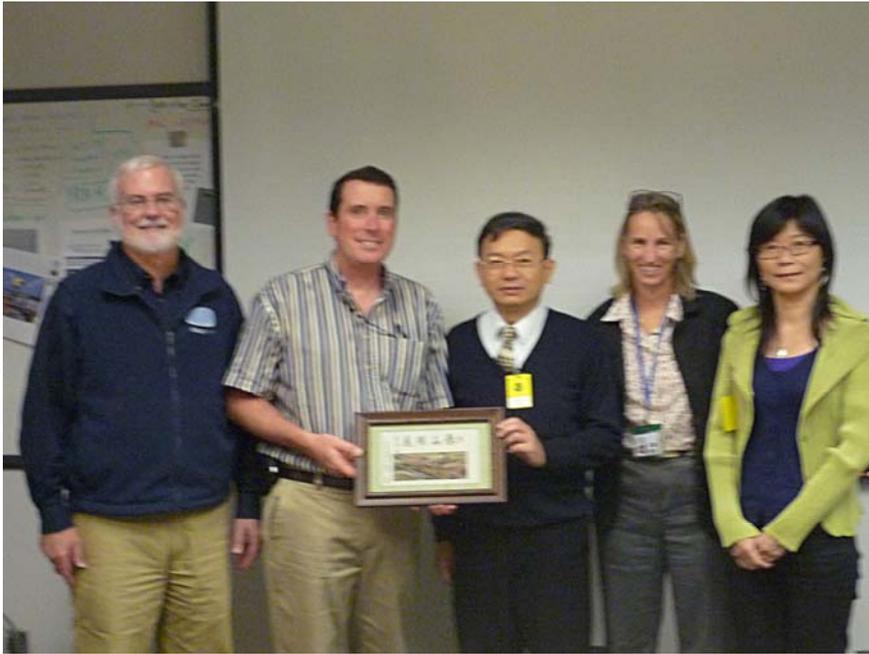
似 Oil Map。而此以模式的另一個優點或是與 Oil Map 不同之處，便是可以使用不同的水理模式作為海流的模擬，不受限於數值網格方式或特殊的水理模式。這是因為受到地形或水深的影響，我們亦會需要使用不同的水理模式。例如，Princeton Ocean Model 在模擬大洋洋流上有其優勢，但在模擬沿岸流時，當地科學家自行撰寫的水理模式可能更接近現場海況。因此，NOAA 的科學家在使用 GNOME 時，常會搭配數個水理模式，依其專業經驗選擇出最適合的模擬結果。另外，在做 GNOME 的後續模擬校正時，該中心的科學家建議最好的發是便是以專業空中觀測為主，其他遙測設備為輔。而運用該模式於台灣本島的最大挑戰，便是需建置相關的數值邊界圖。

ADIOS 2 是溢油諮詢資料庫軟體，內建數百種各式油品資料。是該中心最廣為人知的軟體，該軟體除了可提供油品的基本資料，更可在輸入現場溢油狀況及海氣象資料後，計算出溢油隨時間變化而揮發、消散、與滯留海面的量。同時，該軟體更可模擬海上燃燒時所產生的煙柱範圍，以及運用汲油器後對總溢油量的影響評估。

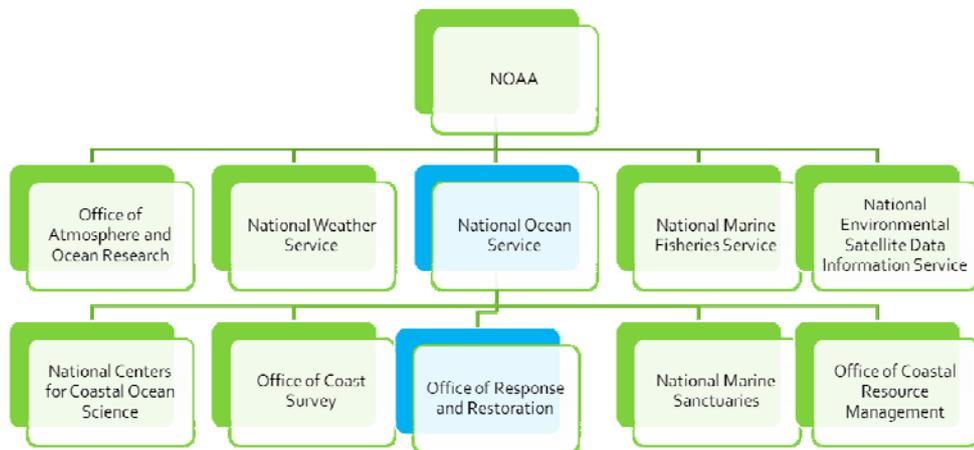
化學應變軟體 ALOHA 已為本署毒管處做為模擬化學品空中警戒區，此次參訪 NOAA 便教授如何將 ALOHA 的模擬結果展現在 Google Earth 上，已方便應變中心判讀。此外海洋污染應變與復育中心以正在研發 ALOHA 的 3-D 版，未來 ALOHA 將能模擬化學品於水中及空中的

3D 變化。

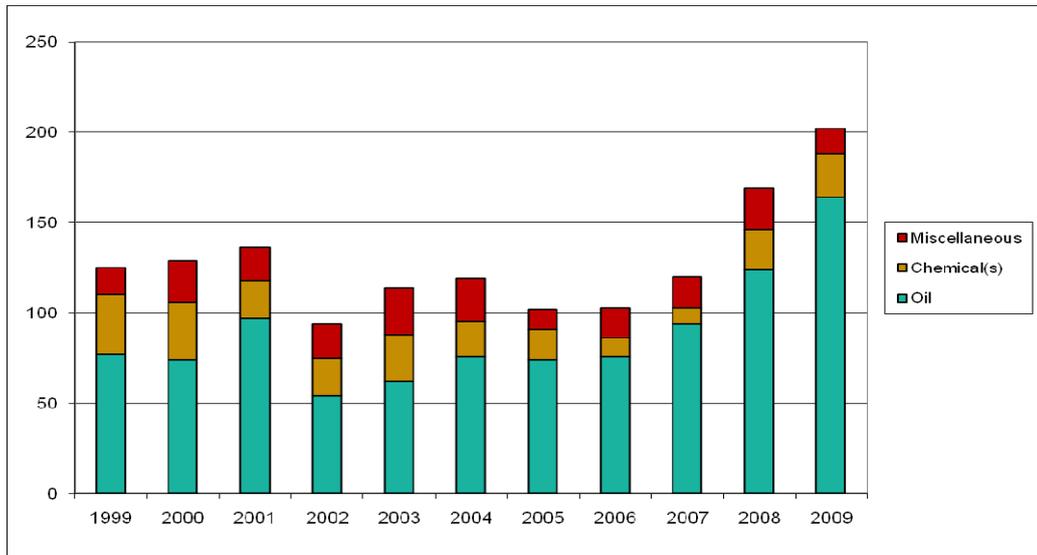
CAMEO 是 EPA 與該中心聯合研發的化學應變軟體，其內含上萬種化學物質，除可列出該化學物質的物質安全表 (MSDS)、相對應的安全防護、及消防準則外，更可模擬數個化學物質接觸，或化學物與水及空氣接觸時的反應及安全注意事項，所以該軟體對於海上化學事故有著極大的助益。



與 NOAA 官員合影



NOAA 的組織架構



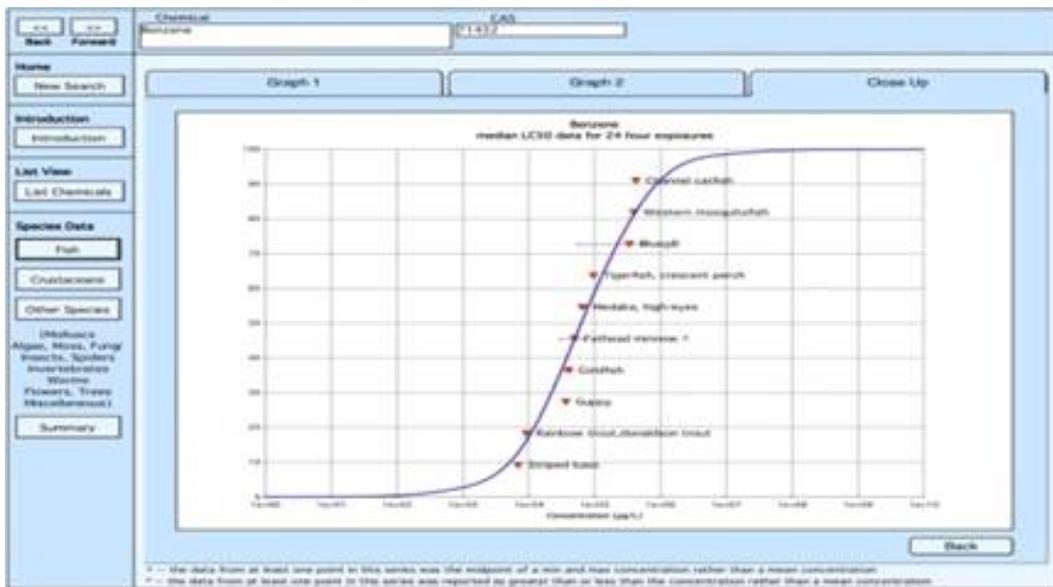
NOAA 每年的海污應變數目



NOAA 海洋污染應變與復育中心的海污應變項目



ALOHA



CAFÉ

Chemical Data Sheet - Mozilla Firefox

http://www.cameochemicals.com/chemical/2962

CAMEO Chemicals

Home
Help

Search Chemicals
New Search
Modify Search
Search Results

MyChemicals
chemicals: 0
View MyChemicals
Predict Reactivity

Chemical data sheet for:
CHLORINE

Section 1 - Chemical Identifiers

[Back to top | What is this information?](#)

CAS Number	UN/NA Number	STCC Number	CHRIS Code
7782-50-5	1017	4920523 4920539	CLX

NFPA 704:  **DOT Hazard Label:** POISON GAS
CORROSIVE

General Description
A greenish yellow gas with a pungent suffocating odor. Toxic by inhalation. Slightly soluble in water. Liquefies at -35°C and room pressure. readily liquefied by pressure applied at room temperature. Density (as a liquid) 13.0 lb / gal. Contact with unconfined liquid can cause frostbite by evaporative cooling. Does not burn but, like oxygen, supports combustion. Long-term inhalation of low concentrations or short-term inhalation of high concentrations has ill effects. Vapors are much heavier than air and tend to settle in low areas. Contact CHEMTREC to activate chlorine response team 800-424-9300. Used to purify water, bleach wood pulp, and to make other chemicals.

Rate of onset: Immediate to hours
Persistence: Minutes to hours
Odor threshold: 3.5 ppm

CAMEO

ERMA Portsmouth, NH

Map Info About

Legend Layer Data Tools

Incident Information

- Forecast (light)
- Forecast (medium)
- Forecast (heavy)
- Forecast (uncertainty)

Resources at Risk NH

Shoreline Classification (line)

- 100+ - Scrub shrub wetlands (most sens)
- 10A - Salt & brackish-water marsh
- 10A+ - Salt & brackish-water marsh (m)
- 9A - Sheltered tidal flats
- 9A+ - Sheltered tidal flats (most sens)
- 8C - Sheltered riprap
- 8C+ - Sheltered riprap (most sens)
- 8B - Sheltered, solid man-made structure
- 8B+ - Sheltered, solid man-made structure
- 8A - Sheltered rocky shores
- 8A+ - Sheltered rocky shores (most sens)
- 7+ - Exposed tidal flats (most sens)
- 6B - Riprap (most sens)
- 6A - Gravel beaches
- 6A+ - Gravel beaches (most sens)
- 5 - Mixed sand & gravel

Scale = 1:1000
Zoom = 12/19
70 77633, 43 15135

Map data ©2006 Tele Atlas + Terra, ©2006
© 2007 University of New Hampshire

ERMA

二. 參訪 **Puget Sound Partnership** 暨華盛頓州立大學城市與水污染中心

(一) 前言

州政府與學術研究單位在美國發生重大海洋與海岸污染事件時，同樣扮演了極重要的腳色。其中州政府部分，除牽涉到州政府與聯邦間的分權互動，州政府內部的跨單位協調整合，更是值得我們探討學習的部分。而本次參訪的華盛頓州立大學城市水污染中心，則是美國近來政府與學術單位結合的新趨勢。

(二) **Puget Sound Partnership**

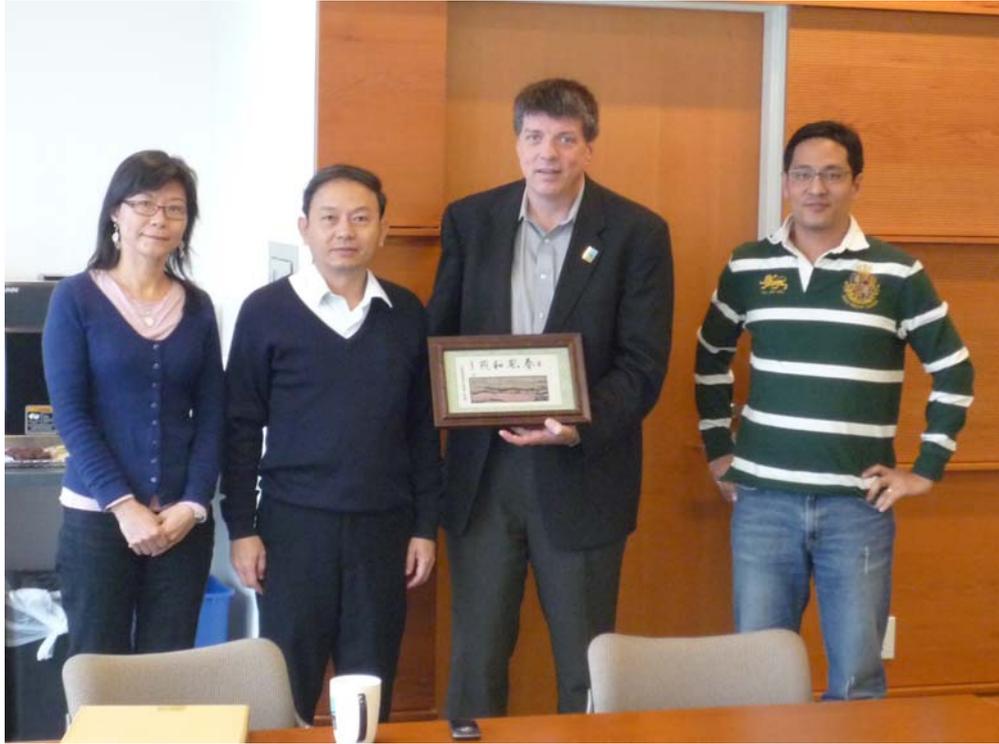
Puget Sound 涵蓋了加拿大、美國華盛頓州及奧勒岡州，是美洲西北部最重要的水域。在涉及環境保護事務時，在美國華盛頓州領域便有 NOAA、EPA、軍方、華盛頓州生態部 (Washington State, Department of Ecology) (該州無環保部的編制) 及西雅圖市環保局等軍方政府單位的參與。由於涉及聯邦、州、市、軍方及學術單位，所以往往無法有效整合意見，並且浪費各種資源。有鑑於此，華盛頓州政府特別設立了 **Puget Sound Partnership**，此委員會直接隸屬於州長辦公室，其經費來源主要來自 EPA、華盛頓州政府及民間捐助，並得以運用上述款項，提供各單位對 **Puget Sound** 的研究經費。由於得到 EPA 與州長的授權與經費支持，使得該組織能有效整合各級單位。目前 **Puget Sound Partnership** 目前主要專注於下列事項：

1. 水域底泥中重金屬及致癌物質如 PAHs 的減量與移除。
2. 暴雨對水質的影響。
3. 總量管制 (TMDL)。
4. 國際合作，該組織與加拿大、日本、歐盟的官方環保單位均保持聯繫，共同為保護環境資源而努力。

(三) 華盛頓州立大學城市水污染中心

學術研究單位在美國發生重大海洋與海岸污染事件時，亦扮演了極重要角色，其除可提供專業意見，亦可藉其崇高的社會地位，在面臨重大爭議時提出適當的環境保護意見。如此次墨西哥灣溢油案，針對散油劑的使用與海底未知的油柱是否存在，便是依靠學術單位如聖地牙哥大學、佛羅里達大學及華盛頓大學的中立調查做出結論。

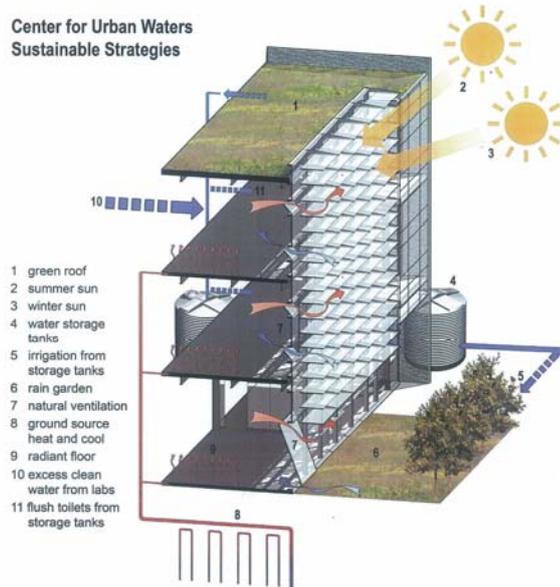
華盛頓州立大學城市水污染中心是由 Puget Sound Partnership 出資，結合了 Tacoma 市、NOAA 及華盛頓大學所成立的研究單位，並於本次墨西哥灣溢油案中負責部分海灣水質及底泥監測的工作。該中心另一個亮點是其結合綠建築與化學安全的建築設計，包含外牆的自動遮陽調溫設計、水的再生利用、及實驗室用水的分離處理等。



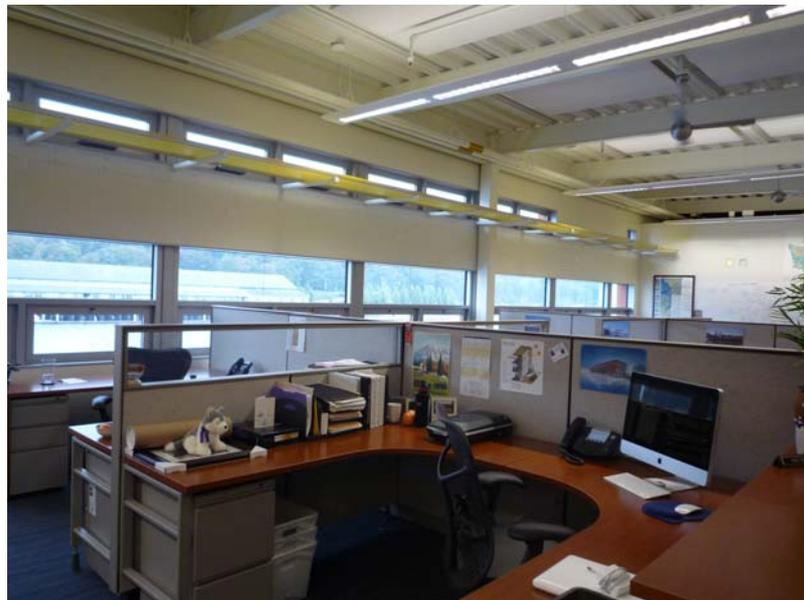
與華盛頓州立大學城市與水污染中心主任 Joel Baker 教授合影



城市與水污染中心外觀



城市與水污染中心的綠建築概念圖 (Center for Urban Waters)



內部辦公室的節能設計

三. 參訪舊金山灣基金會

(一) 前言

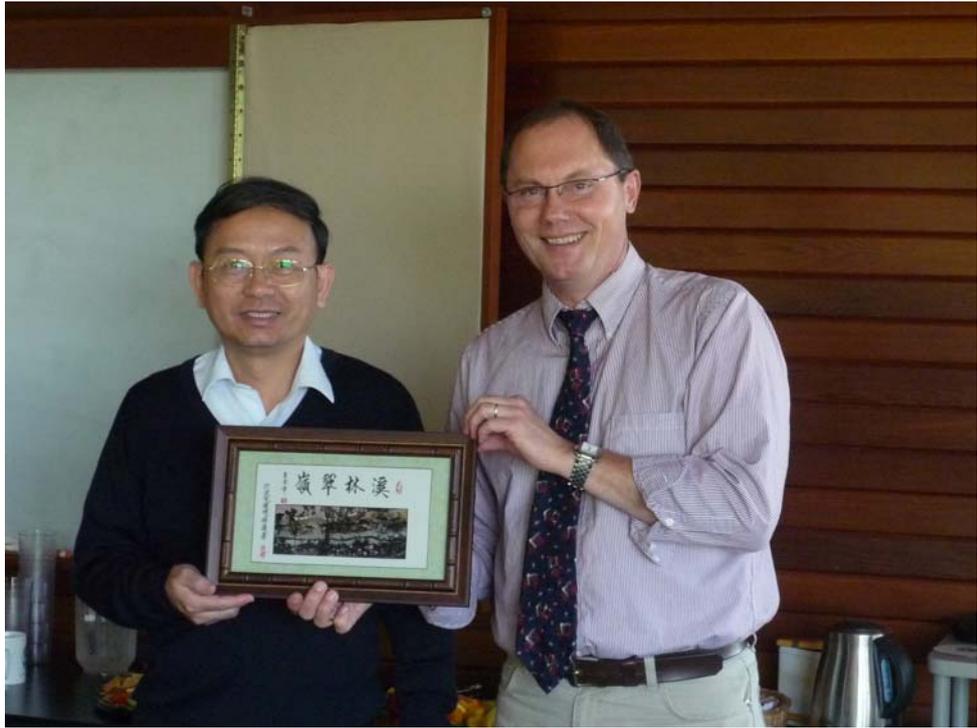
大型的非營利性的學術基金會在美國發生重大海洋與海岸污染事件時，同樣扮演了極重要的角色，如 San Francisco Estuary Foundation、Chesapeake Bay Foundation、Great Lake Environmental Center 等。這些基金會均長期接受聯邦或地方政府委託，進行獨立的環境監測。其財務來源大都來自政府補助、企業捐款、個人捐款及執行計畫所得。其中，政府補助部分可以像是汽機車的特殊牌照費及指定環境檢測費。同時為了避免民眾疑慮會受到補助單位的影響，基金會往往會設立兩道保護閥。第一道便是多元的委員會成員。其成員包含各級政府代表、業界代表、大學教授及環保團體。此外由於定位為學術基金會，各單位在派遣委員代表時，均會考慮代表的專業能力與學經歷，並避免政治酬應。第二道保護閥則是請具有從高學術聲望的專家擔任執行長。截至目前為止，美國民眾及學界對於此類運行方式並無疑慮。

(二) 舊金山灣基金會

舊金山灣基金會屬於非營利的基金會，位於奧克蘭市共有 45 名員工，本次墨西哥灣溢油案中負責協助建置網路資源管理平台。該基金會長期於舊金山灣進行環境監測，監測項目包含水、空氣、底泥及生物。分析內容除傳統水質檢測項目外，還包含有機致癌物如 PAHs、PCBs、PBDEs 及有

機汞等。其所有的監測資料均公開上網免費提供外界下載。由於污染物對自然生物的影響很大，該基金會特別針對生物毒性累積，及污染物經食物鏈的作用，成立專門研究部門，並且強調在做環境監測時，不能只作水質、底泥或空氣的監測，而須同時監測相關化學物質於周遭生物體內的變化。

該基金會同時亦依監測分析資料，提供加州政府擬定相關法令。最新的一個案例便是該會發現舊金山灣的含銅量過高，經長期的資料分析比對，發現主要的來源竟是汽車的金屬煞車片。該基金會提報加州政府後，加州政府便協調業者決定於 2025 年時，所有的汽車煞車片不得含銅。



與執行長 Rainer Hoenicke 合影



與 SFEI 同仁合影

肆、心得與建議

國內建立海污應變量能時，除了攔油索、吸油棉、應變船隻、汲油器及散油劑等裝備之建置、操作維護及人員訓練外，有關科技在應變上的支援，包含使用遙測工具、溢油模擬及環境敏感指標地圖等，雖亦持續進行，但此部分涉及科技專業人才及投資經費，因此仍有相當大的努力空間。

回顧這次墨西哥灣溢油案中，聯合應變中心由於獲得 NOAA 在溢油區域模擬、空中遙測偵照、區域敏感地圖、溢油的物理化學特性、海上燃燒及散油劑的使用時機、網路應變整合系統等資源協助，所以應變中心能在有限時間與資源下，充分調度與使用應變能量。有鑒於此，美國聯邦政府亦準備再次擴充該中心的專家數量及經費，以備不時之需。

學術研究單位及非營利性的學術基金會，在美國發生重大海洋與海岸污染事件時，亦扮演了極重要角色，其除可提供專業意見，亦可藉其崇高的社會地位，在面臨重大爭議時提出適當的環境保護意見。如此次墨西哥灣溢油案，針對散油劑的使用與海底未知的油柱是否存在等議題，便是依靠學術單位的中立調查做出結論，消除民眾的疑慮。

建議未來國內應整合有限的科技應變資源，妥善結合學術研究單位及非營利性的學術基金會，強化各級應變人員對科技資源的認識，期能提升污染應變之質量。

肆、 附件

一、拜會名單

(一)、NOAA

John Tarpley, 應變行動部主任

Debbie Payton, 科技支援部主任

Amy Mertin, 資訊整合部主任

Mark Miller, 軟體發展部主任

Jerry Galt, 溢油模擬部顧問 (前應變中心主任)

William Lehr, 資深科學家

Michele Jacobi, 環境科學家

David Streett, 衛星資訊中心主任

(二)、Puget Sound Partnership 及華盛頓州立大學城市水污染中心

Joel Baker, 華盛頓州立大學水污染中心主任兼 Puget Sound Partnership 科學總監

David Dicks, Puget Sound Partnership 執行總監

Chris Townsend, Puget Sound Partnership 執行總監特別助理

Geoffrey Smyth, Tacoma 市 公共事務室主任

Dana Leon, Tacoma 市 環境事務部資深經理

(三)、舊金山灣基金會

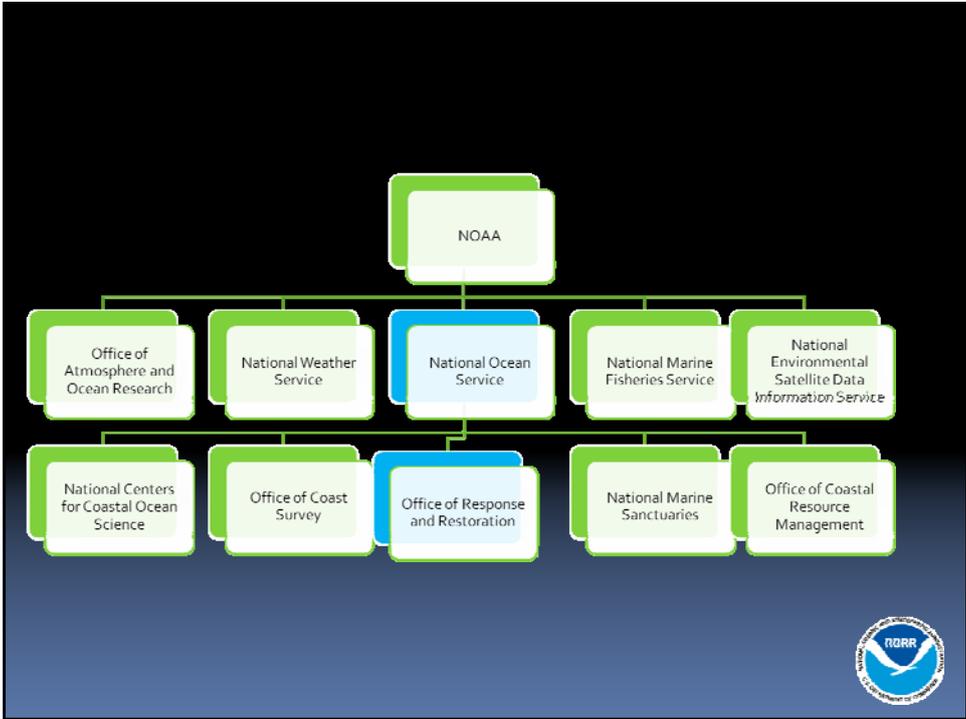
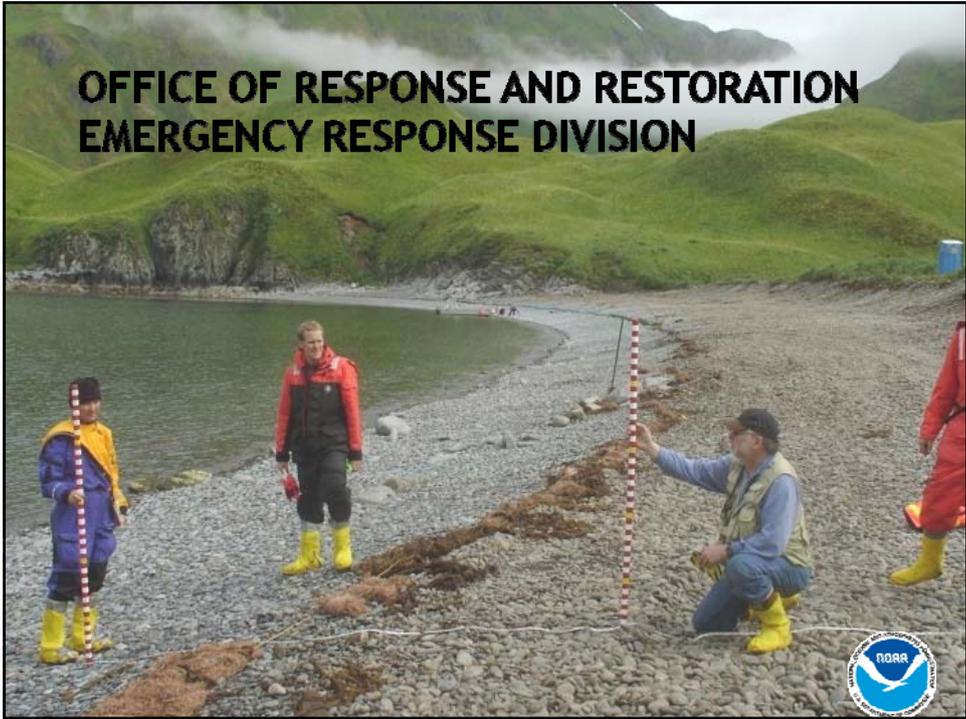
Rainer Hoenicke, 執行長

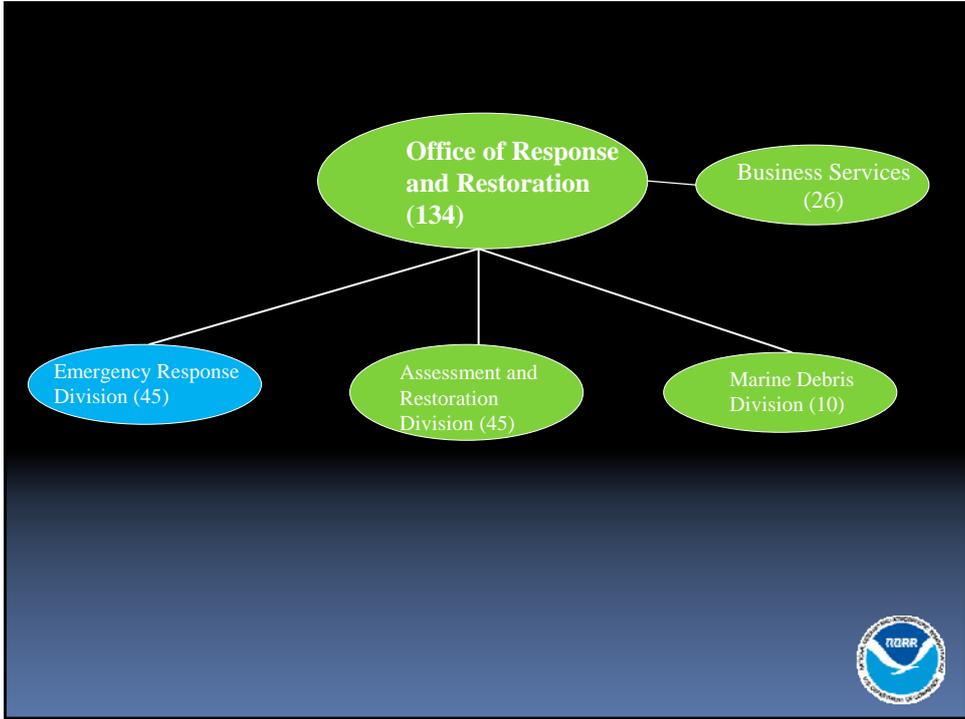
Meg Sedlak, 計畫總監

Donald Yee 環境科學家

Susan Klosterhaus 環境科學家

二、美國國家海洋暨大氣總署海洋污染應變與復育中心簡報





Mandates/Drivers

- National Oil and Hazardous Substances Contingency Plan
- National Response Framework (ESF-10)
- Emergency Planning and Community Right to Know Act (SARA Title III Amendment)

Providing accurate, timely, and credible scientific advice to commands charged with mitigating the effects of spills and other coastal hazards.

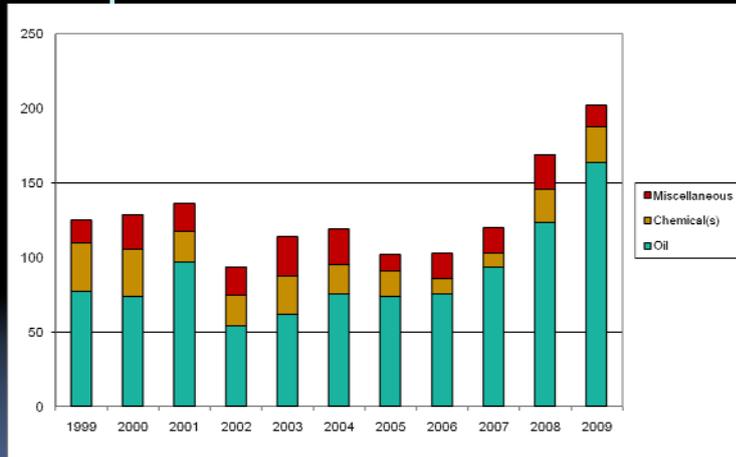


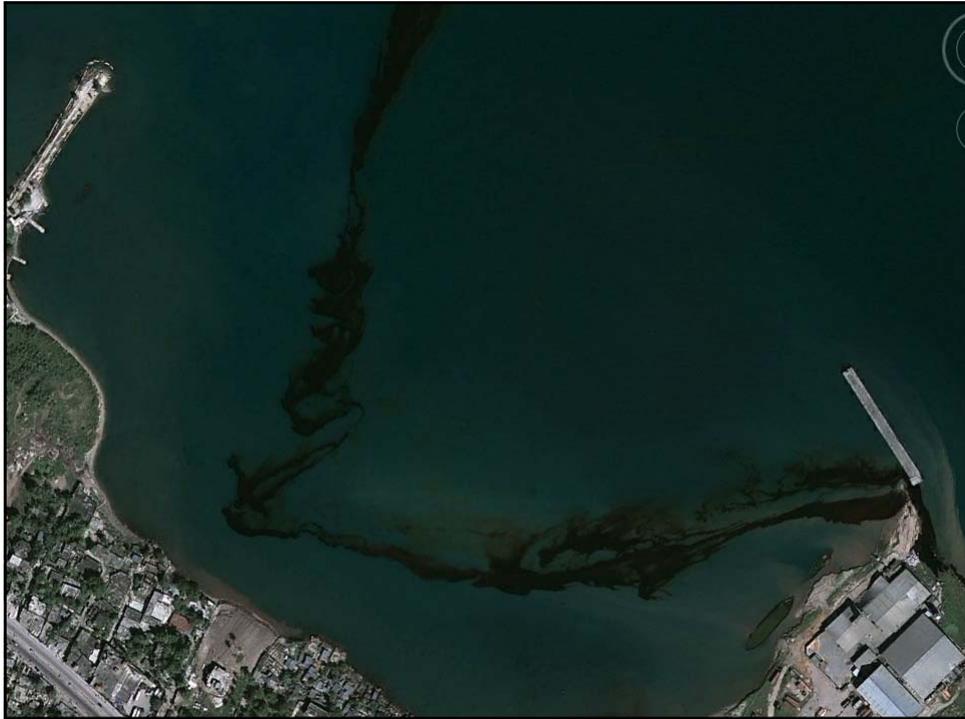
What We Do

- λ **Response:** modeling, shoreline assessment, biological and resource assessment, weather coordination, overflights, data management, communications
- λ **Preparedness:** drill support, guidelines, ESIs, training and outreach
- λ **Development:** tools, models, web access
- λ **Coordination:** Other Federal Agencies, States, academia, IOOS



Number of ERD Spill Responses



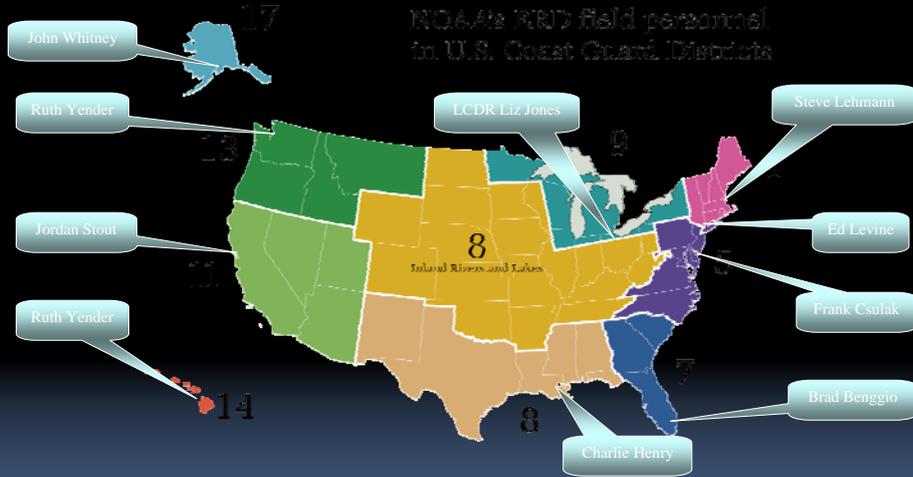


Response Requirements

- Provide 24/7 scientific support during oil and hazardous material releases
- Identify, assess, prioritize, and mitigate injuries caused by hazardous material releases
- Accelerate restoration and recovery by integrating habitat improvement into response actions
- Provide credible, timely and appropriate advice



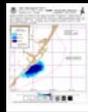
Scientific Support Coordinators



The Scientific Support Coordinators are staff advisors to Federal On-Scene Coordinators (FOSC) responsible for coordinating the scientific aspects of spill response



What happened?



Where does it go?



Who does it hit?



How does it hurt?



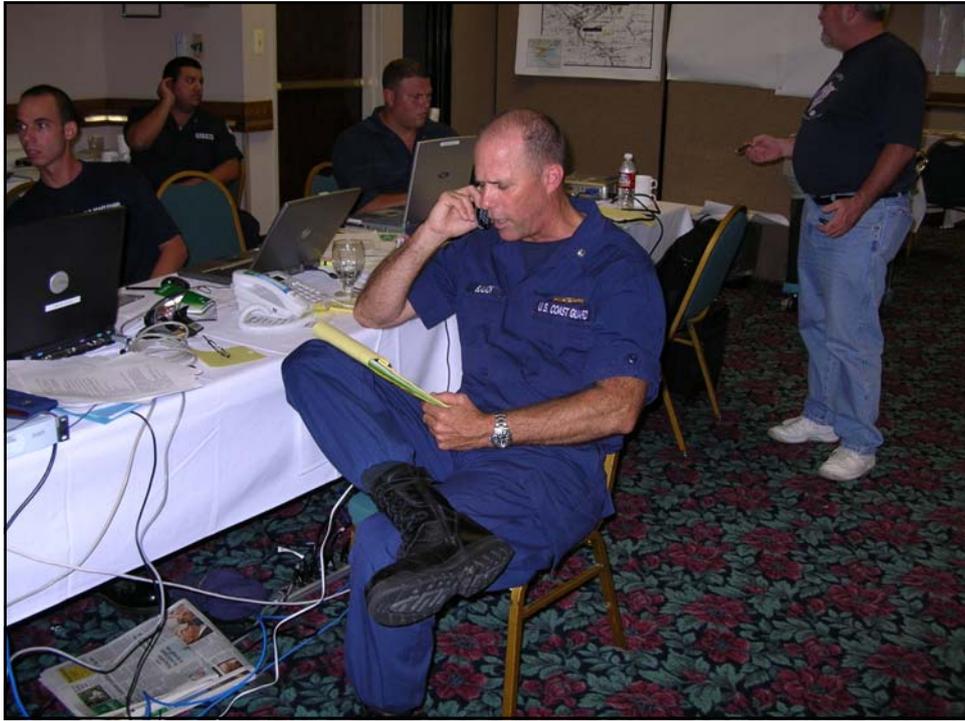
So what?



NOAA Scientific Support Includes:

- Science coordination
- Trust resource representation
- Weather/Trajectory forecasts
- Chemical assessment/analysis
- Resources at Risk assessment
- Field assessments (shoreline and aerial)
- Protection/Cleanup recommendations and priorities
- Information management
- Remediation/Restoration review







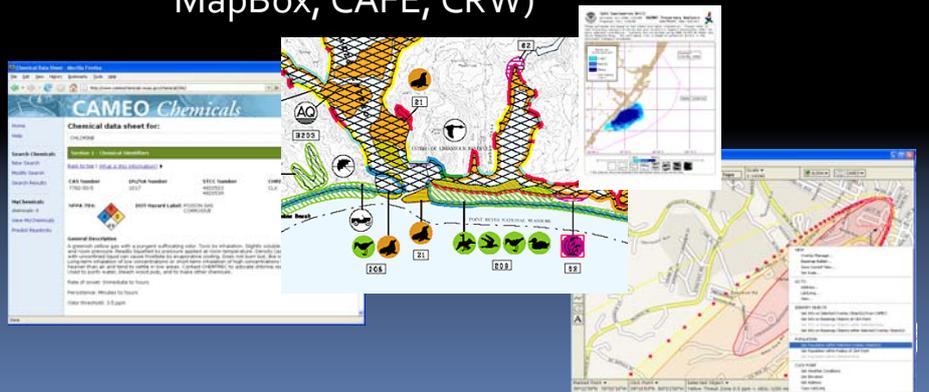
Preparedness

- Drills: 20-40 per year, every other year a major drill (SONS, TOPOFF, etc.)
- Guidelines: Job Aids, Standards (ESI, SCAT)
- ESIs: Atlases for all US Coastline (1:24,000) with biological, socioeconomic and cultural resources mapped against shoreline type and sensitivity to oil
- Training and Outreach : approximately 1,000 people/year, significant variation in length/type of training provided



Development

- Models (GNOME, ADIOS, ALOHA, CATS)
- Tools (Converters, GOODS, SHIO, CAMEO, MapBox, CAFÉ, CRW)



ERD R&D focus

- λ Improve 3D modeling
 - » Subsurface Circulation/Transport Improvements
- λ Waterborne Chemical Fate (CAFÉ)
- λ Playing with others (IOOS, MAST, DMAC, SS drill, Agency MOAs, GOODS)
- λ CAMEO/ALOHA Improvements and Extensions
- λ Understanding/Describing Uncertainty
- λ Approaches to assessing risk (ChemTAP, ERA)
- λ Better field tools/data management (eSCAT, photologger)
- λ Historical information, info dissemination



Annual Planning

- λ It's all about the HOP!! (Hazmat Operating Plan)
 - λ Five Goals (align with last strategic plan, address Goal 0 to align with OR&R): Response, Preparedness, Training, R&D, Improving the Organization
- λ Goal 0: Regaining Leadership as Responders, Building Response Capacity, Reaching Inward, Investing in Growth Areas, Managing for Performance
- λ HOP . . . ProjectTracker Performance Plans

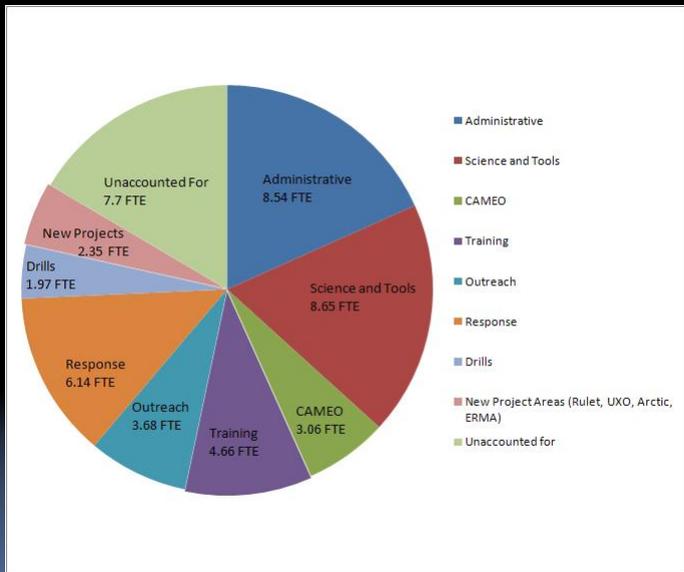


Debbie Payton

Milestones				
Project	Goal	Activity Description	Due	Milestone
Drills	2	Incorporate staff training and product testing into ERD drill support	4	Usability of one new experimental or existing product evaluated
GNOME/3D Modeling	4	Improve present forecasting ability and develop capability to forecast fate and transport for non-floating materials	1	Formulate a GNOME/3D development plan
Internal Training	2	Conduct training to improve and maintain readiness, competency and proficiency of the SST	Ongoing	Offer periodic training series on different software applications and technical issues (e.g. ESI Viewer, Google Earth, 3D-GNOME, dispersants, etc.)
International Coordination	5	Korean government's response capability increased	1,2	Dy Lee's visit/research facilitated to ensure skills transfer
Response Readiness	2	Increase SST and support staff capacity	2	Identify SST roles, responsibilities training and proficiency needs
Science Coordination for ERD	4	Coordinate with FF's on CEREC funded projects and serve on modeling working group	2	Complete report on Response modeling (w/ Wolfgang Kunkel)
Overhead	4	Support MOU's risk assessment of HTCC's	4	Provide general technical assistance on modeling and capacity

Assignments		
Project	Time (%YR)	Assignment
Administrative Overhead	10	Timely submission of attendance in WebTA, Travel Auths. & Vouchers, weekly reports, supervision, ERD All-Hands meetings and other appropriate meetings
External Training, National	5	Serve as instructor as needed. Help coordinate using contractors as instructors when appropriate
Field Tools	< 5	Provide support, coordinate with Ian and Jeff on completing eSCAT and Overflight tools
GNOME/3D Modeling	15	Develop plan, provide direction on model modifications, set priorities, provide input on GNOMEAnalyst, coordinate with UXO and visualization contractor
HAZMAT Operating Plan	5	Lead for Goal 2, coordinate updating of PT database for FY 2010
International Coordination	< 5	Coordinate Korean scientist visit

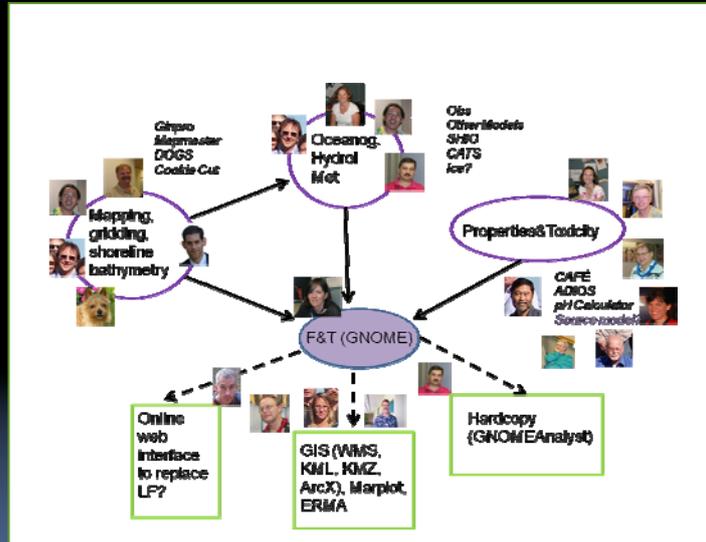




EXTRAS



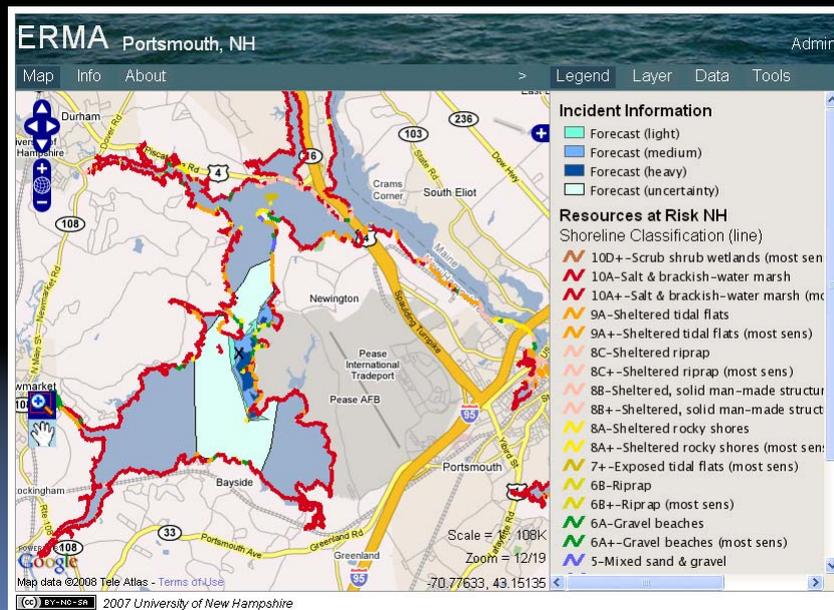
3D Modeling Workgroup



FY09 approximately 3.5 FTE
 FY10 approximately 5 FTE



Critical Datasets for Environmental Response



 **GNOME Online Oceanographic Data Server (GOODS)**
 Use GOODS to access currents or winds from various models and data sources and convert to GNOME compatible NetCDF.

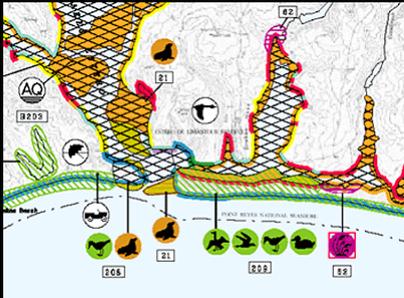
Global Ocean Current Models	Regional Ocean Current Models
<p>Navy Coastal Ocean Model (NCOM) Output from the Global NCOM model served by the National Coastal Data Development Center.</p> <p>Navy Layered Ocean Model (NLOM) Output from the Global NLOM model served by the Asia Pacific Data Research Center. A username and password are required to access Nowcast/forecast files.</p> <p>Hybrid Coordinate Ocean Model (HYCOM) Output from the Global HYCOM model is available through the Center For Ocean-Atmospheric Prediction Studies (COAPS), at FSU.</p>	<p>NCOM California Current System (CCS) Output from the NCOM California Current System model from the Naval Research Lab (NRL).</p> <p>TGLO/TAMU Gulf of Mexico Texas A&M University (TAMU) and Texas General Land Office (TGLO) Gulf of Mexico model.</p> <p>COOPS models Operational NowCast/Forecast models from the Center for Operational Oceanographic Products and Services.</p> <p>CSDL Gulf of Mexico Operational forecast model for the Gulf of Mexico.</p>
<p>Measured currents</p> <p>Coastal HF radar Output from HF radar is served by the National Data Buoy Center. Hourly data is available for the last three days.</p> <p>Geostrophic currents Sea Surface Height derived currents.</p>	<p>MARCOS/HOPS Forecasts (updated weekly) from the Mid-Atlantic Regional Observation System (MARCOS) - Harvard Ocean Prediction System (HOPS) implementation.</p> <p>New York Harbour (NYHOPS) Operational forecast system for the Hudson River, the East River, NY/NJ Estuary, Raritan Bay, Long Island Sound and the coastal waters of New Jersey.</p>
<p>Winds</p> <p>National Weather Service Forecast Winds Wind forecast from the NWS National Digital Forecast Database.</p> <p>National Data Buoy Center Winds Wind data from the National Data Buoy Center.</p>	<p>Hawaii ROMS model Hawaii ROMS model under development at U.H</p>

GOODS toolbar: [Extract Coastline](#) | [Update Local Files](#)

Natural Resources at Risk

- ESIs
- ESI Maps
- RARs
- Endangered Species
- Manager Consultations
 - Planning
 - Spill Response
 - Post-Incident
 - Ecological Risk Assessments

[NOAA Trust Resources](#)

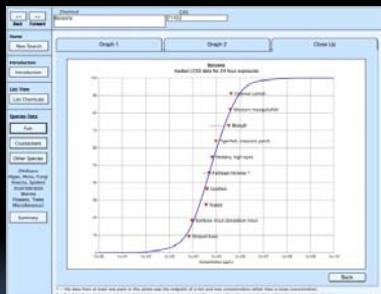



CAMEO: Planning and Response Tool

- λ Search for response recommendations for over 5,000 chemicals.
- λ Predict hazards if chemicals mixed using the Reactivity Worksheet.
- λ Estimate threat zones for chemical releases using ALOHA.
- λ Link information to map objects (such as chemical facilities) in MARPLOT.
- λ Manage Emergency Planning and Community Right-to-Know Act (EPCRA) data using the other modules (such as Chemical Inventory).
- λ Over 10,000 National/International users

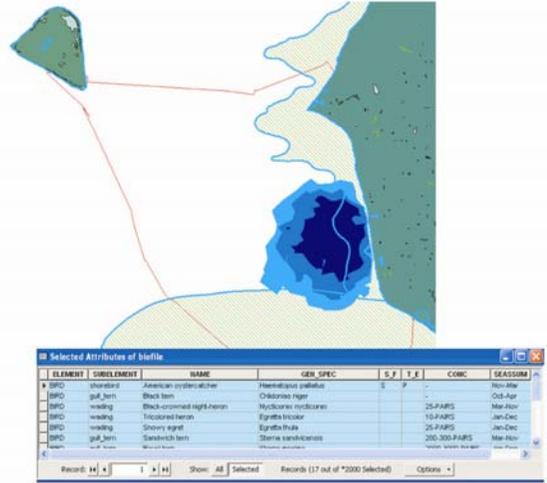
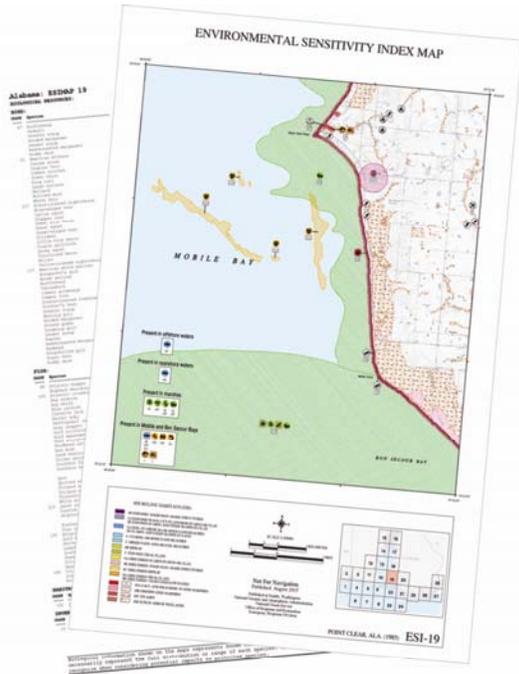


Chemical Aquatic Fate & Effects database (CAFÉ)



- Internal Tool to provide quicker access for assessing risk
- Over 3,000 chemicals
- Based on EPA EcoTox database and Syracuse Physical property database
- Undergoing review, qa/qc, pulse-exposure research

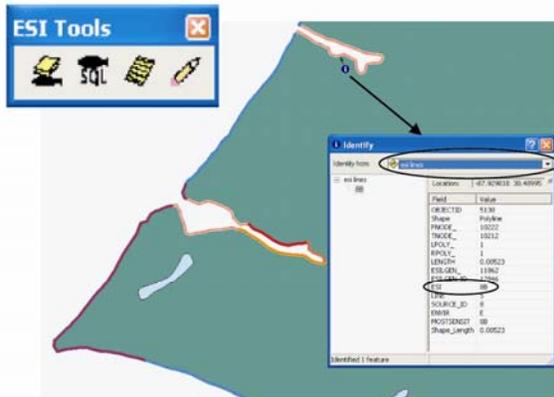
三、美國國家海洋暨大氣總署環境敏感指標地圖製作教學大綱



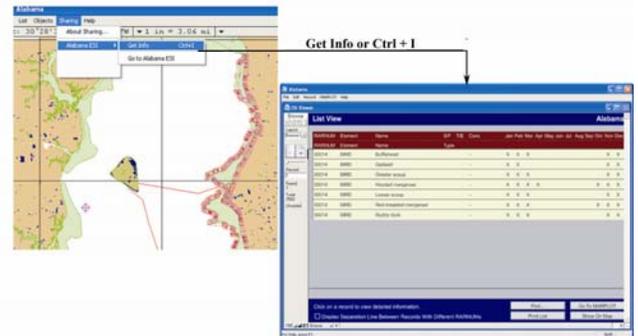
Using ESI maps to identify resources at risk

What is an ESI map?

Introduction to Environmental Sensitivity Index Maps



ESIs in ArcMap



Free ESI Viewer



April 2008

Purpose of this Manual

The goal of this document is to introduce how the Environmental Sensitivity Index, or ESI, maps and data can be utilized. We will look at an oil spill scenario, and the task will be to identify the probable resources at risk. The ESI data are distributed in multiple formats. This manual will look at how to use the hard copy/PDF version of the data, the free ESI-viewer product, and, if you have ESRI's ArcMap (vs. 9.2 or higher) installed, how to use the map document and tools available to simplify ESI viewing and querying. The same scenario will be used for all of these formats, and the same basic questions will be answered. As you go through the scenario queries, you will hopefully think of other questions you might want to answer and other situations where the data on the ESI maps might be useful. The scenario provided takes place in Mobile Bay, but these same queries could be done on any of the ESI maps provided in these formats.

Supporting Materials

A portable document format (PDF) version of this document and all of the supporting data referenced in this tutorial can be downloaded from http://response.restoration.noaa.gov/ESI_Training. If you have an original hardcopy of this manual, these documents may also be found on the "ESI_Training" CD inserted on the back cover. Included are the following directories:

- ESI_VIEW: Installers for both Macintosh and Windows platforms of the Alabama ESI data and free software for viewing and querying
- GEODATABASE: Alabama ESI in ESRI's geodatabase format and an ArcMap document with database links and symbolization pre-set
- PDFS: The entire Alabama ESI atlas in Portable Document Format
- GNOME: GNOME.dll, a tool to import trajectories generated by GNOME Analyst, and a directory called "scenario" which has the GNOME export files for the Mobile Bay scenario
- ESI_Tutorial.pdf: This document in PDF format
- ESI_Tools: Four .dll files for use with the ESI data from within ArcMap and supporting documentation

It is recommended that the entire contents of the training CD be copied on to your hard drive and placed in a directory call ESI_Training. That way the pathnames will match those that appear in this tutorial. If you choose to create your own directory, do not include spaces in the name. ArcMap will not work with pathnames that have embedded spaces.

Using this Manual with Other ESI Atlases

The methods outlined in this manual can be applied to any of the ESI atlases. The only differences will be the area covered by the trajectory and the resources impacted. Because a GNOME trajectory may not be available for your area, Appendix B gives instructions on how to draw your own trajectory footprint for use in ArcMap.

If you are using an ESI CD/DVD other than the ESI Training CD, you will access the directory ***PDFS*** for section 1. For the ArcMap section, copy to your hard drive the entire directory named for your atlas (i.e. Alabama) from inside the directory ***GEODATABASE***. (DVDs that contain multiple atlases will have the name of the atlas twice in this pathname, i.e. Alabama/GEODATABASE/Alabama.) Make sure there are no spaces in any of the directories that comprise the pathname to the geodatabase. ArcMap cannot handle embedded spaces.

The installers for the ESI Viewer section will be found in the directory ***ESI_VIEW***. If you are working from a CD or DVD that does not have a ***GEODATABASE*** directory, this is an atlas that was published before that technology was supported. It also means that the ESI Viewer software is pre OS-X on the Macintosh platform and pre Vista on the Windows platform. Visit the ESI page at <http://response.restoration.noaa.gov/esi> and follow the links to ESI status. There you can download the PDF *Status of OR&R's ESI Products*, which lists all of the available formats. On that same page, follow the link *Get ESI Maps and GIS Data* to find ordering information or download instructions from the NOS Data Explorer site.

Introduction to ESI Maps

In the event of an oil spill, responders must quickly decide which locations along the shoreline to protect. To do this effectively, they first need to assess which areas would suffer the greatest consequence if impacted by the spill. Since there will be limited response equipment available, they will want to focus their efforts on the more sensitive shoreline areas and the areas where sensitive biological and human resources are found.

Environmental Sensitivity Index (ESI) maps can be a valuable tool in this process. The ESI maps systematically compile information of three types:

- Shoreline type
- Biological resources
- Human-use resources

The shoreline is ranked on a scale from 1 to 10 based on sensitivity to oiling determined by:

- Relative exposure to wave and tidal energy
- Biological productivity and sensitivity
- Substrate type (grain size, mobility, penetration and trafficability)
- Shoreline slope
- Ease of cleanup
- Ease of restoration

Optimally, the priority would be to protect the shorelines ranked with the higher values, as these are the more sensitive areas and the areas where oil would be more apt to persist and cleanup, if even possible, would be the most difficult.

The biological resources mapped include birds, fish, invertebrates, marine mammals, terrestrial mammals, and habitats (eelgrass, kelp, etc). In ESI terms, these are called “elements”. When deciding what to map, emphasis is placed on:

- Rare, threatened, endangered, and special concern species
- Commercial and recreational species
- Species of significance to the local community
- Areas of high concentration
- Areas where sensitive life-history stages or activities occur

When evaluating protection strategies, it is important to consider which species are most likely to be adversely affected by oiling *at the time the spill occurs*. Seasonality plays a significant role in where members of a particular species will congregate, and what life stages will be found. The ESI maps not only show the probable location and extent of various species, they also have supporting data tables that indicate the monthly presence and breeding activities. Other information includes concentration, threatened/endangered status, and, in the case of the digital data, source level metadata that can assist in identifying the local experts for “real time” information.

Human use resources mapped are those that might be sensitive to oil, useful during response operations, or may be vulnerable during response activities. These may include:

- High-use recreational and shoreline access areas
- Officially designated natural resource management areas
- Resource extraction sites
- Cultural resources

These resources should be considered from a variety of perspectives. Some of these resources may be sensitive to oiling; others may be even more vulnerable to damage from cleanup equipment or responder traffic. Still other resources mapped may be useful in determining possible access or staging locations.

All together, the resources mapped on the ESI provide a very good starting point for planners and responders in the event of a spill. However it is important to remember the data reflect the conditions that existed at the time the maps were made. All of these resources have the potential to change. Local management agencies and experts should be contacted as soon as possible to verify the actual conditions at the time of the spill.

For information specific to the ESI you are working with, or to get a broader discussion of the ESI product, read the INTRO.pdf located in ESI_Training\PDFS\ESI_DATA or in the PDFS\ESI_DATA directory of your atlas CD.

Spill Scenario

On April 18, 2008, a storm hits the Mobile Bay area (Alabama, USA). The winds are primarily from the west. At 08:00, a vessel crossing the main ship channel and heading north to the Mobile port, suffers a leak and an oil spill occurs. 1000 barrels of medium crude oil is spilled. The release point is 30° 28.33' N, 88° 01.07' W during a flow tide. Within the first hour after the spill, the oil reaches the Gaillard Island shoreline. Ten hours later, about 8 miles of the east coast of the bay (from Great Pt Clear to Fish River Pt) are also affected. When the storm ends, the winds are from the southeast, the predominant weather pattern for the region. The oil that remains in the water is carried to the northwest area of the bay. It again impacts the Gaillard Island shoreline as well as the west coast of Mobile Bay.

In order to understand how ESIs can be used to assess the resources at risk, this exercise will focus on the area projected to be impacted ten hours after the release. On the next page you will see output from the GNOME model, another product of NOAA's Emergency Response Division (ERD). GNOME uses wind and current data to predict where spilled oil will travel. Here the trajectory has been imported into ArcMap and symbolized. As a general rule, it is best to consider the entire area within the uncertainty bounds (the red footprint) when establishing priorities. Overlaid on the map, is the Alabama *Index* layer. This will help identify the maps we need to use.

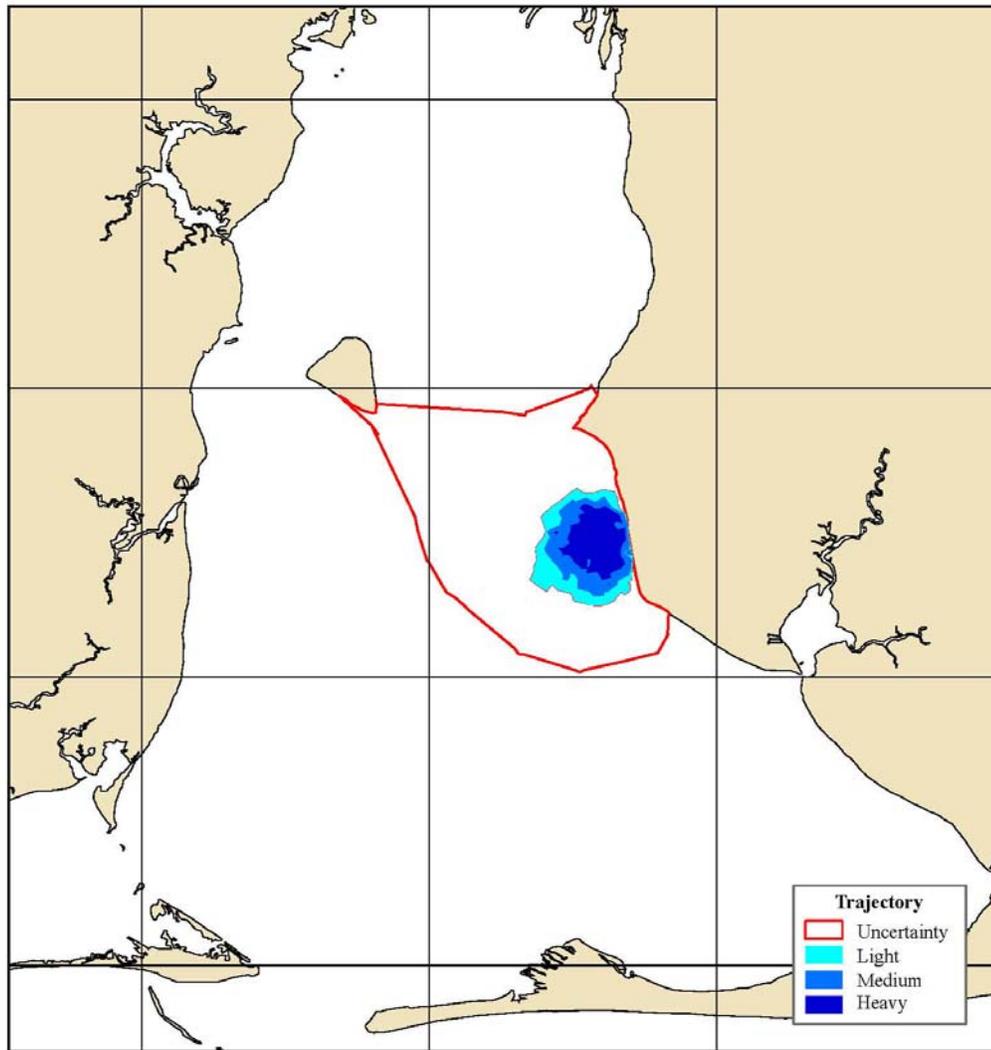
April Spill Scenario

NOAA/HAZMAT (206) 526-6317



Estimate for: 1800, 4/18/08
Date Prepared: 1128, 10/22/08

These estimates are based on the latest available information. Please refer to the trajectory analysis briefing and your Scientific Support Coordinator (SSC) for more complete information. This output shows estimated distributions of heavy, light, and medium concentrations as well as an outer confidence line. The confidence line is based on potential errors in the pollutant transport process.

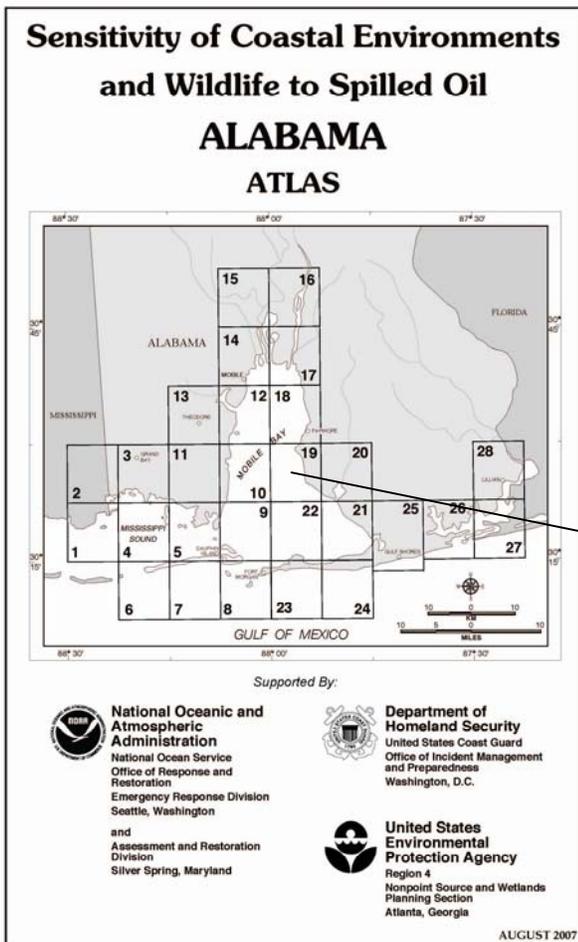


this scale bar shows the meaning of the distribution terms at the current time

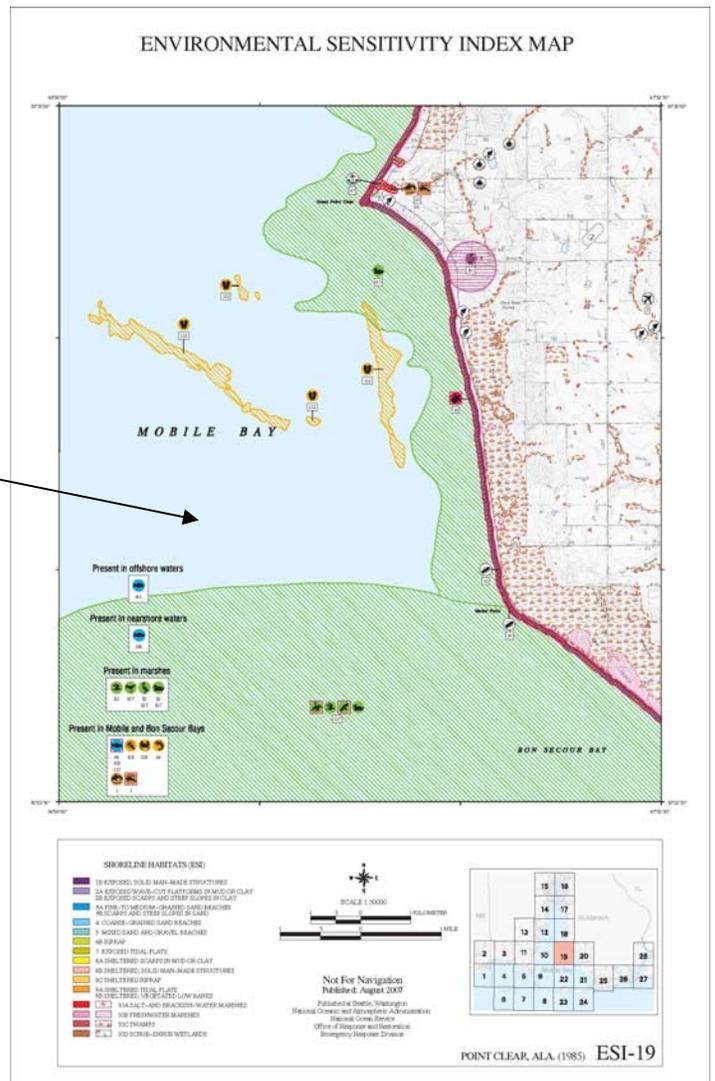
Section 1: Using the hard copy and PDF versions of the maps

For this section, you will need the PDF directory provided either on the ESI Training CD, or available at http://response.restoration.noaa.gov/ESI_Training. You may also use the PDFs provided on the Gulf ESI DVD, in the Alabama directory. Open the Alabama index (PDFS\ESI_DATA\INDEX.PDF) by double-clicking the file icon. In addition to being the title page, this PDF shows the extent of the Alabama mapping project, and the area covered by each of the maps. You will see that the ESI maps impacted by our scenario are numbers 10 and 19.

As you move your cursor over the map index, it will become a pointing finger. With this cursor active, click inside the outline of



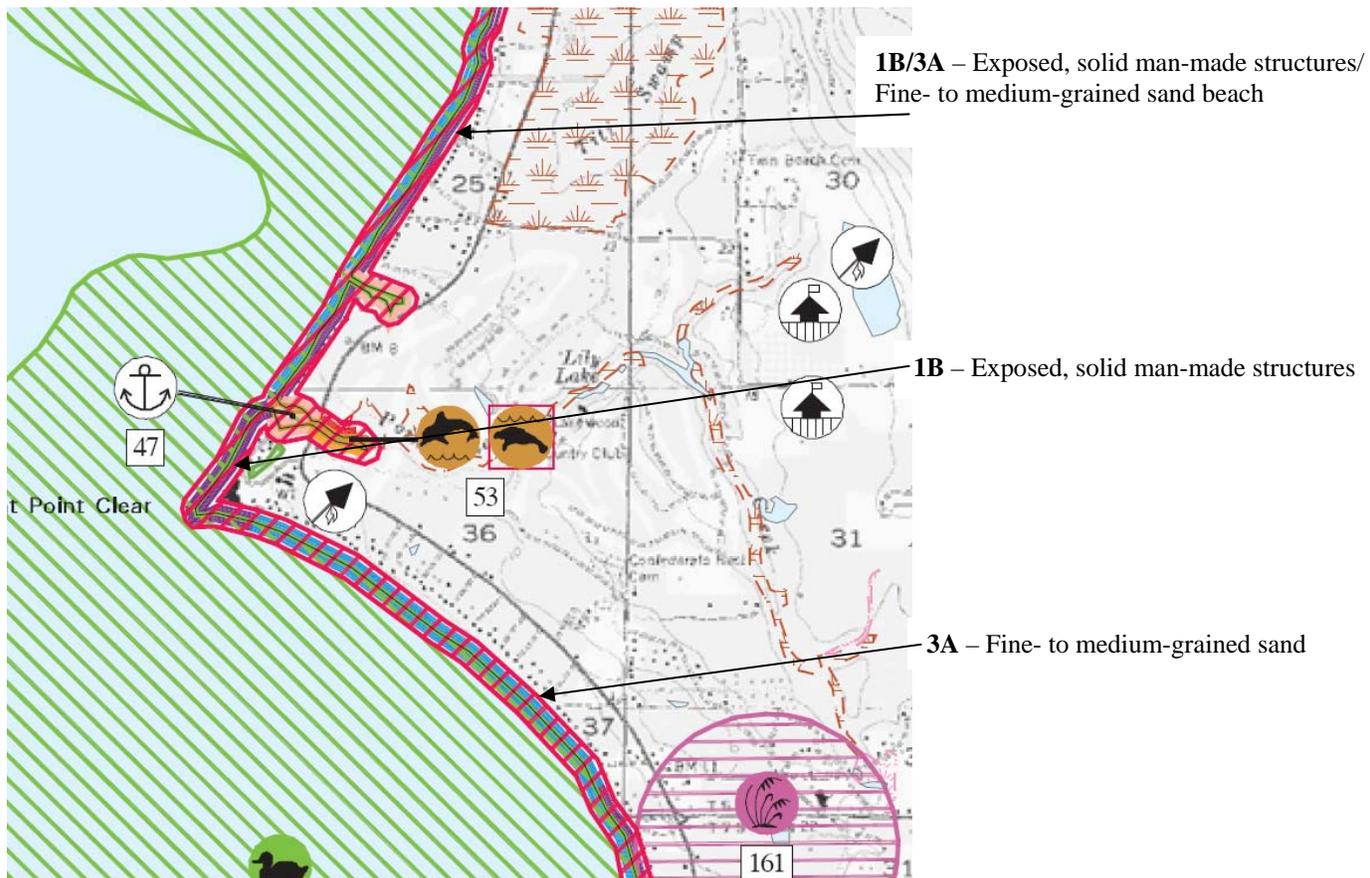
map 19. This will navigate you away from the map index and to map 19, as shown here.



According to the trajectory, there is a possibility of oiling throughout this area. Look first at the shoreline types involved.

On this map, the color coded shoreline is a bit difficult to see, because of the red reptile polygon that is spanning the coastline. Zooming in makes it a bit easier to discern the affected shoreline types.

Below, a portion of the ESI-19 shoreline is shown. There are shoreline segments color-coded with blue, purple, and blue and purple. (A shoreline segment may actually have up to three different types associated with it.) Looking at the legend at the bottom of the map, you will see these colors represent shoreline types 1B – Exposed, solid man-made structures (purple) and 3A – Fine to medium-grained sand beaches (blue), or a combination of these two types. Because the color-coding for types 3A and 3B are the same, on the map you can not be sure which of those two types are represented. With the digital data you will find you can easily make that distinction.



Additional information about the types of shorelines, predicted oil behavior and response considerations can be found in the atlas introductory pages. These are always included in the PDFS directory on the atlas CD/DVD. A representative photo of each shoreline type is also included. Here is a sample for shoreline type 3A from the Alabama atlas:

FINE- TO MEDIUM-GRAINED SAND BEACHES	ESI = 3A
<p>DESCRIPTION</p> <ul style="list-style-type: none"> • These beaches are flat to moderately sloping and relatively hard packed • They are composed of predominantly quartz sand • There can be heavy accumulations of wrack present • They are utilized by birds and turtles • Upper beach fauna include ghost crabs and amphipods; lower beach fauna can be moderate, but highly variable • They are generally areas of heavy recreational use • Common along the barrier islands 	
	
<p>PREDICTED OIL BEHAVIOR</p> <ul style="list-style-type: none"> • Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone • Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide • Maximum penetration of oil into fine- to medium-grained sand is about 10-15 cm • Burial of oiled layers by clean sand within the first week after a spill typically will be less than 30 cm along the upper beach face • Organisms living in the beach sediment may be killed by smothering or lethal oil concentrations in the interstitial water • Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas 	
<p>RESPONSE CONSIDERATIONS</p> <ul style="list-style-type: none"> • These beaches are among the easiest shoreline types to clean • Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore • Traffic through both oiled and dune areas should be severely limited, to prevent contamination of clean areas • Manual cleanup, rather than road graders and front-end loaders, is advised to minimize the volume of sand removed from the shore and requiring disposal • All efforts should focus on preventing the mixing of oil deeper into the sediments by vehicular and foot traffic • Mechanical reworking of lightly oiled sediments from the high-tide line to the upper intertidal zone can be effective along outer beaches 	

Now consider the biological resources. Some of these are mapped using color coded hatch patterns, to illustrate the extent of a mapped species, or group of species. On this map there are bird polygons – green, reptile polygons – red, habitat polygons – purple and invertebrate polygons – orange. In some cases, where a polygon represents multiple elements, it may be shown with a black hatch pattern to simplify the presentation.

Associated with each polygon will be one or more icons and a number. The icons can be helpful for a quick visual assessment. They show which “subelements” are found in that area. This is a grouping of species with similar life habits, such as habitat preference or feeding styles; an example is raptors. The number is called the Resource at Risk number, or RAR#. It references a listing on the back of the map (scroll down to page 2 of the map PDF) of all the associated species, their seasonality and other useful information, such as concentration, when available, and their threatened/ endangered status.

RAR#	Species	S F Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting	Migrating	Molting	
47	Bufflehead		X	X	X								X	X	-	-	-	
	Gadwall		X	X									X	X	-	-	-	
	Greater scaup		X	X	X								X	X	-	-	-	
	Hooded merganser		X	X	X	X						X	X	X	-	-	-	
	Lesser scaup		X	X	X								X	X	-	-	-	
	Red-breasted merganser		X	X	X								X	X	X	-	-	-
	Ruddy duck		X	X	X								X	X	-	-	-	

In the lower left side of the map, you will also see a number of icons and RAR#s



presented in a box with a textual description as to where the species are found. These boxes, nicknamed the “common throughout” boxes, are created to minimize clutter on the map. With the digital data, polygons of these areas are retained, so the user can query the data for location and extent. There are examples of this in the following sections.

In the case of the scenario presented, the entire area on map 19 is impacted by the spilled oil, so we can start out considering all of the species on the back of the map as potentially “at risk”. Now is when the seasonality information can help to narrow down what species are particularly vulnerable. Below is the seasonality summary for just the birds on map 19.

BIRD:	RAR#	Species	S F Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting	Migrating	Molting	
	47	Bufflehead		X	X	X								X	X	-	-	-	
		Gadwall		X	X									X	X	-	-	-	
		Greater scaup		X	X	X								X	X	-	-	-	
		Hooded merganser		X	X	X	X						X	X	X	-	-	-	
		Lesser scaup		X	X	X								X	X	-	-	-	
		Red-breasted merganser		X	X	X								X	X	X	-	-	-
		Ruddy duck		X	X	X								X	X	-	-	-	
	52	American bittern		X	X	X								X	-	-	-		
		Canada goose		X	X	X	X	X	X	X	X	X	X	X	X	MAR-JUN	-	-	
		Caspian tern		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Common moorhen		X	X	X	X	X	X	X	X	X	X	X	MAY-JUL	-	-		
		Green heron		X	X	X	X	X	X	X	X	X	X	X	MAY-JUL	-	-		
		King rail		X	X	X	X	X	X	X	X	X	X	X	APR-AUG	-	-		
		Least bittern		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Mallard		X	X	X	X	X	X	X	X	X	X	X	APR-JUL	-	-		
		Mottled duck		X	X	X	X	X	X	X	X	X	X	X	APR-JUL	-	-		
		White ibis		X	X	X	X	X	X	X	X	X	X	X	APR-JUN	-	-		
	107	Black-crowned night-heron		X	X	X	X	X	X	X	X	X	X	X	APR-JUN	-	-		
		Blue-winged teal		X	X									X	-	-	-		
		Cattle egret		X	X	X	X	X	X	X	X	X	X	X	MAY-JUN	-	-		
		Clapper rail		X	X	X	X	X	X	X	X	X	X	X	MAY-AUG	-	-		
		Great blue heron		X	X	X	X	X	X	X	X	X	X	X	FEB-JUL	-	-		
		Great egret		X	X	X	X	X	X	X	X	X	X	X	MAR-JUN	-	-		
		Green-winged teal		X	X	X								X	X	-	-	-	
		Killdeer		X	X	X	X	X	X	X	X	X	X	X	APR-AUG	-	-		
		Little blue heron		X	X	X	X	X	X	X	X	X	X	X	MAR-JUL	-	-		
		Purple gallinule		X	X	X	X	X	X	X	X	X	X	X	MAY-JUL	-	-		
		Snowy egret		X	X	X	X	X	X	X	X	X	X	X	APR-JUN	-	-		
		Tricolored heron		X	X	X	X	X	X	X	X	X	X	X	MAY-JUN	-	-		
		Willet		X	X	X	X	X	X	X	X	X	X	X	MAY-AUG	-	-		
		Yellow-crowned night-heron		X	X	X	X	X	X	X	X	X	X	X	APR-JUL	-	-		
	127	American white pelican	P	X	X	X	X							X	X	-	-	-	
		Bonaparte's gull		X	X	X	X							X	X	-	-	-	
		Brown pelican		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Bufflehead		X	X	X								X	X	-	-	-	
		Canvasback		X	X	X								X	X	-	-	-	
		Common goldeneye		X	X	X								X	X	-	-	-	
		Common loon		X	X	X	X							X	X	X	-	-	-
		Double-crested cormorant		X	X	X								X	X	X	-	-	-
		Forster's tern		X	X	X								X	X	-	-	-	
		Greater scaup		X	X	X								X	X	-	-	-	
		Herring gull		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Hooded merganser		X	X	X								X	X	-	-	-	
		Horned grebe		X	X	X	X							X	X	X	-	-	-
		Laughing gull		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Lesser scaup		X	X	X								X	X	-	-	-	
		Osprey	P	X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Red-breasted merganser		X	X	X								X	X	-	-	-	
		Redhead		X	X	X								X	X	-	-	-	
		Ring-billed gull		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Royal tern		X	X	X	X	X	X	X	X	X	X	X	-	-	-		
		Ruddy duck		X	X	X								X	X	-	-	-	

The records with species that are present in April are all highlighted. Any species that is nesting in a particular area on this map during April, potentially increasing their vulnerability, is highlighted in red. The two species highlighted in blue may be of special concern because they are listed by the state as “protected”. Of course it is important to remember this is just a starting point in developing protection priorities. If a spill happens at either the beginning or end of a month, or if the weather conditions are particularly harsh or mild for a season, it may be a good idea to window your observations to include either the month prior or following that of the event. Of course, because ESI mapping is really a snapshot in time, it is imperative to check with the regional experts to verify if these conditions are in fact valid at the time of the spill. This is another case where the intro pages are useful. The sources of the resources mapped, will always be listed there. In the Alabama atlas, there are actually local expert names and numbers to help responders access timely, updated information. Other general information about the species mapped is also included. An excerpt is shown below.

BIRDS

Bird concentration areas depicted in this atlas include:

Waterbird and shorebird nesting and wintering sites – Locations where waterbirds (e.g., herons, egrets, skimmers, pelicans, terns, shorebirds, etc.) have been documented as nesting are mapped. Colony size (number of birds present) is included in tables on the reverse side of the maps and was provided by State biologists. Piping plovers (federally threatened) winter along the Gulf and Mississippi Sound. Designated critical habitat occurs in this area.

Waterfowl, diving bird, and pelagic bird migratory staging and wintering – Concentration areas are shown for migratory and wintering waterfowl, diving birds, pelagic birds, and gulls/terns in Mississippi Sound, Mobile Bay, Perdido Bay, Gulf of Mexico, and associated smaller bays, rivers, and marshes. Alabama DWFF and DCNR provided distribution information based on many years of surveys and field expertise. Waterfowl nesting areas are mapped, most commonly for Canada goose, mottled duck, mallard, snow goose, and occasionally for other species in wetlands when information was available.

Migratory shorebird stopover areas – Sites where large concentrations of shorebirds occur annually, particularly during the spring and autumn months, are mapped along the Gulf Coast, the Delta, and other areas as appropriate.

Marsh birds, raptors, and passerine species – General locations of marsh birds (e.g., rails), raptors (e.g., eagles, osprey; nesting habitat/sites are depicted), and passerine species of concern (e.g., some sparrow species), particularly threatened and endangered species, were mapped.

Expert contacts for Alabama birds are:

Name	Agency	City	Phone	Species
Patric Harper	USFWS	Daphne, AL	251/ 441-5857	Federally listed birds
Dianne Ingram	USFWS	Daphne, AL	251/ 441-5839	Federally listed birds
Roger Clay	ADWFF	Daphne, AL	251/ 626-5474	Coastal birds
Carl Ferraro	ADCNR	Spanish Fort, AL	251/ 621-1216	Coastal resources
Chuck Sharp	ADWFF	Daphne, AL	251/ 626-5474	Waterfowl
James Masek	ADWFF	Daphne, AL	251/ 626-5474	Waterfowl
Mark VanHoose	ADCNR MRD	Dauphin Island, AL	251/ 861-2882	Coastal birds

Major Data Sources Used: Birds

Alabama Natural Heritage Program. 2006. Alabama Natural Heritage Program Element Occurrence Data for Rare and Endangered Species in Alabama, vector digital data.

Imhof, T.A. 1976. Alabama Birds. Second Edition. The University of Alabama Press, 445 pp.

Mirarchi, R.E., Bailey, M.A., Haggerty, T.M., and Best, T.L. 2004. Alabama Wildlife, Volume Three: Imperiled Amphibians, Reptiles, Birds, and Mammals. The University of Alabama Press, Tuscaloosa, AL, 225 pp.

USFWS. 2001. Piping plover critical habitat – wintering grounds, vector digital data

A number of human use resources are also found on ESI map 19. Some unnamed historic and archaeological sites are shown, as well as some marinas and boat ramps that reference supporting information via a human use number, or HUN# (the equivalent of the RAR# used with the biological resources). An example symbol and its related reference on the back of the map appear below. When a contact name and/or number are available or appropriate, they are also provided.



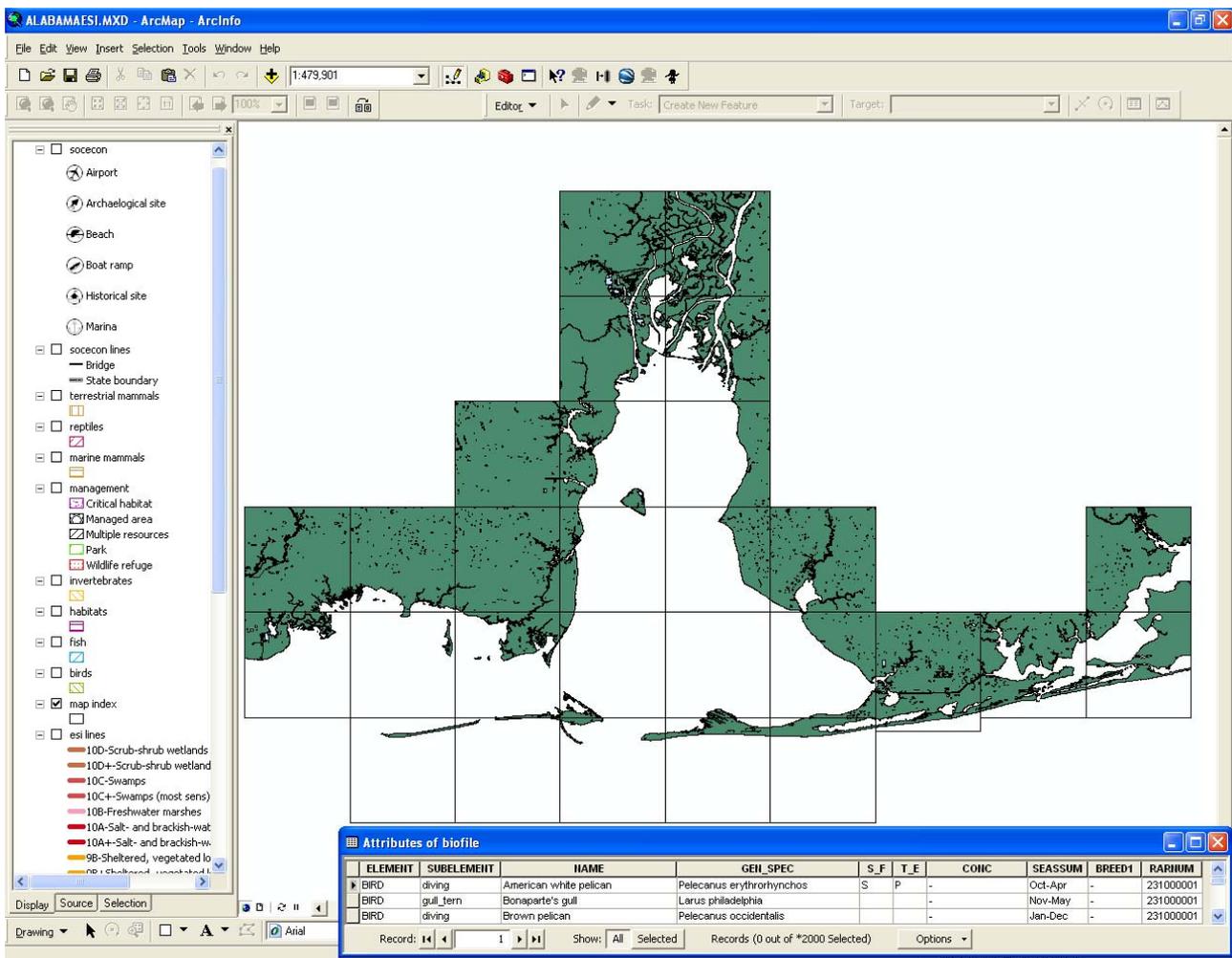
We have now examined all of the resources mapped on ESI 19. To complete the inventory of resources at risk by the given spill scenario, the same process would be repeated on the impacted areas on ESI 10.

Using the PDF and/or hardcopy ESI maps has both advantages and disadvantages. It is relatively simple to do and does not require knowledge of any specialized software products. However, it is not easy to extract the information to create a resource summary, nor to visualize the integration of data from other sources. In the following sections, you will see how Geographic Information System (GIS) software can make many of these tasks much easier.

Section 2: Using ESRI's ArcMap with the ESI map document and tools

For this section, you will need ESRI's ArcMap installed on your computer (vs. 9.2 or later). If you don't have access to this software, you may want to read through the first few pages (up to Task 1), then skip to the section titled *ESI Viewer*. There you will be guided on how to install and use the free ESI Viewer software that allows you to perform many of the same types of queries that are outlined here.

The first step is to get the ESRI geodatabase and map document on your local computer. From the training CD, copy the directory ESI_Training/GEODATABASE/Alabama in its entirety onto your hard drive. (You may also download this directory from http://response.restoration.noaa.gov/ESI_Training). Launch the Alabama ESI map project by double-clicking the alabamaESI.mxd icon, or by opening it from within ArcMap. The startup screen will look something like this:

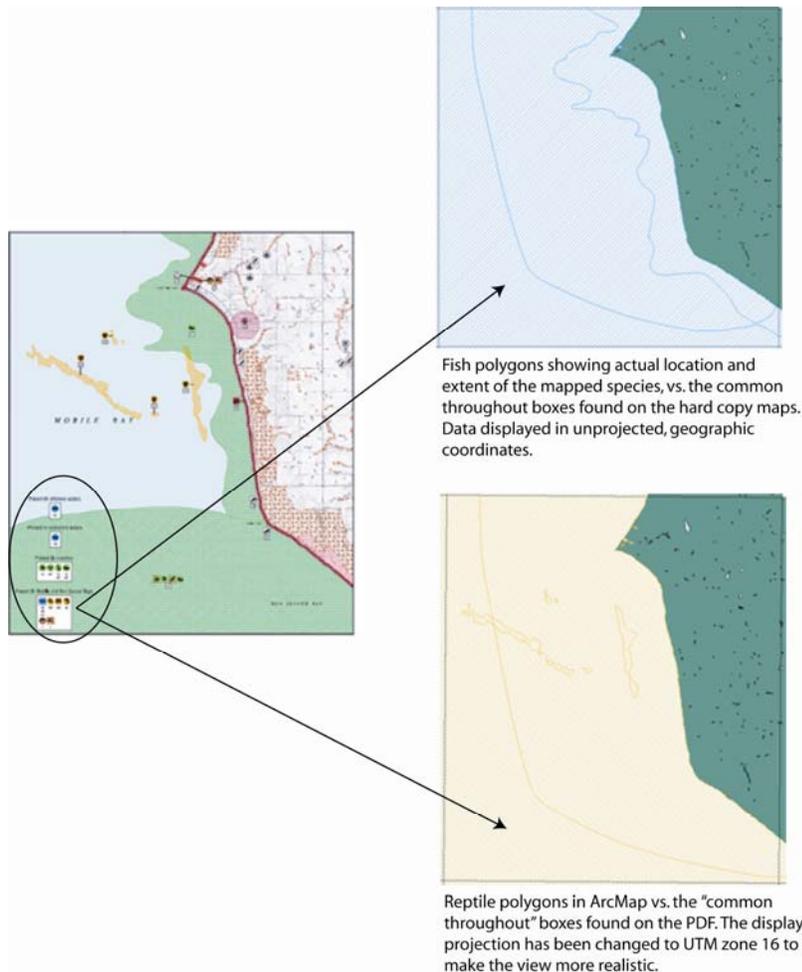


The screenshot shows the ArcMap interface with the Alabama ESI map project open. The map displays a green-shaded area representing the ESI region. The left pane shows a legend with various categories like 'socecon', 'management', and 'habitats'. The bottom pane shows the 'Attributes of biofile' table with columns for ELEMENT, SUBELEMENT, NAME, GEN_SPEC, S_F, T_E, CONC, SEASSUM, BREED1, and RARIUM.

ELEMENT	SUBELEMENT	NAME	GEN_SPEC	S_F	T_E	CONC	SEASSUM	BREED1	RARIUM
BIRD	diving	American white pelican	Pelecanus erythrorhynchos	S	P	-	Oct-Apr	-	231000001
BIRD	gull_tern	Bonaparte's gull	Larus philadelphia	-	-	-	Nov-May	-	231000001
BIRD	diving	Brown pelican	Pelecanus occidentalis	-	-	-	Jan-Dec	-	231000001

Initially, only the hydro and index layers are turned on. You may turn other layers on and off by selecting the checkbox next to the layer name in the legend window on the left. Try turning on some of the biology layers. You will notice that the GIS “maps” look very different from the cartographic product found on the hard copy ESI maps and the PDF version. In particular, look at the ArcMap window with the fish layer turned on. Now turn that off, and turn the reptile layer on. Remember the “common throughout” boxes discussed in the last section? Here you are seeing the underlying data, rather than the cartographic presentation intended to make the maps more readable and visually pleasing. In order to get answers to spatial queries, the polygons are needed to show both the location and extent of the mapped species.

Below is an example comparing the ESI-19 PDF with its appearance in ArcMap. Aside from the polygons that now totally cover the water, you might notice that the aspect ratio of the map with the fish polygons is quite different than that of the PDF. This is because the GIS data is distributed in un-projected, geographic coordinates. This format was chosen because with ESI coverage virtually nation-wide, the ideal projection, or at the very least, the parameters of a given projection, will vary from one atlas to another. Geographic coordinates allow consistency across the country, and make it easy to integrate multiple atlases. The downside of this is that as you move away from the equator, the map display becomes distorted. Whereas one degree of longitude = one degree of latitude at the equator, as you move towards the poles a degree of longitude becomes increasingly shorter than the degree of latitude. In the un-projected view, this reality is not taken into account.



As you will see in Task 1, it is easy enough to change the display projection so that the appearance of the data is a bit more realistic.

Task 1: Change the display projection:



a) Right click on the data frame name, Layers.

b) Select **Properties...**

c) On the *Coordinate System* tab, open the folder
Predefined/Projected Coordinate Systems/UTM/NAD 1927

d) For Alabama, select **NAD 1927 UTM Zone 16N**

e) Click **OK**

If you are working with an atlas other than Alabama, there is a chart at the end of this document that will help you determine what UTM zone is appropriate. The zone will vary depending on the longitude of your map. (There may also be times when a UTM, NAD 1983 projection should be used, rather than NAD27. Check the metadata to verify the datum of the source data.)

GNOME

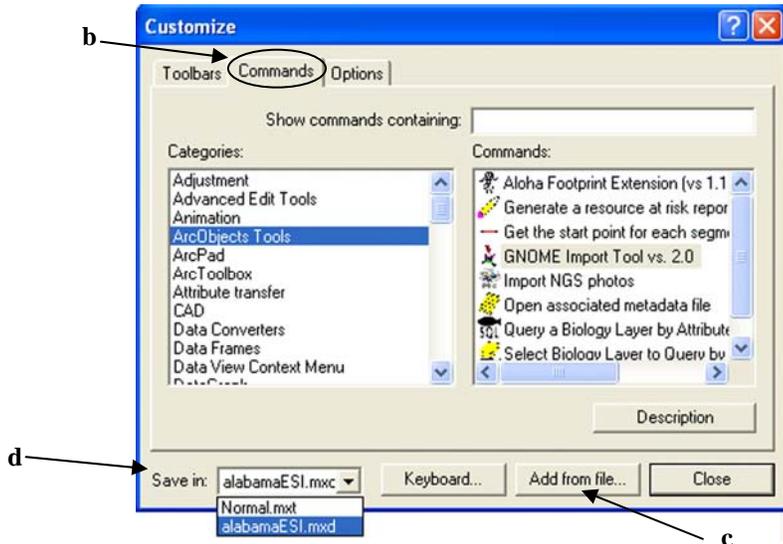
GNOME is an oil spill trajectory model developed and used by NOAA's Office of Response and Restoration both for spill planning and response. Drawing on input describing the location of the spilled oil, the weather conditions, and tidal and current information, GNOME will predict where the spilled oil will travel. The oil is represented by hundreds of discrete points, called SPLOTS, which travel independently. In some cases, a second program called GNOME Analyst is used to generate polygon contours from the GNOME output. These contours can be exported from GNOME Analyst as a group of MOSS files, a simple text format for geographic data.

An ArcMap tool has been developed to import the GNOME Analyst trajectory contours. In the next steps, we will add the GNOME Import tool and bring in the trajectory for the tenth hour of the spill scenario. For this exercise, you will need to load on to your computer the GNOME directory found on the tutorial CD or at the http://response.restoration.noaa.gov/ESI_Training.

If you are not working with the Alabama training materials, you can still use this tutorial to learn about the ESIs in ArcMap. Skip tasks 2 and 3 below. Instead, go to the back of this tutorial and in Appendix B, you will see how you can draw in your own trajectory footprint. In the later tasks, you will use the trajectory you created the same as the trajectory imported below.

Task 2: Add the GNOME Import tool:

- Right-click on the ArcMap toolbar and scroll down to **Customize...** (or choose the **Customize...** option under the Tools menu).
- Select the **Commands** tab on the Customize window.



- Click the **Add from file...** button. Navigate to the `gnome.dll` file on your hard drive. Select the file and click **Open** to add the GNOME Import Tool to your available tools. Click **OK**.
- In the bottom, left-hand corner of the Customize dialog box, choose to save the tool with the `alabamaESI.mxd`
- In the scrollable list on the left side of the Customize... window, highlight **ArcObject Tools**. To the right, you should see the **GNOME Import Tool vs. 2.0**.

- Click on the GNOME icon and drag it onto your standard tool bar. Release the mouse button when your cursor becomes a vertical bar. (You need to release the mouse button at or before the last icon on your toolbar.)
- Exit the Customize... window by clicking **Close**. The GNOME Trajectory Import Tool is now ready to use.

Task 3: Import the GNOME trajectory:

- Click on the GNOME tool icon. 
- Highlight **Import GNOME Trajectory Analysis**, and hit **OK**.
- Navigate to the GNOME trajectory files for the Alabama scenario. The files will be in `ESI_Training/GNOME/Scenario`. Highlight `scenario.ms1` and hit **Open**.
- Specify where you would like the trajectory geodatabase to reside, and what you would like it called. The default will put it in the same directory as the input files, with the root being the same as that of the input. In this case it is called `scenarioContours.mdb`. Click **Save**.
- A dialog box will come up that describes shoreline clipping options. Click **OK**.
- We are going to clip the trajectory to the ESI shoreline. In the *Select Shoreline* dialog box, highlight option 1, **User Shoreline**. Click **OK**.
- A dialog box with all the polygon layers listed will appear. Highlight **hydro** and click **OK**.

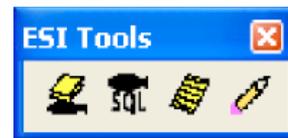
The import process will take a minute or two. At the conclusion of the import and clipping, you will be in an ArcMap Layout View, similar to the one that appears on page 8. At the bottom, there is a scale bar that shows the relative coverage of each of the oiling categories. It is essential to keep this information with any trajectory that is distributed, as the light, medium and heavy classifications are always relative.

The uncertainty contour reflects the potential variability of the winds and currents from those that were input and used to generate the trajectory. In general, it is wise to consider the entire area within the uncertainty bounds when establishing protection priorities and determining resources at risk. That will be the approach we use here.

The ESI database is a fairly complex set of relational tables. To make using and querying the data within ArcMap a little bit easier, four ESI tools have been developed. We will add these to our ArcMap document now, in the same manner as we added the GNOME Import tool.

Task 4: Create an ESI Toolbar and add the ESI mapping tools:

Before starting this task, it is a good idea to verify that you have the latest release of each of the ESI tools. Whenever bug fixes or enhancements are made, a new version is posted to the OR&R website at: <http://response.restoration.noaa.gov/esitoolkit>. The

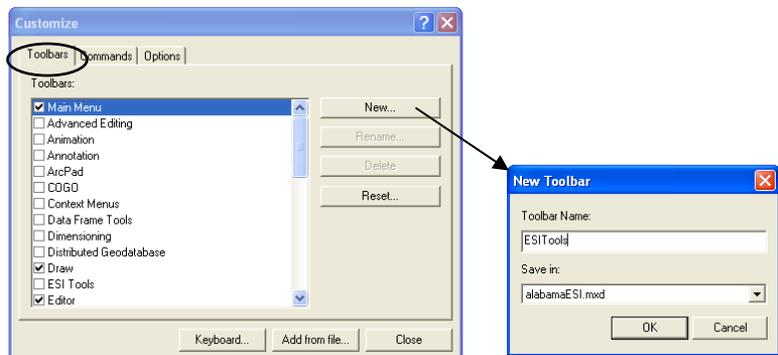


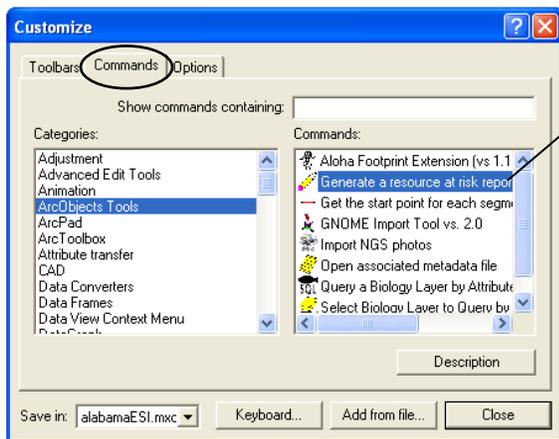
tools on the training CD were current as of March 30, 2008. If any of the tools on the above site have a release date after April 3, 2008, replace those on the training CD located in the ESI_Training/ESI_Tools directory. The ESI tools were developed in ArcMap 9.2 and are not compatible with earlier versions.

To add the ESI tools and/or to do any data analysis, you will need to be in the Data view window. (Importing the GNOME trajectory put you into Layout view mode). Under the **View** menu, select **Data View**.

Create the toolbar:

- Right-click on the ArcMap toolbar and scroll down to **Customize...** (or choose option **Customize...** under the Tools menu).
- Select the **Toolbars** tab on the Customize window.
- On the right side, click **New...**
- In the pop-up window, name the toolbar ESITools and save it in alabamaESI.mxd. Click **OK**. The new ESITools bar will be added to your data window.





Add the tools:

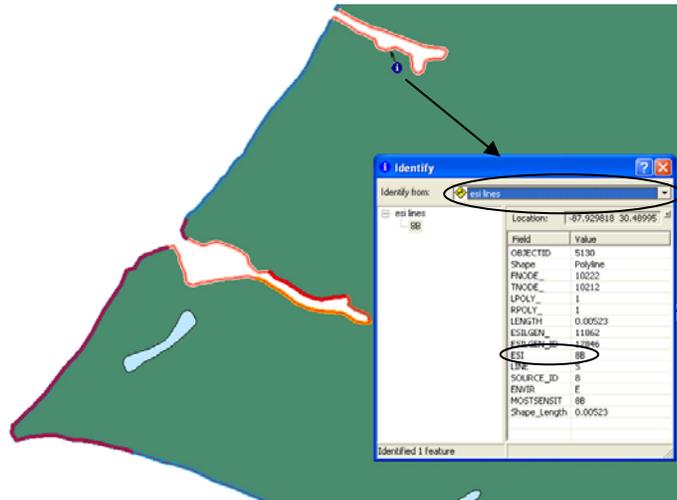
- e) Now click the **Commands** tab in the Customize window.
- f) Click **Add from file...**. Navigate to ESI_Training/ESI_Tools . One at a time, add the four ESI tools. You can do this by double-clicking the icon, then clicking **OK** in the pop-up window, or you can select the tool name, and click **Open**, then **OK**. As the tools are added, they will show up in the right hand **Commands:** panel of the Customize window.

- g) After the tools have been added, drag each of them onto the ESI Tools toolbar. To do this, select the icon and drag it on to the toolbar. Release the mouse button when the cursor becomes a vertical bar.
- h) Close the Customize window.

Task 5: Identify the ESI types of the impacted shoreline segments:



We are now ready to look at the resources that might be impacted by the April spill scenario. Check the checkbox next to the *esi lines* layer to make it visible. Use the zoom and pan tools on the “Tool” toolbar to focus on the trajectory area.

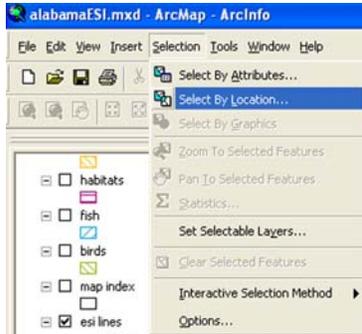


Investigate the types of shoreline that might get oiled. One way to do this is

to select individual shoreline segments using the Identify tool. Set the *Identify from:* layer to “esi lines”. Click on a variety of lines to see their ESI value. Here is an identify example with a value of 8B.

You may also do a quick assessment of the impacted shoreline types by their color. Remember “hotter” colors (like red) are the more sensitive shoreline segments. Cooler colors (like purple and blue) indicate less sensitive shoreline types. In the ESI ArcMap document, shoreline segments that have multiple values will be color coded using the most sensitive shoreline type included. For the table item, *MOSTSENSIT* (on which the map legend is based), these lines will be labeled with the highest ESI value involved followed by a “+” sign to indicate there are other shoreline types associate with that segment. The table item *ESI* will list all of the ESI types.

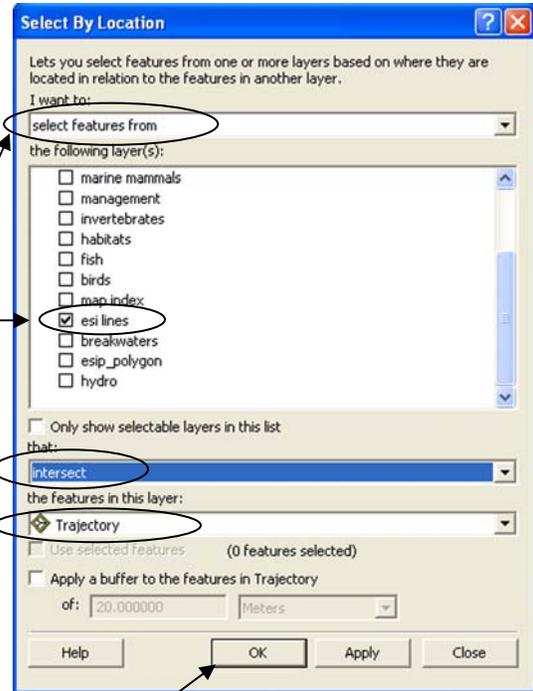
It is also possible to do a spatial query that identifies all of the shoreline segments that fall within the trajectory uncertainty bounds.



a) Under the *Selection* menu, choose *Select by Location...*

b) In the dialog box:

1. Set *I want to:* to select features from
2. Set the selectable layer to *esi lines*
3. Set the spatial operation to *intersect*
4. Set the intersect layer to *Trajectory*



5. Click *OK*

c) Open the attribute table for the esi lines layer. To do this, right click on the layer name *esi lines* in the legend window and select *Open Attribute Table*. You should see a table that looks something like this:

OBJECTID	Shape	FNODE	THODE	LPOLY	RPOLY	LENGTH	ESILGEI	ESILGEI_ID	ESI	LRIE	SOURCE_ID	EHVIR	MOSTSEISIT	Shape_Length
5095	Polyline	10137	10135	1	2669	0.00006	11717	12602	10C	S	8 E	10C		0.00006
5096	Polyline	10138	9799	1	2538	0.02588	11718	12636	10A6B	S	1 E	10A+		0.025885
5097	Polyline	10126	10139	1	1	0.00064	11719	12729	9B	S	8 E	9B		0.000638
5098	Polyline	10139	10132	1	1	0.00067	11724	12734	8A	S	8 E	8A		0.00067
5099	Polyline	10143	10137	1	2669	0.00046	11725	12806	10C	S	8 E	10C		0.000458

Click on *Selected* to view only the impacted segments

There are 19 shoreline segments selected

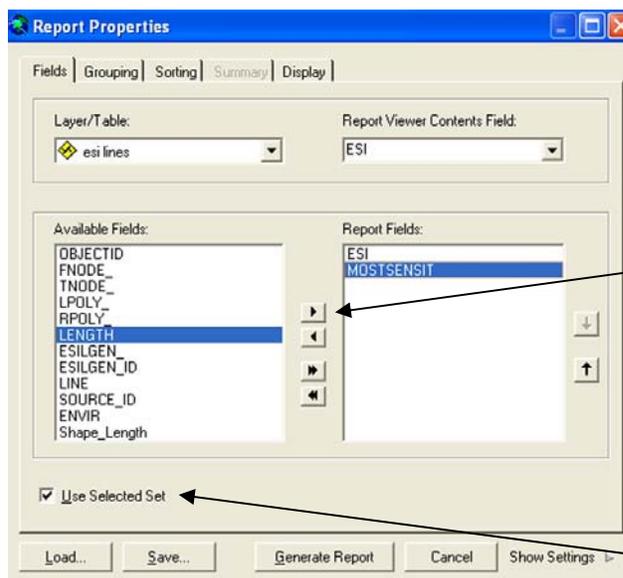
ESI types

Segment length in decimal degrees

- d) You may now create a table, showing only the selected objects and the most pertinent fields. Click on the *Options* button and select *Reports > Create Report...*



- e) In the *Report Properties* window, highlight the desired fields for the report and add them by clicking on the arrow key as shown below. For this report, the fields ESI, MOSTSENSIT, and Length will be included:



Highlight the name, then click the arrow to add the field *Length*

Make sure the box *Use Selected Set* is checked

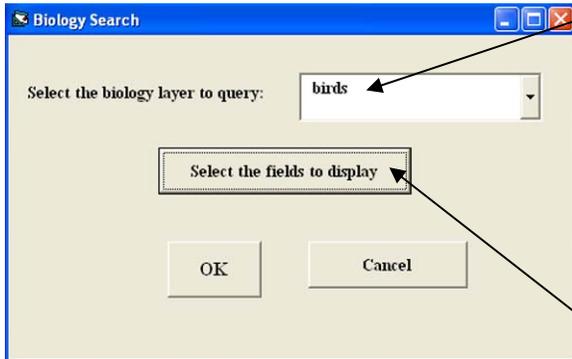
- f) Click **Generate Report**.
- g) At the top of the report will be a menu item called **Export**. This item will allow you to export the report either as a text file or as a PDF. Choose to export it as a PDF.

Unfortunately, this process is a bit cumbersome, and the result shows all of the segments individually, even if they are duplicates of the same ESI type. In addition, a length shown in decimal degrees is not particularly useful. It is planned to add a tool to export a more useful ESI line report to the ESI Toolbar. This may either be a new tool, or a modification to the current Report Generator tool. 🖋️ Remember to check the website for updates!

- h) Close the esi lines attribute window, and turn off the visibility of the esi line layer.

Task 6: Use the ESI select layer tool to identify the impacted birds:

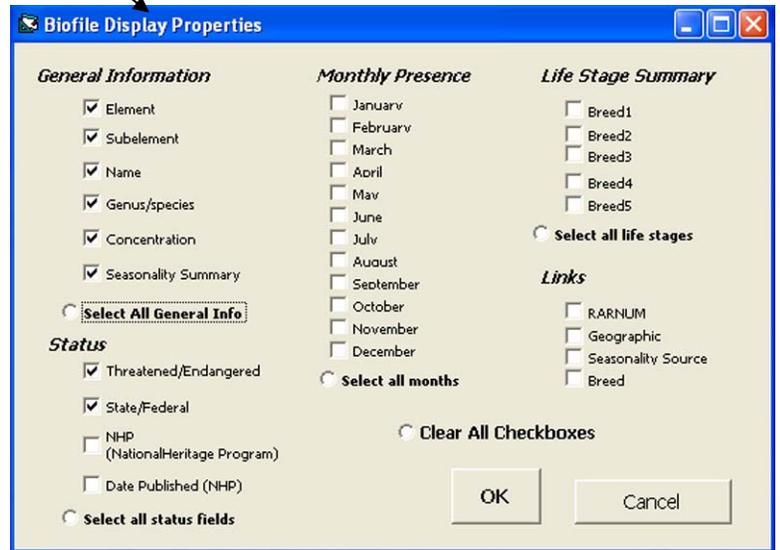
- a) Turn on the visibility of the birds layer, and zoom into the impacted spill area.
- b) Set the layer to query using the ESI select layer tool . When you click on this tool, you will see the following window:



- c) Set the biology layer to query to *birds*. This is a drop down menu that will give you the option of selecting any of the biology layers that are linked to the Biofile table, the table with all of the relevant attributes for the biology layers.
- d) Click the *Select the fields to display* button. In the pop-up window, you will have the option of setting the Biofile fields that are of interest. Below are the default values, or those set by checking *Select All General Info*.

- e) Click *OK* in both windows to continue.

Once a biology layer has been selected, you may use any of the ArcMap methods to select objects and see which species are present. Use the *Select Features* tool  to examine a few of the bird polygons within the spill area. The bird species present, and their related attributes, will show up in the biofile window.



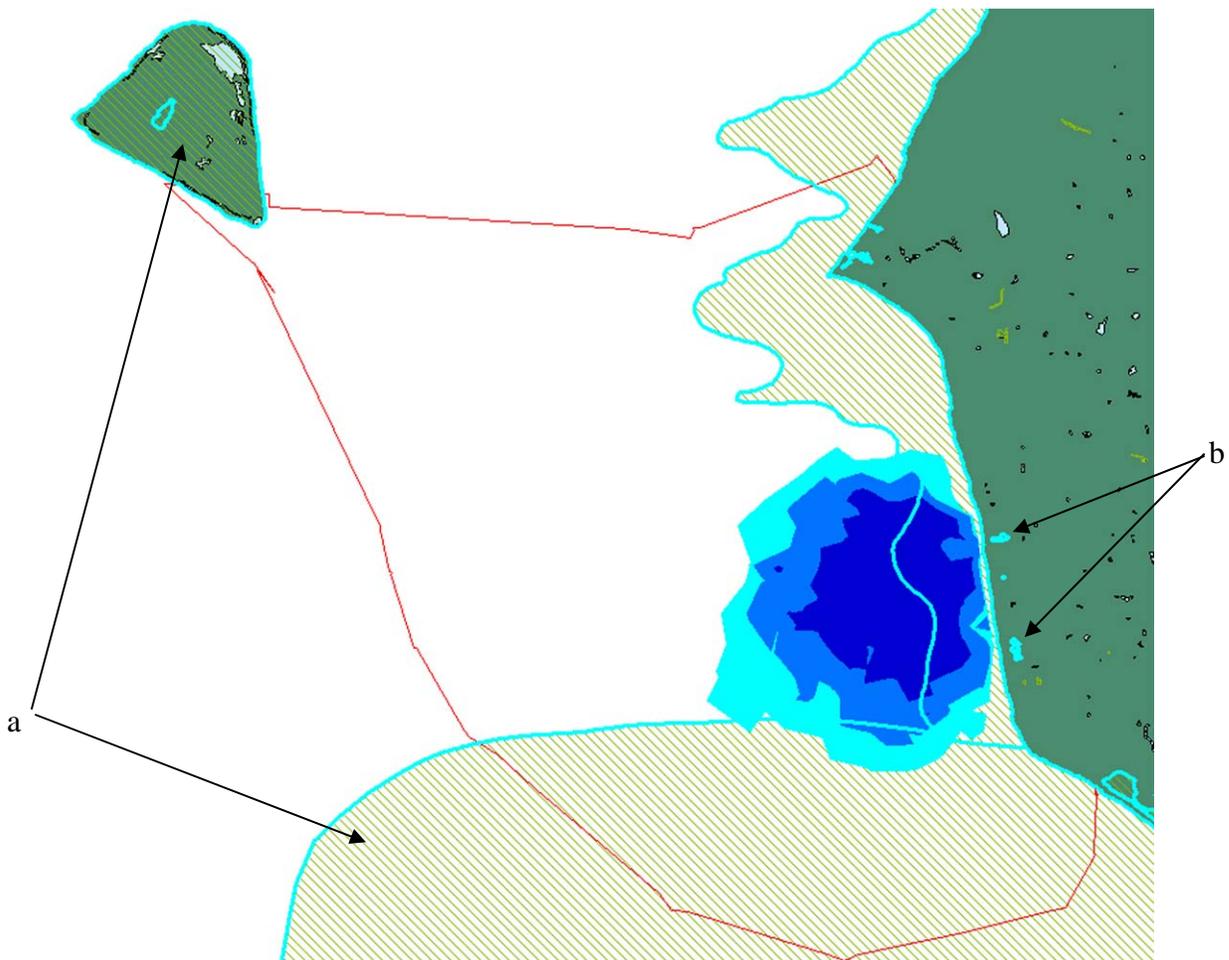
If you set the display properties to the *General Info* option, you will see the species common and scientific names, concentration information if available, a summary of the seasonality when each species is present, and information regarding their threatened or endangered status.



ELEMENT	SUBELEMENT	NAME	GEN_SPEC	S_F	T_E	CONC	SEASSUM
BIRD	shorebird	American oystercatcher	Haematopus palliatus	S	P	-	Nov-Mar
BIRD	gull_tern	Black tern	Chlidonias niger			-	Oct-Apr
BIRD	wading	Black-crowned night-heron	Nycticorax nycticorax			25-PAIRS	Mar-Nov
BIRD	wading	Tricolored heron	Egretta tricolor			10-PAIRS	Jan-Dec
BIRD	wading	Snowy egret	Egretta thula			25-PAIRS	Jan-Dec
BIRD	gull_tern	Sandwich tern	Sterna sandvicensis			200-300-PAIRS	Mar-Nov
BIRD	gull_tern	Brewster's tern	Sterna bergii			1000-2000 PAIRS	Jan-Dec

Now we will use the **Select by Location** option to identify the bird polygons impacted by the trajectory and to see the species they represent. The instructions that follow are an abbreviated version of those outlined in the ESI identification section. If necessary, refer back to steps a and b of Task 5 for a graphic example of how to set the **Select by Location** criteria.

- f) Under the **Selection** menu, choose **Select by Location**. Set the selection criteria as follows:
1. *I want to: **Select features from:***
 2. *the following layer(s): **birds** (make sure all other layers are unchecked)*
 3. *that: **intersect***
 4. *the features in this layer: **trajectory***
 5. *apply a buffer to the features in trajectory of: **250 meters***
 6. Click **OK**



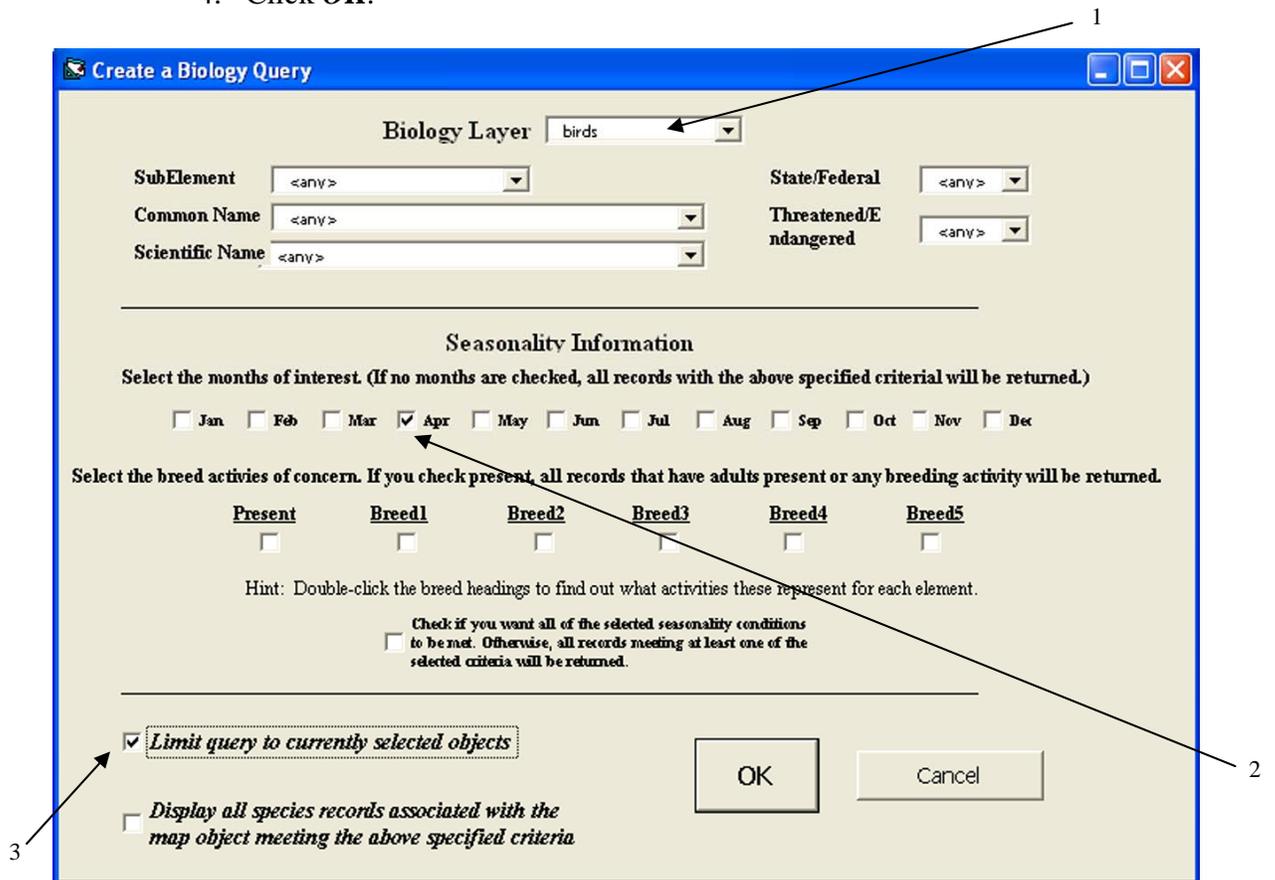
The selected polygons are highlighted in blue. Notice that the entire polygon is selected if even a portion of it intersects the trajectory layer (a), and that some of the land bound polygons are included (b). The latter is because we set the buffer distance to 250 meters.

The impacted species records are highlighted and shown in the Biofile table. You might find that some species names are listed multiple times in the table and they may even have different seasonal summaries or concentrations listed. This is because there will be a record for each species present, for each polygon. The life history, seasonality and concentration information will be specific to the polygon and species indicated.

There are 79 records currently selected in the Biofile. In the next step, we will narrow the selection down to the records where the species are present in April, the time frame of our scenario.

Task 7: Narrow the selected records to species present in April:

- a) Click on the *Query Biology by Attribute* tool. 
 1. Set drop down *Biology Layer* menu to “birds”
 2. Check the *Apr* seasonality box
 3. Check the *Limit query to currently selected objects*
 4. Click *OK*.



This reduces the number of bird records selected to 59, but all the polygons that were originally selected remain selected. It may be helpful to be even more restrictive in your selection criteria. You might want to consider only birds that have some sort of endangered status, or limit the query to only shorebirds. Life history is an important consideration when determining protection priorities. In the next step, you will restrict your selection to birds that are nesting in April.

b) Again click on the *Query Biology by Attribute* tool. 

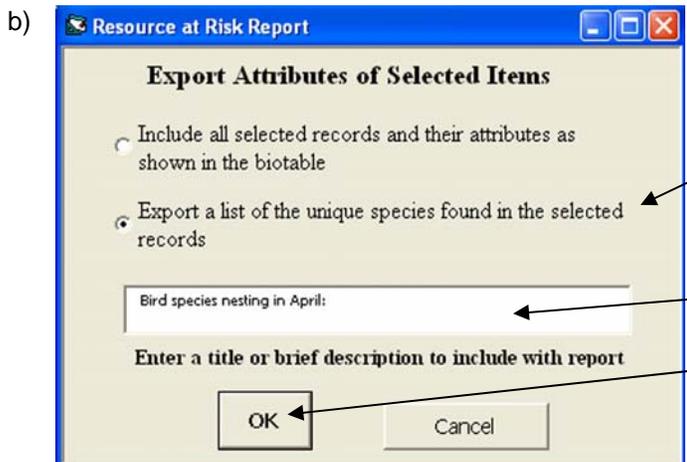
1. Set **Biology Layer** to “birds”
2. Check the **Apr** seasonality box
3. Check the **Breed1** box (Double click on a Breed heading; you will see the activities to which it refers depending on the element being queried.)
4. Check the **Limit query to currently selected objects**
5. Click **OK**.

This reduces the number of selected records to 21, but more importantly, it has limited the area selected to Gailliard Island and a few of the inland polygons selected due to the buffering of the trajectory. This knowledge may be helpful in determining how to best use limited response resources.

Task 9: Create a report of birds nesting in April

It may be useful to have a report listing the affected bird records found within the spill trajectory. The *Resource at Risk Report* tool gives you two options for generating a report. You may choose to export all of the selected records, along with all of the fields you have displayed in the onscreen biofile table, or you may choose to export a list of only the unique species selected. The second option will export one record for each species, along with the information that does not change from polygon to polygon.

a) Click on the *Resource at Risk Report* tool 



Select the list of unique species option

Type in a header line for the report

Click **OK**

- c) Select the destination folder and name the output report.
- d) The output will be a tab delimited text file. You may need to adjust the tabs on your document, and you may also want to alter the font or style to make the report easier to read. The output can also be brought into any spreadsheet or other program that accepts tab delimited input.

Bird species nesting in April:

<u>Element</u>	<u>Subelement</u>	<u>Name</u>	<u>Gen Spec</u>	<u>S F/T E</u>
BIRD	wading	Black-crowned night-heron	Nycticorax nycticorax	
BIRD	waterfowl	Canada goose	Branta canadensis	
BIRD	wading	Great blue heron	Ardea herodias	
BIRD	wading	Great egret	Ardea alba	
BIRD	shorebird	Killdeer	Charadrius vociferus	
BIRD	wading	King rail	Rallus elegans	
BIRD	wading	Little blue heron	Egretta caerulea	
BIRD	waterfowl	Mallard	Anas platyrhynchos	
BIRD	waterfowl	Mottled duck	Anas fulvigula	
BIRD	wading	Snowy egret	Egretta thula	
BIRD	wading	White ibis	Eudocimus albus	
BIRD	wading	Yellow-crowned night-heron	Nyctanassa violacea	

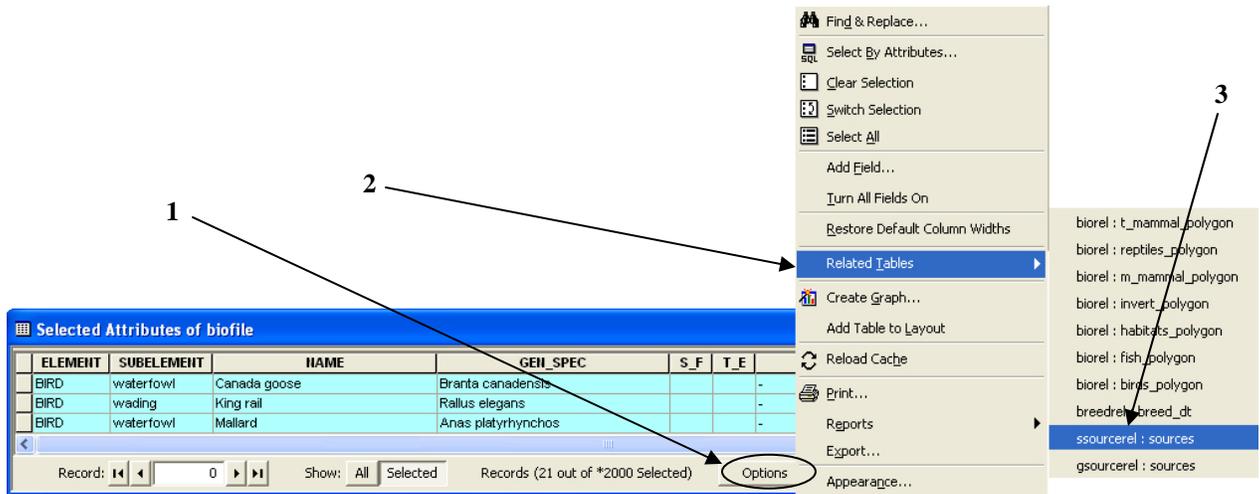
You could go through the steps above and do similar queries with the other biological layers. The results can be added to this report by giving the report the same name, and choosing the option “append”. At this time it is only possible to export biology records to the report.

Task 10: Identify the source of the selected bird records:

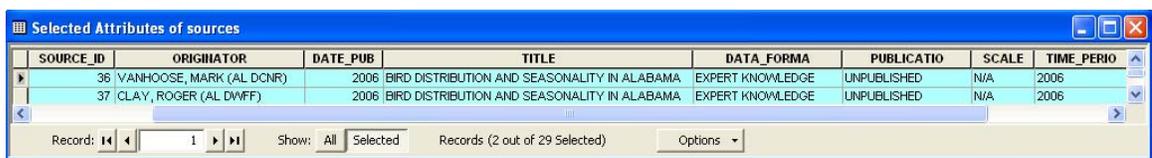
Knowing the source of the information you are viewing may help identify possible expert contacts to coordinate with during a spill event. The attributes found in the ESI source table can also give you a greater understanding of the data you are seeing. For instance, there is both a date published and time period date listed to help evaluate the currency of the data. With document sources, the title may provide some insight into the purpose of the original data collection effort.

There are object level metadata for all of the biology and human use features. This means you can look at a polygon or group of polygons, and determine the document or expert that provided both the geographic (location and extent) information and the related seasonality data. Many times these sources will be the same, but there are occasions when these data come from different places or from multiple sources. In this task, we will look at the process for viewing the source records related to the birds we determined to be nesting in April within our spill area. Retrieving the source information is not a direct process, but it isn’t really too difficult. At some time, a tool may be developed to make this more of a one step process for the end user. Remember to look for updates and new tools on the ESI website!

From the *biofile* window, click on options then highlight **Related Tables** -> *ssourcerel*:



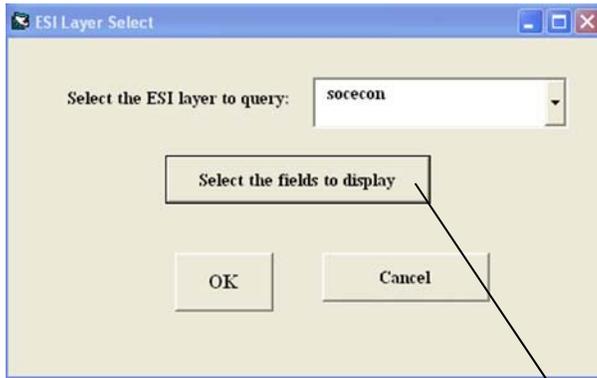
ArcMap will open the sources window, and the appropriate records will be highlighted. Choose to show only the selected records; there are only two. Below you can see the types of information stored in the sources table. The link between these files is a relate that goes from the Seasonality Source field in the biofile to the Source_ID in the sources file. If you try this same process with *gsourcerel* you will find you get these same two records and an additional source record. This relate goes from the Geographic Source field in biofile to the Source_ID in sources. If for any reason the the relates do not work, or the ESI tools are not working with the ESI data, you can redefine the relates. This process is described in Appendix C. Understanding how the relates are set up and knowing the naming conventions expected by the tools will also help you if you want to use the ESI data in a map document other than the .mxd provided with the atlas.



Task 11: Use the ESI select layer tool to identify the impacted Human Use Resources:

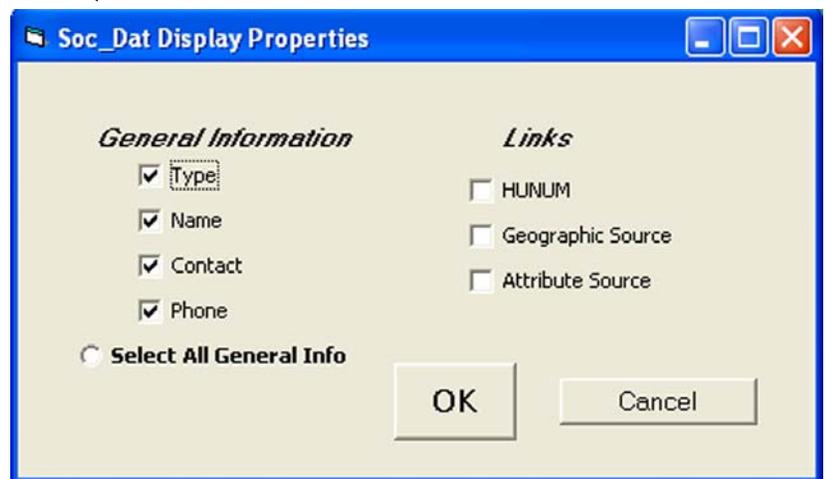
This process basically duplicates the steps followed in Task 6. This time we will look at the human use resources found in the *socecon* layer.

- Turn off the visibility of the *birds* layer; turn on the layer *socecon*
- Set the layer to query using the ESI select layer tool . As shown below, select *socecon*



- c) Click the *Select the fields to display* button. In the pop-up window, you have the option of setting the soc_dat fields that are of interest. Here we choose to see just the general information and to exclude the link fields.
- d) Click **OK** in both windows to continue.

As was the case with the biology layers, once the socecon layer has been selected, you may use any of the ArcMap methods to select objects and view their attributes. Use the *Select Features* tool  to examine a few of the socecon points. Their attributes will be displayed in the soc_dat table.



Now we will use the *Select by Location* option to identify the socecon points impacted by the trajectory. The method is the same as we saw for the shoreline selection and the bird selection. If necessary, refer back to steps a and b of Task 5 for a graphical example of how to set the *Select by Location* criteria.

- g) Under the *Selection* menu, choose *Select by Location*. Set the selection criteria as follows:
 1. *I want to: Select features from:*
 2. *the following layer(s): socecon* (make sure all other layers are unchecked)
 3. *that: intersect*
 4. *the features in this layer: trajectory*
 5. *apply a buffer to the features in trajectory of: 250 meters*
 6. Click **OK**

Seven *soceon* points are selected by our search. The associated attributes are shown below:

TYPE	NAME	CONTACT	PHONE
MARINA	GRAND HOTEL		
BOAT RAMP	MULLET POINT PARK		
BOAT RAMP	BOAT RAMP		
ARCHAEOLOGICAL SITE	ARCHAEOLOGICAL SITE		

In the Alabama atlas, there isn't any contact or phone information listed for the *soceon* objects. The other human use layer, *management* does contain this information. If you would like, make that layer visible and using the ESI tool, set it to the layer to query. Select a few random polygons to see the types of information provided.

Task 10: Check out the metadata!

Published with all ESI atlases are very detailed metadata reports. These documents contain all types of information about the data coverage and extent, collection and processing methods, sources, etc. Imagine you have a particular interest in the Northern pintail. You see that it does not appear in the list of nesting species within the trajectory area, but cannot tell if that is because it does not occur there or if perhaps that species wasn't mapped for this atlas. The metadata can help answer this question.

- Click on the *Metadata* tool.  This launches Adobe Acrobat and opens the metadata document.
- Under the bookmarks on the left side of the page, highlight *Birds*.
- Scroll down to the *Completeness Report*. This section lists all of the bird species that were mapped in this atlas. You will see that species number 17 was the Northern pintail, and that it was, in fact, mapped in the Alabama atlas.

This does not necessarily mean that the Northern pintail does not live in the spill impacted area, but it does mean that for whatever reason, its population wasn't felt to be significant enough to show in this area. Or it may mean that the species was ruled out by virtue of our selection criteria, i.e. that the bird be present in April and that it be nesting.

Once again this emphasizes the importance of contacting local experts and on-site biologists as soon as possible after an actual spill event. The ESI provides useful baseline information quickly and easily, and is an ideal starting point for assessing potential resources at risk. Still, it is a snap shot in time and it does not attempt to map everything that may be of interest during an event. The metadata provides source information, so it is another resource for identifying the local experts. As you saw in the previous sections, source and expert information may also be found in the introductory pages of the hard copy or PDF atlas, as well as in the object level metadata in the sources table.

Section 3: Using the ESI Viewer

The ESI Viewer merges a free mapping program, Marplot, with a stand alone Filemaker application, to give those without access to ArcMap a way to view and query the digital ESI data. There are Macintosh and Windows versions of the Viewer. On the Macintosh, the latest software requires a post 10.3 version of Mac OS X be installed. The Windows version requires a minimum of Windows 2000 - service pack 4 or Windows XP - service pack 2. Other than a slight difference in the installers and how to launch the program, the functionality of the software is virtually the same on either platform.

Install the ESI Viewer software:

Windows:

- e) From the ESI_Training/ESI_VIEW/Windows directory, double click the installer icon  Alabama ESI Installer.exe (If you are running Vista, you will need to be logged on as an administrator and will be asked for your password).
- f) A set up wizard is launched. To accept the default settings (recommended), simply click on ***Next*** in the following four windows
- g) On the final window, “Completing the Set Up Wizard” click on ***Finish***

Macintosh:

- a) From the ESI_VIEW/Macintosh directory, double click the installer icon: 
- b) Type in an administrator name and password. (This is a security measure of the OS-X operating system, as part of this process will install the MARPLOT font)
- c) In the next window select ***Install***.
- d) The default will be to install the software in your Applications directory. To accept this, click ***Choose***.
- e) After the install is complete, click ***OK*** on the “successful installation” window.

The ESI Viewer software is now ready to use.

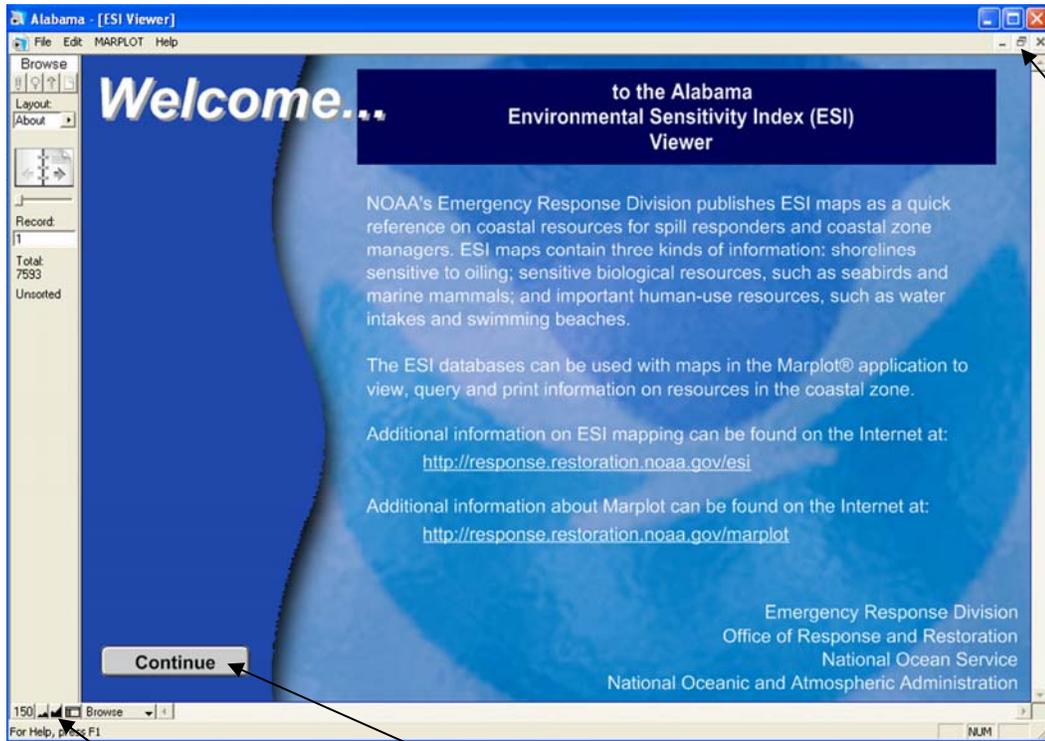
Launch the ESI Viewer

Windows: Double click on the desktop shortcut ***Alabama ESI Viewer*** or launch the applications from All Programs > ESI Viewer > Alabama

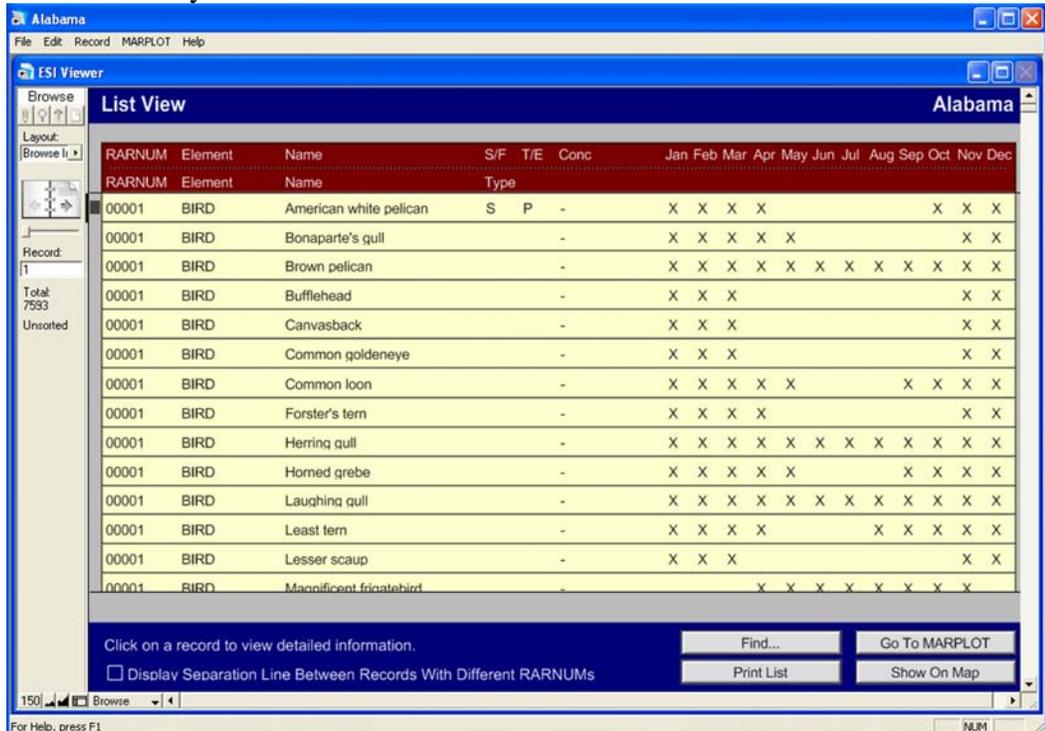
Macintosh: Double click on the ***Alabama ESI Viewer*** icon found in Applications > ESI Viewer Alabama.

Maximize the view of the database window:

Click on the two icons shown below, then, if necessary, adjust the window size to accommodate the larger Welcome... screen. Hit **Continue**.

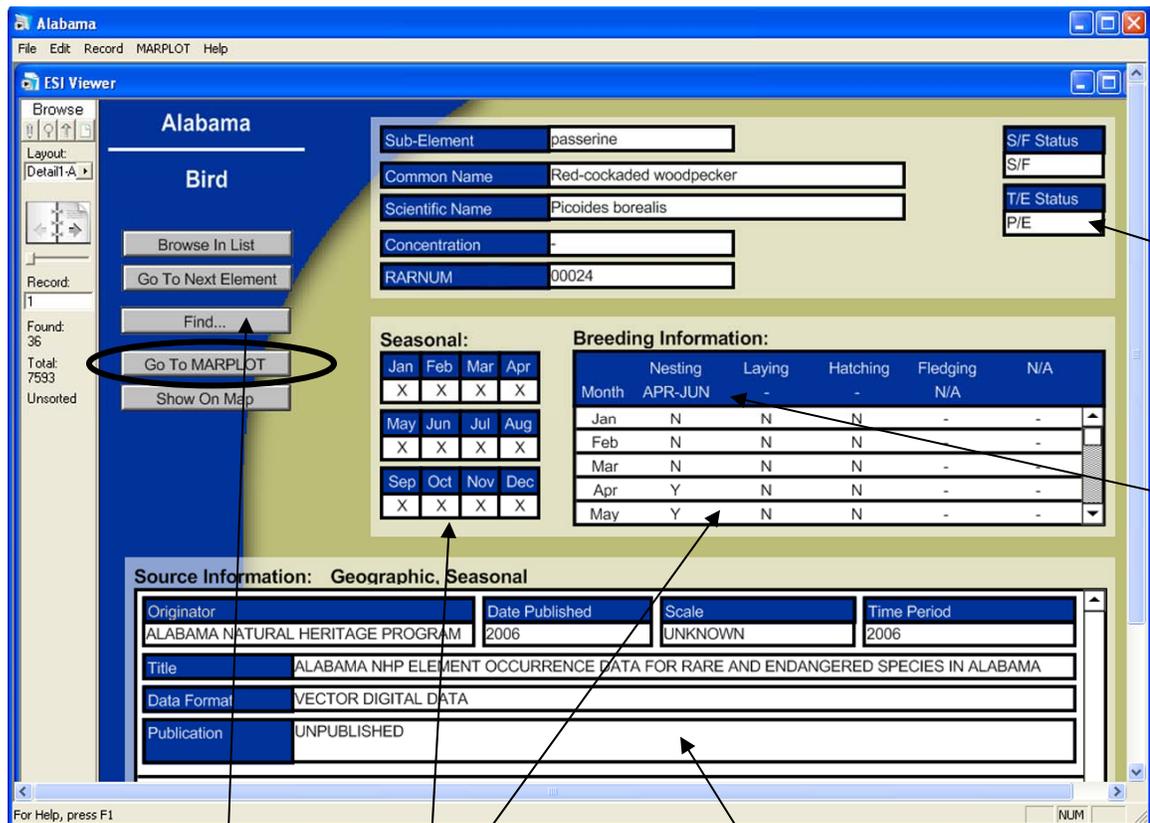


The next window you see is the database list view:



Currently there are no records selected, so every record in the database is visible. The list view shows basic information about each species in a resource at risk (RAR) group. This includes the species' common name, threatened and endangered status, concentration (if known) and the months each species is present in the area. (Remember, an RARNUM defines a group of species found together in a mapped polygon or point. The same grouping (therefore the same RARNUM) may appear in multiple places on a map or within the atlas)

If you would like more detail about any of the species records found in a particular RAR group, just highlight the line where that species appears. This will take you to a detailed screen as shown below. Here, among other things, you will find information about breeding activities, the species' scientific name, and the source metadata. This is also the screen where you can formulate a query based on attributes.



Formulate query by attribute

Searchable seasonal and breeding information

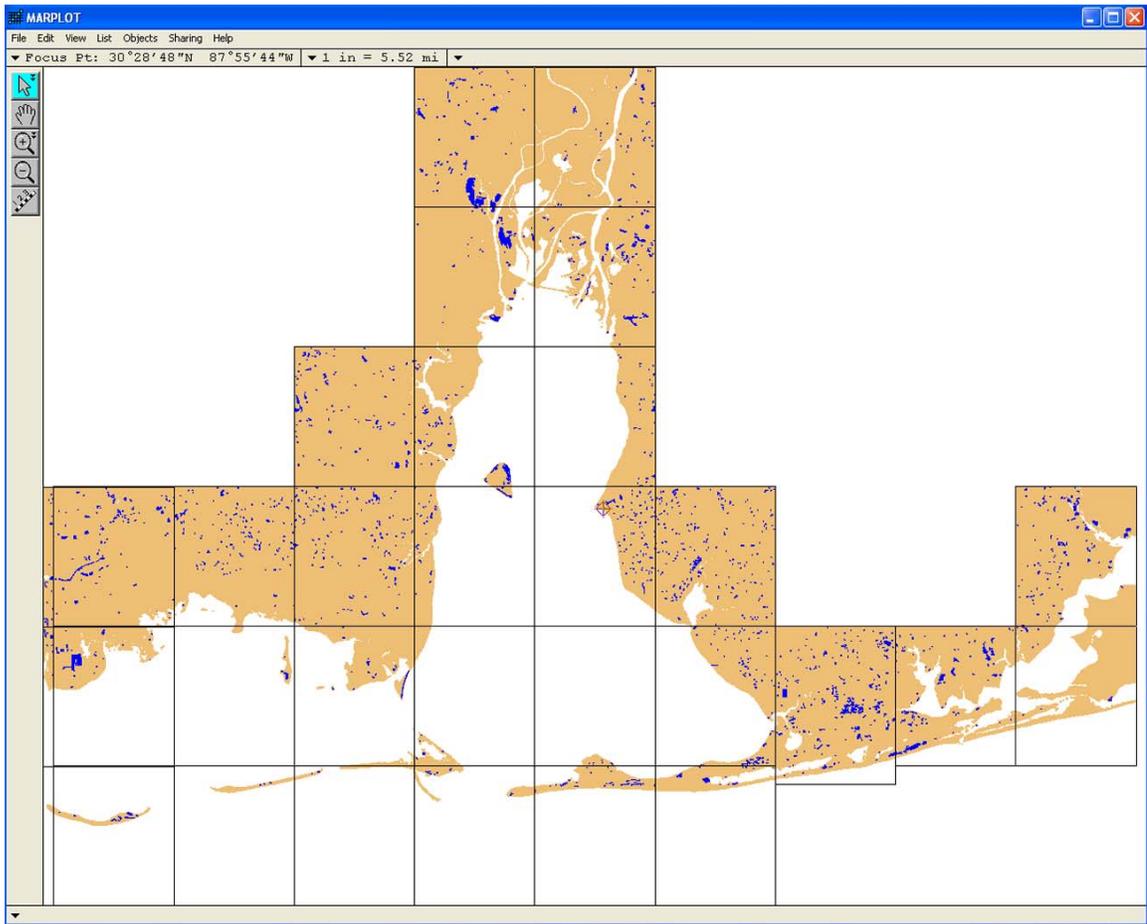
Object level source metadata (Scroll down to see Seasonal source if not the same as the geographic source)

Threatened/Endangered Status

Monthly breed summary

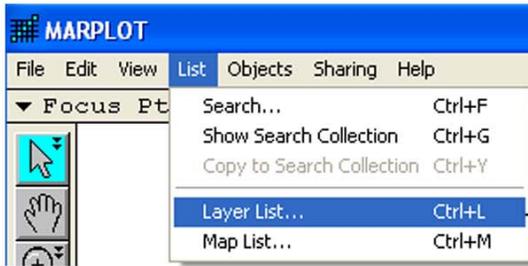
Go to the MARPLOT Map

Circled on the detail screen illustration is the ***Go To Marplot*** button. Click here to launch the mapping side of the ESI Viewer; on the startup screen, click ***OK***. Your screen should look similar to that shown below, with only the hydro and index layers visible. If Marplot has been run previously on the computer other layers may be turned on, as the program remembers the settings from the prior session.

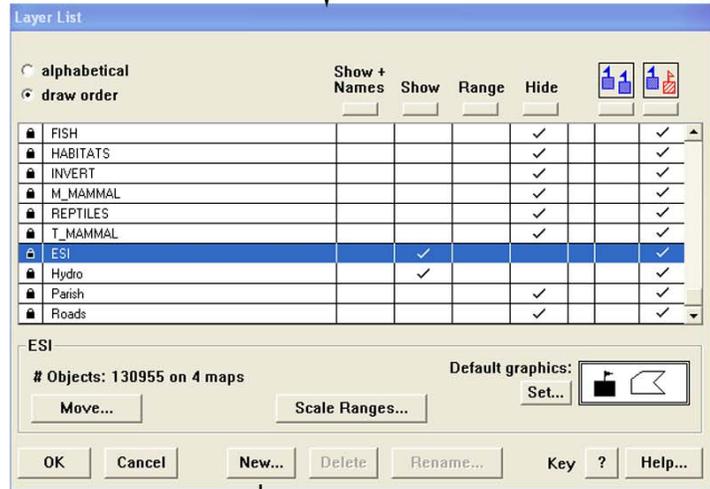


Task 1: Create a trajectory layer:

Unlike ArcMap, Marplot can not directly import the GNOME trajectory output. That means the first task will be to draw a polygon to represent the confidence limits of the trajectory for our scenario. To do this we will create a new layer called "trajectory". While in the layer dialog box we can do some other "housekeeping" to help get ready for the tasks to follow.



- a) Under the MARPLOT menu *List*, select the option *Layer List*
- b) Set the ESI layer to visible by checking the box under *Show*. Make sure that the only other layers “showing” are Hydro and Index



- c) Create a new layer by clicking on the *New...* button at the bottom of the Layer List window
- d) Make sure the radio button next to *create layer* is the option selected
- e) Name the new layer “trajectory”



- f) Click *OK* on the New Layer window, then on the Layer List window

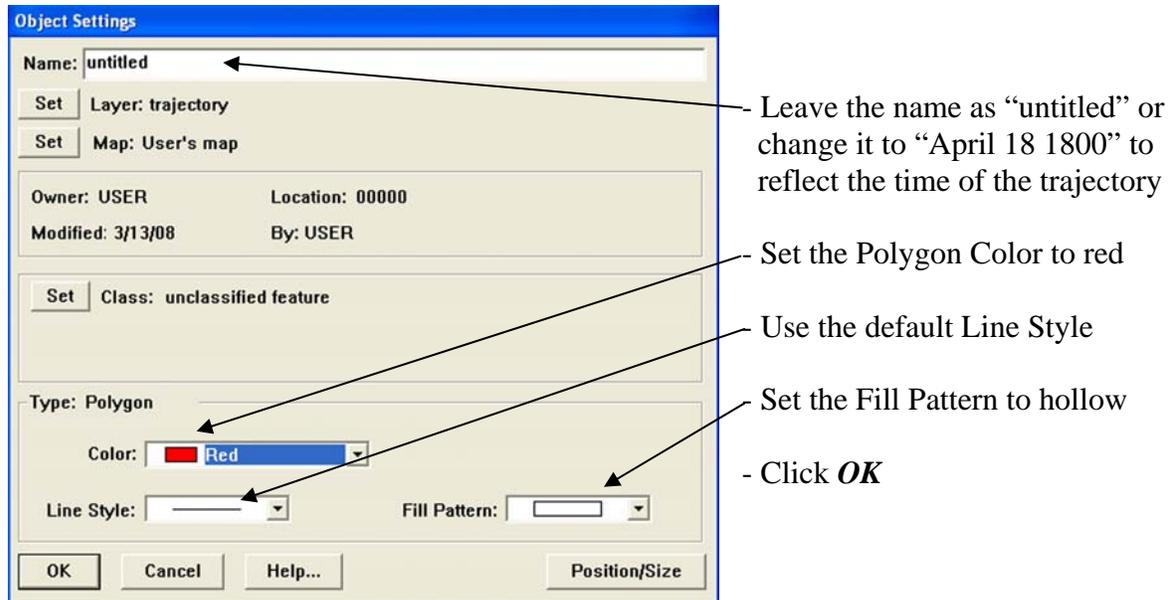


By default, the trajectory layer just created is unlocked, meaning it is editable. On the left side of the screen, a new palette of draw tools has been added. To create the trajectory outline, we will use the polygon tool.

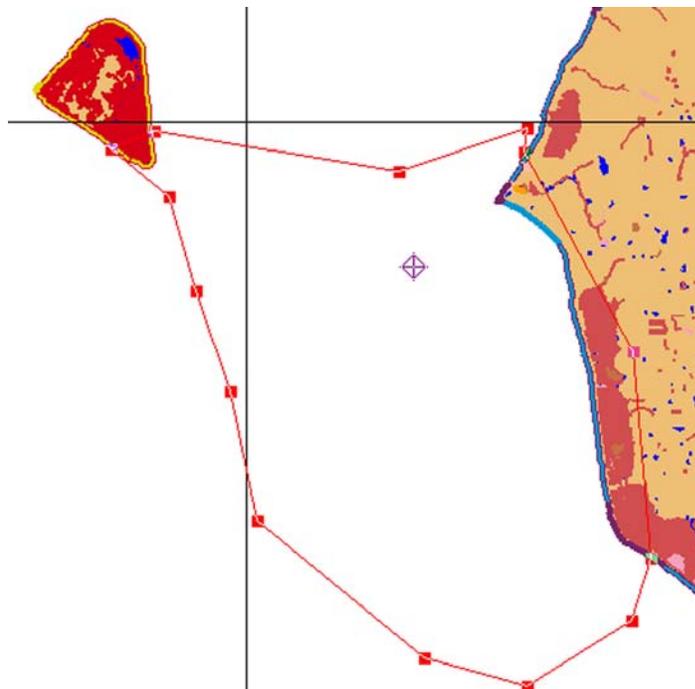
← Polygon draw tool

Refer back to the trajectory output at the beginning of this tutorial. If you are working with an ESI atlas other than that on the training CD, you can follow these same steps to draw in a trajectory for your own scenario.

- h) Zoom into the area that is impacted by the trajectory
- i) With the polygon draw tool, click to enter the points to define the trajectory polygon. When you are finished, double click and the polygon will close. The following dialog box will appear:

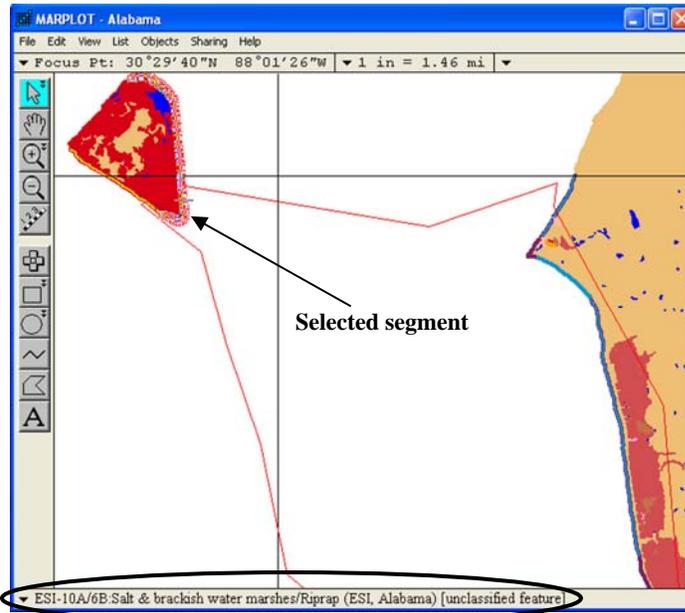


Your map should now look something like this:



The trajectory is not clipped to the shoreline, but overlaps it a bit so any geographic queries will include the shoreline and some of the inland polygons. If you want, you can go back under the menu item *List > Layer List* and move the trajectory under the shoreline, so it is more visually pleasing. We will do this next time we need to turn a layer off or on.

Task 1: Identify the ESI types of the impacted shoreline segments:



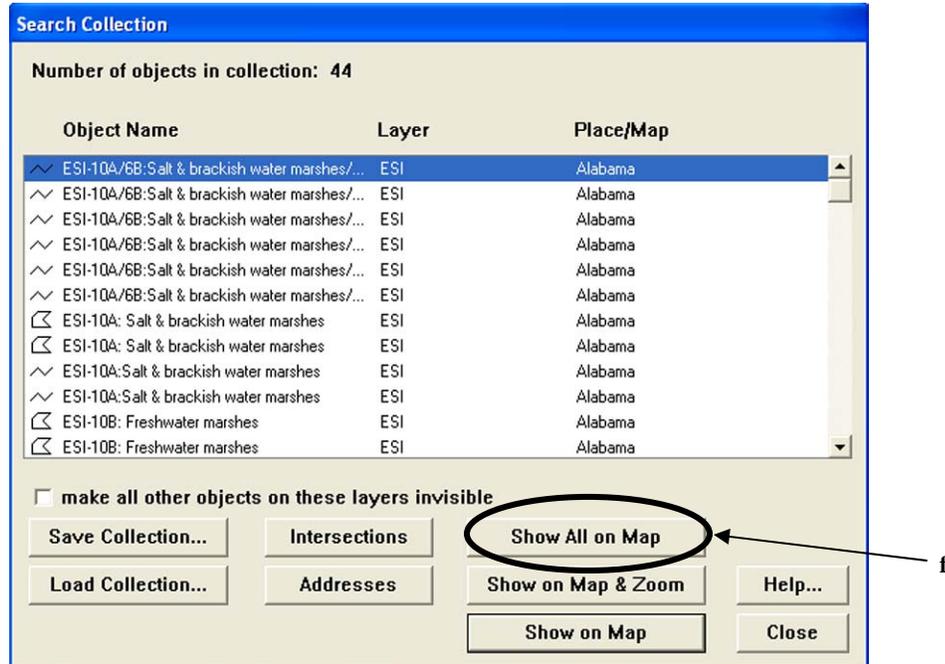
- Zoom in to the area impacted by the trajectory
- Using the Arrow tool, click on a shoreline segment; it will be highlighted as shown above
- In the lower left corner of the screen, you will see the shoreline type of the selected segment. In this case it is an ESI-10A/6B: Salt & brackish water marshes/Riprap

This is a very simple way to identify the ESI type of single shoreline segments. Now we will look at a way to get a listing of all the impacted shoreline segments.

- Using the Arrow tool, click on the line defining the spill trajectory
- Under the menu item **List**, select **Search...**

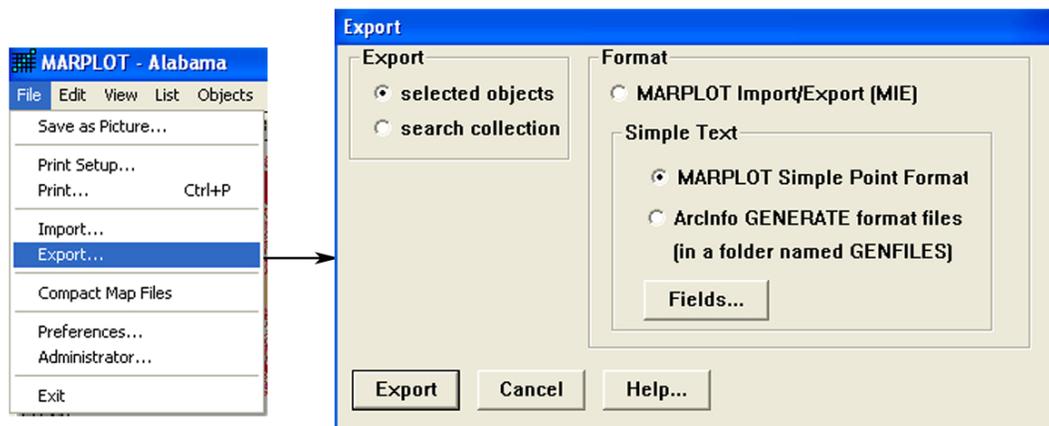
- Set the search for objects to ***are inside of or touching...; the currently selected object***
- Set the Layer(s) to search to ***ESI***
- Map(s) to search: to ***Maps in View***
- Choose to ***replace previous collection***
- Click ***Search***

You will see that a total of 44 map objects are selected. This includes both ESI line segments (~) and ESI polygons (⊞). Scroll through the list to see types of shoreline present that might need to be protected. Remember, the higher ESI numbers reflect the more sensitive shoreline types.



There is not a direct way to export these shoreline segment types in order to create a report. However, the steps below enable you to bring attributes – including the ESI type - of the selected polygons and lines into a space delimited text file that can be cleaned up using Excel or another spreadsheet program. At this time, it is not possible to save the length or area of the objects.

- f) From the Search Collection window, click on **Show All on Map**; all of the impacted shoreline segments and polygons will be selected (there will be lines and polygons outside of the selected area selected – this is because at least a portion of that object falls inside the trajectory line)
- g) Under the menu item **Export...**, choose to export the **selected objects** in **MARPLOT Simple Point Format**; Click **Export**



The output will be a text file. This can be opened in Excel where the extraneous fields can be removed. The file will have the polygon objects listed first, then the line objects. It will look something like what appears below.

	A	B	C	D	E	F	G
1	-87.9271	30.48543	ESI-10C: Swamps	ESI	Alabama	0	R209G77B80
2	-87.9303	30.4856	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
3	-87.9314	30.48561	ESI-10A: Salt & brackish water marshes	ESI	Alabama	0	R214G0B24
4	-87.9091	30.4587	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
5	-87.9091	30.45709	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
6	-87.909	30.44826	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
7	-87.9111	30.44705	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
8	-87.9079	30.44489	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70
9	-87.9106	30.44233	ESI-10B: Freshwater marshes	ESI	Alabama	0	R245G162B188
10	-87.91	30.43616	ESI-10B: Freshwater marshes	ESI	Alabama	0	R245G162B188
11	-87.9067	30.42787	ESI-10D: Scrub-shrub wetlands	ESI	Alabama	0	R197G114B70

Task 2: Identify the impacted biology:

The first part of this task will be to simply select and query a few of the bird polygons. To do this, the bird layer must be visible. When we turn it on, we will also move the trajectory layer to the bottom of the drawing order, so it doesn't display on top of the land. As in task 1, where we created the trajectory layer, it will be necessary to go into the layer list view.

- a) Under the MARPLOT menu *List*, select *Layer List*

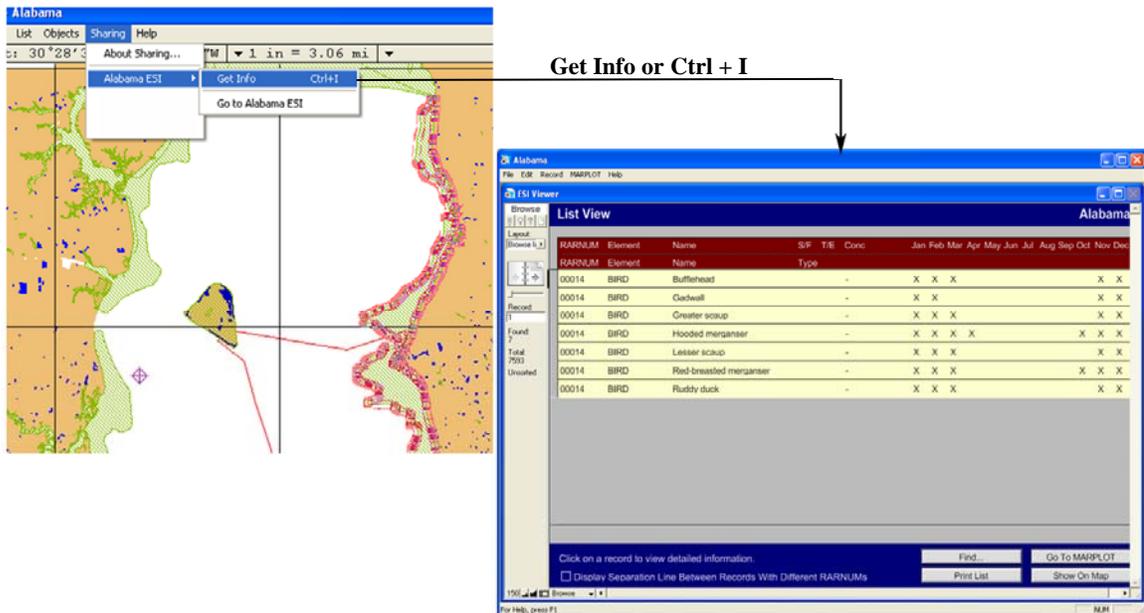
The screenshot shows the 'Layer List' dialog box. At the top, there are radio buttons for 'alphabetical' and 'draw order'. Below these are checkboxes for 'Show + Names', 'Show', 'Range', and 'Hide'. A list of layers is shown with columns for these options. The 'trajectory' layer is selected. A context menu is open over the 'trajectory' layer, with 'Move...' circled. The 'Move...' sub-menu is visible, showing options like 'Top', 'Up', 'Down', 'Bottom', 'Into Group', and 'Out of Group'. Arrows labeled 'a', 'b', 'c', 'd', and 'e' point to various elements in the dialog.

- b) Set the BIRDS layer to **Show**
- c) Verify that the radio button **draw order** is selected
- d) Highlight the trajectory layer
- e) Click on **Move...** and select **Bottom**
- f) Scroll down the layer list and set the ESI layer to **Hide**
- g) Click **OK**



In the ESI Viewer, as long as the layers are visible, it is possible to select and query multiple elements at the same time. For now, we will just choose a few bird polygons to get an idea of how the mapping program and data base work together.

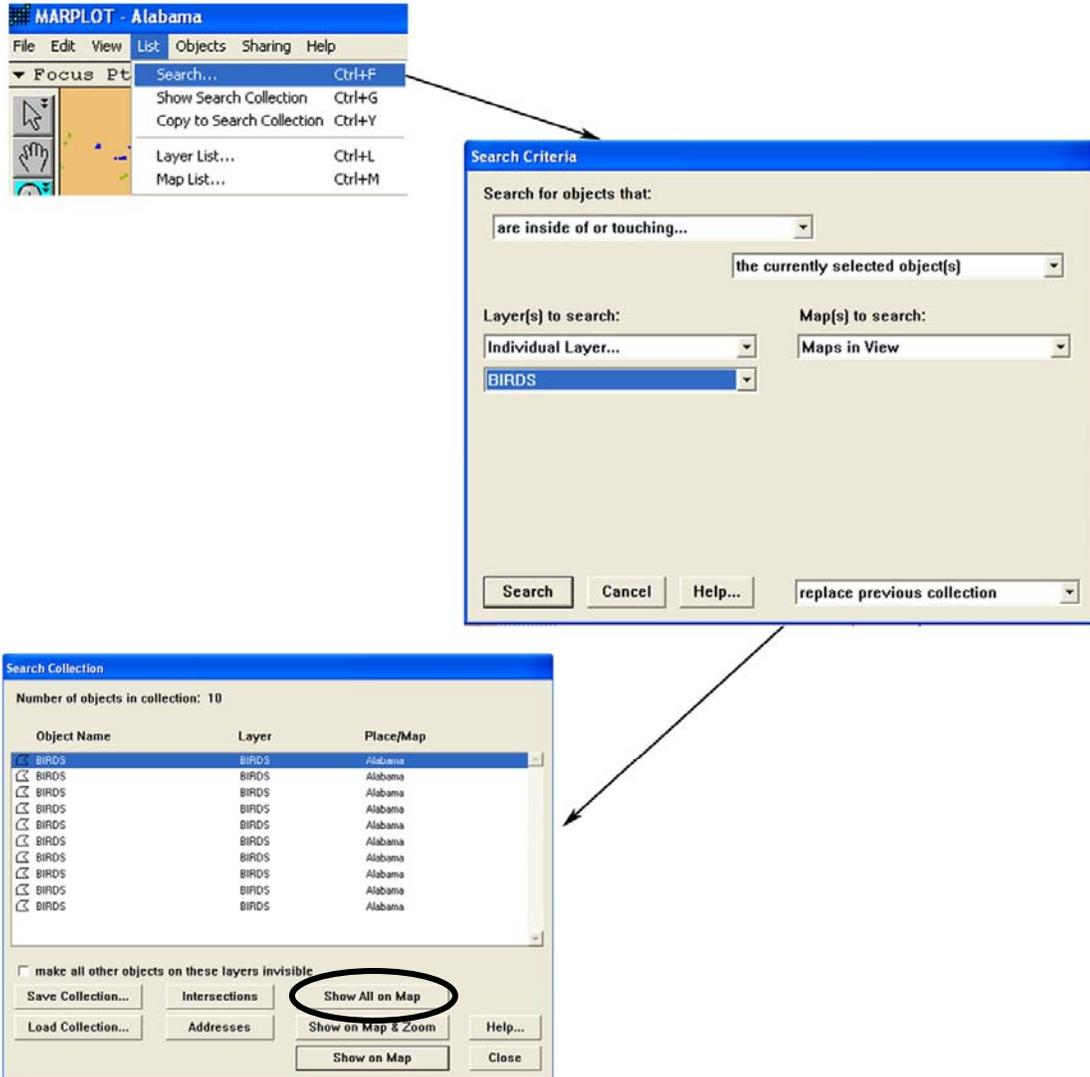
- h) Using the arrow tool, select a bird polygon. (If you want to select more than one bird polygon, hold down the shift key and select additional map objects – OR – click and drag the mouse over the polygons you want to select, then highlight **BIRDS** and hit **Select**.)
- i) Under the MARPLOT **Sharing** menu, select **Alabama ESI -> Get Info**, or, use the keyboard shortcut **Ctrl + I**.



This brings up a database window in list view that shows the birds present in the selected polygon(s). To return to the map you can click on **Go to MARPLOT** in the bottom right corner. If you would like to see if there are other polygons with the same combination of species, click **Show on Map**. This will select all of the polygons that have exactly the same species with the same seasonality as the polygon you selected.

Now we will identify the birds impacted by the spill trajectory. Use the zoom and pan tools to get to a view of the map where you can see the area covered by the trajectory.

- j) With the arrow tool, click on a portion of the trajectory outline, to select the trajectory polygon
- k) On the MARPLOT menu, select **List -> Search...**
- l) In the *Search Criteria* window use the following settings from the drop-down menus:
 - 1) **Search for objects that:** are inside of or touching...
 - 2) the currently selected object(s)
 - 3) **Layers(s) to search:**
 - i) Individual Layer... (If you had other biology layers you wanted to search, you would make them visible and select Multiple Layers...)
 - ii) BIRDS
- m) Replace previous collection
- n) Click on **Search**



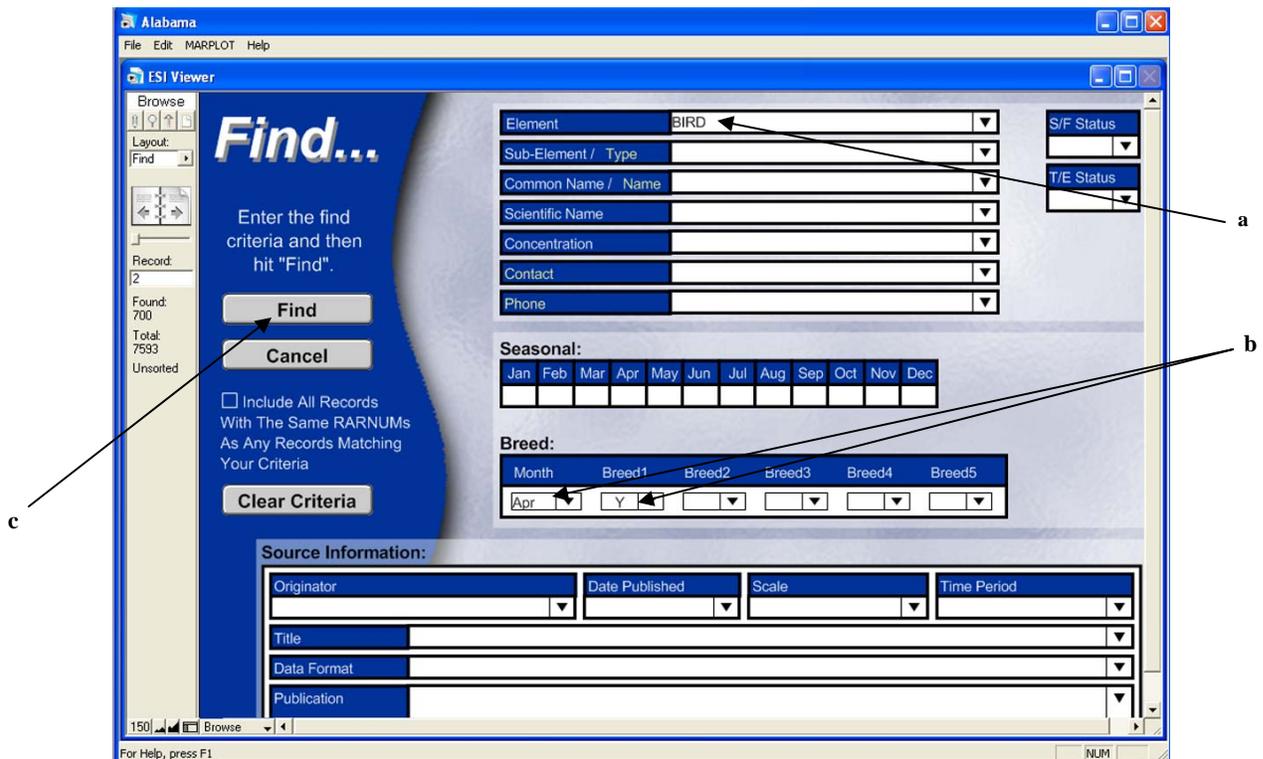
- o) The search collection window will show there were ten bird polygons found that were inside or overlapped the trajectory. To select all of these polygons, click on **Show all on Map**.
- p) From the MARPLOT window, under the **Sharing** menu, select **Alabama ESI -> Get Info**, or, use the keyboard shortcut **Ctrl + I** to get a list of the selected bird records.

There are 79 bird records selected (look under Found: on the left hand side of the Viewer window). Scroll down to see the list of all the selected records.

Task 3: Find where birds are nesting inside the spill trajectory:

With the ESI Viewer, the process of identifying the nesting bird records within a particular area is backwards from the process performed in ArcMap. First, all of the birds nesting in April are identified. Then the polygons they occupy, that fall inside the spill area are selected.

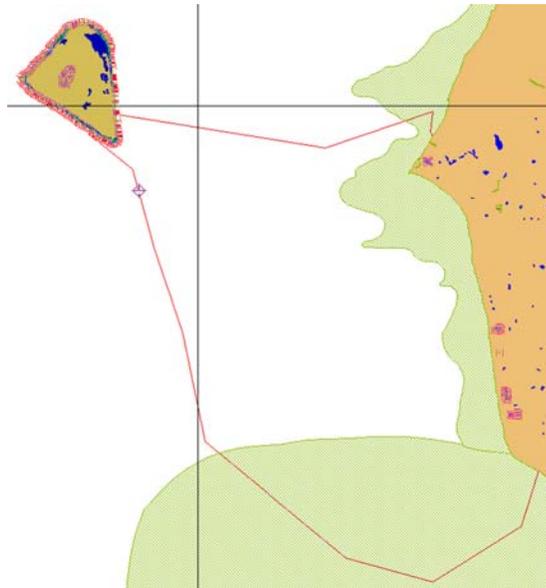
From the ESI Viewer List View window, click the **Find...** button in the bottom right hand corner of the screen.



- a) On the Find... screen, set **Element** to 'BIRD'
- b) Under Breed:, set the month to 'Apr', and Breed1 to 'Y'
- c) Click on **Find**. The List View comes back with 700 records selected.
- d) From the List View, click on **Show on Map** in the bottom right hand corner.

Now you will be on the MARPLOT screen with all of the polygons that have any birds listed as nesting in April selected. We want to narrow this down to only the selected polygons that fall within the trajectory area. With just a few modifications, this will be the same process we performed in task 2, steps j to n.

- e) Under the MARPLOT menu **List**, select the option **Copy to Search Collection**. MARPLOT will now “remember” the selected polygons, so they will be the only ones considered in our search.
- f) With the arrow tool, select the trajectory polygon.
- h) On the MARPLOT menu, select **List -> Search...**
- i) In the *Search Criteria* window use the following settings from the drop-down menus:
 - i. **Search for objects that:** are inside of or touching...
 - ii. the currently selected object(s)
 - iii. **Layers(s) to search:**
 - 1. Individual Layer...
 - 2. BIRDS
- j) In the bottom right hand corner, choose to save a **Subsearch** of the previous collection.
- k) Click on **Search**.
- l) Choose **Show all on Map**. This will select only the bird polygons that fall within the spill area that also have birds nesting in April. Depending on how you drew the trajectory, you should have seven polygons selected and the selection should look similar to the screen shot shown below.



Focusing on the areas where the most vulnerable birds are found in April (when the spill occurs), makes it easier to formulate an appropriate protection strategy when limited response equipment is available.

Task 4: Create a resource at risk report:

All of the currently selected polygons represent areas where birds will likely be found nesting in April. However, when we query the database, we will also get a list of all the other bird species they represent. Unfortunately, from the MARPLOT List View, there is no obvious way to differentiate between the nesting and not nesting records. This is a limitation of the ESI Viewer.

Below are two ways to create a resource at risk report. The second method shows how to include the monthly breeding summary so at least visually it is possible to identify the species that are nesting.

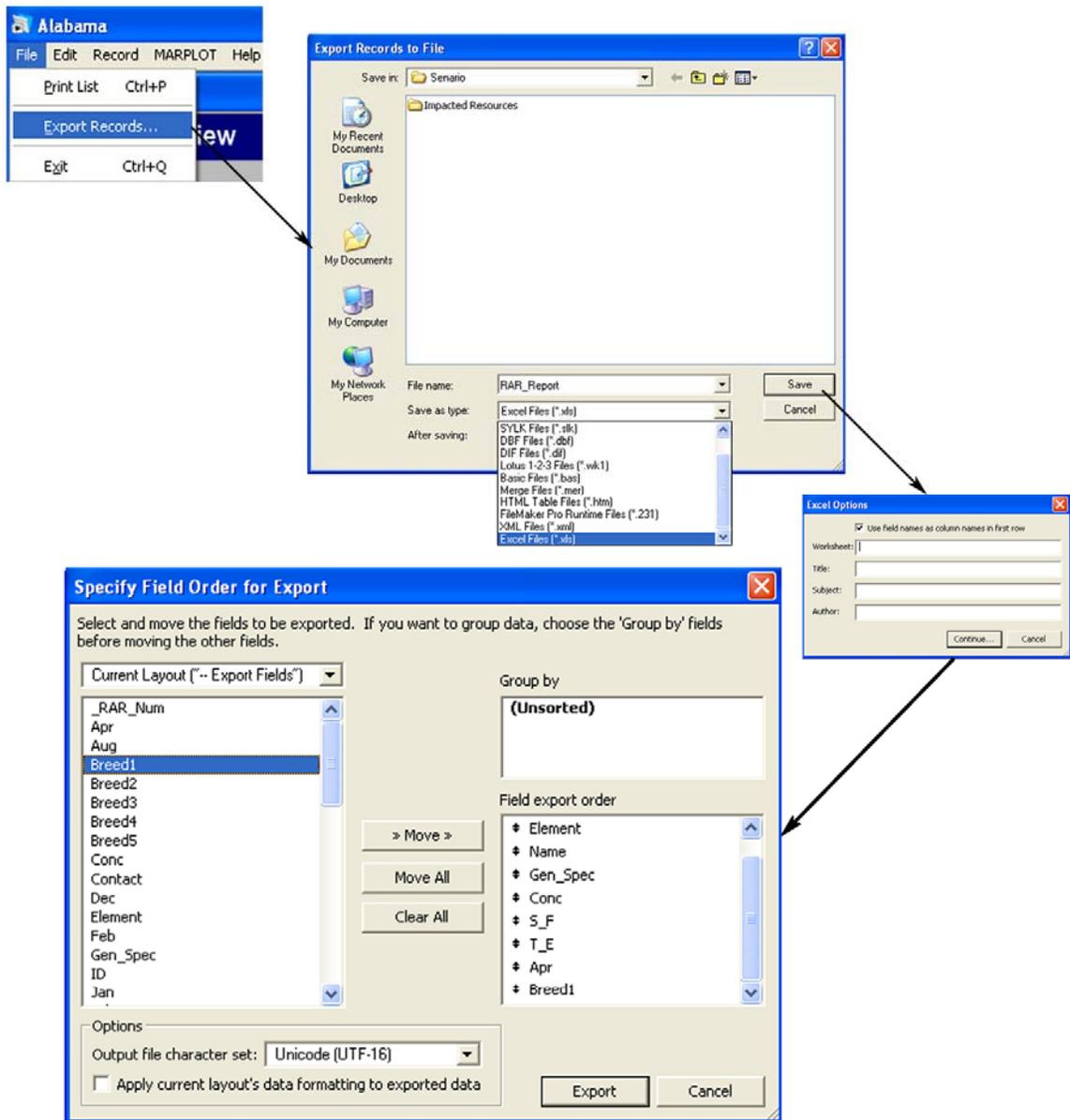
Method 1:

- a) From MARPLOT, under the *Sharing* menu, select *Alabama ESI -> Get Info*, or, use the keyboard shortcut *Ctrl + I*.
- b) In the bottom right corner of the List window, click on *Print List*. This is the easiest way to produce a hard copy or PDF version of the report. Remember, this list will include all of the birds found in the selected polygons.

Method 2: (illustrated on the next page)

- a) From MARPLOT, under the *Sharing* menu, select *Alabama ESI -> Get Info*, or, use the keyboard shortcut *Ctrl + I*.
- b) Under the *File* menu, select *Export Records...*
- c) In the Export Records to File window:
 1. Navigate to the directory where you want to save the report.
 2. Use the drop down *Save as type* menu to select the type of file to create. (In the example diagram, the file will be exported into an Excel spreadsheet. You may need to use the scroll bar to see this option).
 3. Name the report
 4. Click on *Save*
- d) In the Excel Options window, click on *Continue*.
- e) In the Specify Field window, highlight the items you wish to save in your report and click *Move* to move them into the export list on the right side of the screen. Choose to export *_RAR_Num*, *Element*, *Name*, *Gen_Spec*, *Conc*, *S_F*, *T_E*, *Apr*, and *Breed1*.
- f) Click on *Export*.
- g) Navigate to the directory where the Excel report was saved, and open the report.

On the following page is a schematic of the Method 2 process, as well as a sample of the Excel output.



	A	B	C	D	E	F	G	H	I
1	RAR_Num	Element	Name	Gen_Spec	Conc	S_F	T_E	Apr	Breed1
2	00003	BIRD	American oystercatcher	Haematopus palliatus	-	S	P		-
3	00003	BIRD	Black skimmer	Rynchops niger	-			X	MAY-JUL
4	00003	BIRD	Black tern	Chlidonias niger	-			X	-
5	00003	BIRD	Black-crowned night-heron	Nycticorax nycticorax	25-PAIRS			X	APR-JUN
6	00003	BIRD	Black-necked stilt	Himantopus mexicanus	-			X	MAY-JUL
7	00003	BIRD	Brown pelican	Pelecanus occidentalis	4000-5000-PAIRS			X	MAY-JUL
8	00003	BIRD	Caspian tern	Sterna caspia	200-600-PAIRS			X	JUN-JUL
9	00003	BIRD	Cattle egret	Bubulcus ibis	200-PAIRS			X	MAY-JUN
10	00003	BIRD	Common tern	Sterna hirundo	-			X	MAY-JUN
11	00003	BIRD	Gull-billed tern	Sterna nilotica	25-PAIRS	S	P	X	MAY-JUL
12	00003	BIRD	Laughing gull	Larus atricilla	4000-5000-PAIRS			X	JUN-JUL
13	00003	BIRD	Little blue heron	Egretta caerulea	-			X	APR-JUN

Schematic of Method 2 Risk Report

Conclusions

The intent of these exercises is to demonstrate the content of the ESI maps and database as well as provide an introduction into three of the ESI distribution formats. These techniques can be extended to other scenarios and types of queries. Although this example looks at resources impacted by an oil spill, the content of the ESI maps may be useful in any number of different types of applications, such as coastal planning and permitting, habitat protection and restoration, tourism management, etc.

Whenever using the ESI maps, keep in mind they reflect a snapshot in time. The maps should be used as a starting point. The metadata, introductory pages and source information can guide you to local resources who can confirm the presence of the biologic resources mapped and provide updates on life stages present and other important considerations.

At this time about one half of the ESI maps are available in the formats presented here. An effort is underway to redistribute many of the older atlases in these formats as well. This is in addition to the cyclic updates of the ESI data as funds are available. All of the new ESI atlases will be published in these, as well as other, GIS formats. Check the ESI website (<http://response/restoration.noaa.gov/esi>) for atlas availability and additional tools (or updates to tools) for the ESRI geodatabase.

Any comments or questions on this tutorial or ESIs in general may be sent to: orr.esi@noaa.gov.

Appendix A – Zones and Longitude Ranges for the UTM Projection

Zone	Central Meridian	Longitude Range	Zone	Central Meridian	Longitude Range
1	177W	180W – 174W	31	3E	0-6E
2	171W	174W -168W	32	9E	6E-12E
3	165W	168W – 162W	33	15E	12E-18E
4	159W	162W – 156W	34	21E	18E-24E
5	153W	156W – 150W	35	27E	24E-30E
6	147W	150W – 144W	36	33E	30E-36E
7	141W	144W – 138W	37	39E	36E-42E
8	135W	138W – 132W	38	45E	42E-48E
9	129W	132W – 126W	39	51E	48E-54E
10	123W	126W – 120W	40	57E	54E-60E
11	117W	120W – 114W	41	63E	60E-66E
12	111W	114W – 108W	42	69E	66E-72E
13	105W	108W – 102W	43	75E	72E-78E
14	99W	102W – 96W	44	81E	78E-84E
15	93W	96W – 90W	45	87E	84E-90E
16	87W	90W – 84W	46	93E	90E-96E
17	81W	84W – 78W	47	99E	96E-102E
18	75W	78W – 72W	48	105E	102E-108E
19	69W	72W – 66W	49	111E	108E-114E
20	63W	66W – 60W	50	117E	114E-120E
21	57W	60W – 54W	51	123E	120E-126E
22	51W	54W – 48W	52	129E	126E-132E
23	45W	48W – 42W	53	135E	132E-138E
24	39W	42W – 36W	54	141E	138E-144E
25	33W	36W – 30W	55	147E	144E-150E
26	27W	30W – 24W	56	153E	150E-156E
27	21W	24W – 18W	57	159E	156E-162E
28	15W	18W – 12W	58	165E	162E-168E
29	9W	12W – 6W	59	171E	168E-174E
30	3W	6W – 0	60	177E	174E-180E

Appendix B – Creating a trajectory layer in ArcMap

To make your own trajectory layer, you first need to create a shapefile to put it in. This requires ArcCatalog.

Task 1: Create a shapefile:

- a) Launch ArcCatalog.
- b) Select a folder or folder connection in the Catalog tree.
- c) Click the File menu, point to New, and click Shapefile.
- d) Click in the Name text box and type the name “Trajectory”
- e) Click the Feature Type drop-down arrow and select Polygon
- f) Click Edit to define the shapefile's coordinate system.
 1. Select Import...
 2. Browse to the directory where the ESI geodatabase resides
 3. Double-click on the geodatabase icon
 4. Select hydro_polygon as the coordinate system to use
 5. Click OK to accept the new coordinate system
 6. Click OK in the New Shapefile dialog box to complete the process
- g) Close ArcCatalog

Task 2: Set up an edit session:

- a) Launch the Alabama ESI map project by double-clicking the alabamaESI.mxd icon, or by opening it from within ArcMap (for simplicity, the Alabama ESI is referenced here, but you can use these instructions with which ever ESI atlas you are using.)
- b) Click the Add Data button , and add the Trajectory file you created in Task 1
- c) Under the menu Tools, select Editor Toolbar (if the toolbar is not already visible)
- d) On the Editor toolbar, click the drop down menu Editor and select *Start Editing*.
 - a. Set the folder or database source to the directory where the Trajectory file resides
 - b. Click OK
- e) From the drop down menu Task, select Create New Feature
- f) From the drop down menu Target, select Trajectory

Task 3: Sketch the trajectory footprint

- a) Zoom into the area where you want to place the trajectory footprint
- b) Using the sketch tool , click where you want the polygon to start
- c) Continue the polygon sketch by clicking where you want the shape points
- d) When your shape is defined, double click to have the polygon auto-complete

Since we only use the uncertainty bounds in our resource analysis, there is no need to enter any other polygons.

- e) Under the Editor drop down menu, select Stop Editing
- f) When prompted whether to save your edits, click Yes

Task 4: Clip the trajectory to the shoreline

Although the following method may seem a bit convoluted, it was chosen because it can be completed successfully with any ArcMap license.

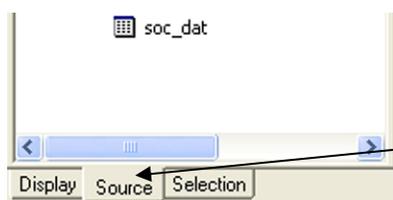
- a) If it is not visible, add the toolbox by clicking the toolbox icon 
- b) In the toolbox, navigate to Analysis Tools -> Overlay -> Union and double click
- c) Under Input Features, use the drop down menu to select and add the layers Trajectory and Hydro
- d) Under Output Feature Class, navigate to the directory where you want the output stored , and name the shapefile Trajectory2
- e) Click OK
- f) On the Editor toolbar, use the drop down menu under Editor to select Start Editing
- g) Set Task: to Create New Feature, and Target: to Trajectory2
- h) Under the main menu, go to Selection -> Select by Attributes...
- i) Set the Layer to Trajectory 2, Method to Create a new selection
- j) Set your query to "WATER_CODE" <> ''
- k) Click OK.
- l) At this point, all of the polygons that are not in the open water should be selected. Use the Delete key to remove these polygons.
- m) Under the Editor drop down menu, select Stop Editing. When prompted choose to save your edits.

You may now symbolize the Trajectory2 layer. Choose a polygon with no fill and an outline in red to match the standard trajectory colors. Trajectory2 is now ready for use in place of the GNOME trajectory imported in the ArcMap example.

Appendix C – The ESI tools and Relates in the ESI Geodatabase

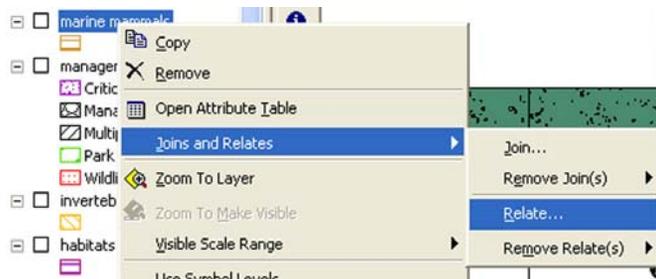
Each atlas comes with a map document (.mxd) that has the ESI data loaded, symbolized and linked to the data tables. In order for the ESI tools to work, these links (relates) must be established and have specific names that the tools will recognize. If at any time the relates quit working, or if you want to put the ESI data into another map document, the following will guide you through the requirements and naming conventions for establishing the ESI data links. Layer files are also included on the ESI CD/DVDs. These are located in the same directory as the ESI .mxd. The layer files have the symbolization and relates set up and can be loaded into other map documents. As long as the attribute tables (see step *a* below) are also loaded into the .mxd, the tools should function properly.

- a) Use the add data tool  to load the attribute tables. To query the **biology** layers, you will need to have the *biofile* and *breed_dt* tables loaded into the .mxd. To query the human use layers (socecon points and management), you will need to have the *soc_dat* table loaded. You may also want to load the *sources* data table, as both the biofile and the soc_dat table have links to this as well.



To check if the attribute tables have already been loaded, click on the **Source** tab at the bottom of the table of contents. Any data tables you have available will be listed in the window above.

- b) Define the relate between any biology layer and the biofile.

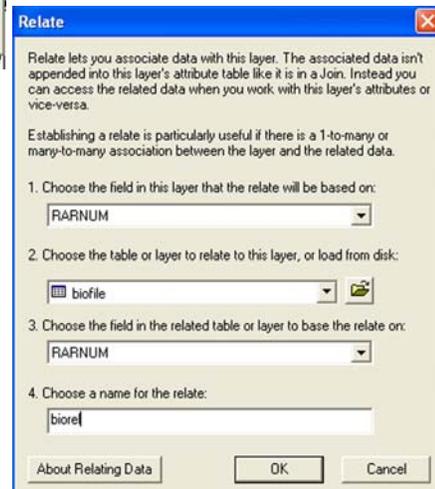


- 1) Right-click on the desired biology layer
- 2) Select **Joins and Relates > Relate...**

3) In the Relate dialog box, set:

1. ...field in this layer.... to **RARNUM**
2. ...table or layer to relate to... to **biofile**
3. ...field in the related table... to **RARNUM**
4. ...name for the relate: to **biorel**

- c) Repeat this process for any of the biology layers you wish to query.



- d) Set up the relate between the biofile and the breed_dt file. Follow the same steps shown above...
 1. Right-click on the table name biofile
 2. Select ***Joins and Relates > Relate...***
 3. Set the dialog box as follows: 1) ***BREED***, 2) ***breed_dt***, 3) ***BREED***, 4) ***breedrel***
- e) Set up the relates from the biofile to the sources table for the geographic source:
 1. Right-click on the table name biofile
 2. Select ***Joins and Relates > Relate...***
 3. Set the dialog box as follows: 1) ***g_source***, 2) ***sources***, 3) ***source_id***, 4) ***gsourcerel***
 Then set it up for the seasonality source:
 1. Right-click on the table name biofile
 2. Select ***Joins and Relates > Relate...***
 3. Set the dialog box as follows: 1) ***s_source***, 2) ***sources***, 3) ***source_id***, 4) ***ssourcerel***
- f) Define the relates between the human use layers (socecon points and management) and the soc_dat file:
 1. Right-click on the desired human use layer name
 2. Select ***Joins and Relates > Relate...***
 3. Set the dialog box as follows: 1) ***HUNUM***, 2) ***soc_dat***, 3) ***HUNUM***, 4) ***socrel***
- g) As in step e, define the relates from the soc_dat table to the sources table, only name the geographic relate ***gsource*** and the attribute source ***asource***

Following these steps, you should be able to use the ESI data and the ESI tools in either the .mxd provided, or in any map project you may already have set up for an area. Just remember, it is imperative to keep the names of the relates as specified here in order for the ESI tools to recognize the relationship. All links between the ESI tables are set up as relates (not joins), as in all cases the relationship between tables is many to many.