

# Harbor Seal GIS: Population Distribution in Southern Massachusetts



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2009

# Outline

- Background
- Aerial Surveys
- Objectives
- Database
- Models
- Preliminary Results
- Conclusion



# Background

- The Harbor Seal Population in Southern New England is not well understood
- Seals have been protected since the 1970's by the Marine Mammal Protection Act
- Seal populations are thought to be increasing
- Species are not endangered, so receive little research funding
- Aerial surveys have been conducted since 2005
- Data has not yet been analyzed

# Aerial Surveys

- NOAA Twin Otter
- Monthly: Oct - May
- 750'
- Canon EOS-1Ds  
Mark II 16mp, 300mm
- Observer + data  
recorder
- Low tide
- Weather...



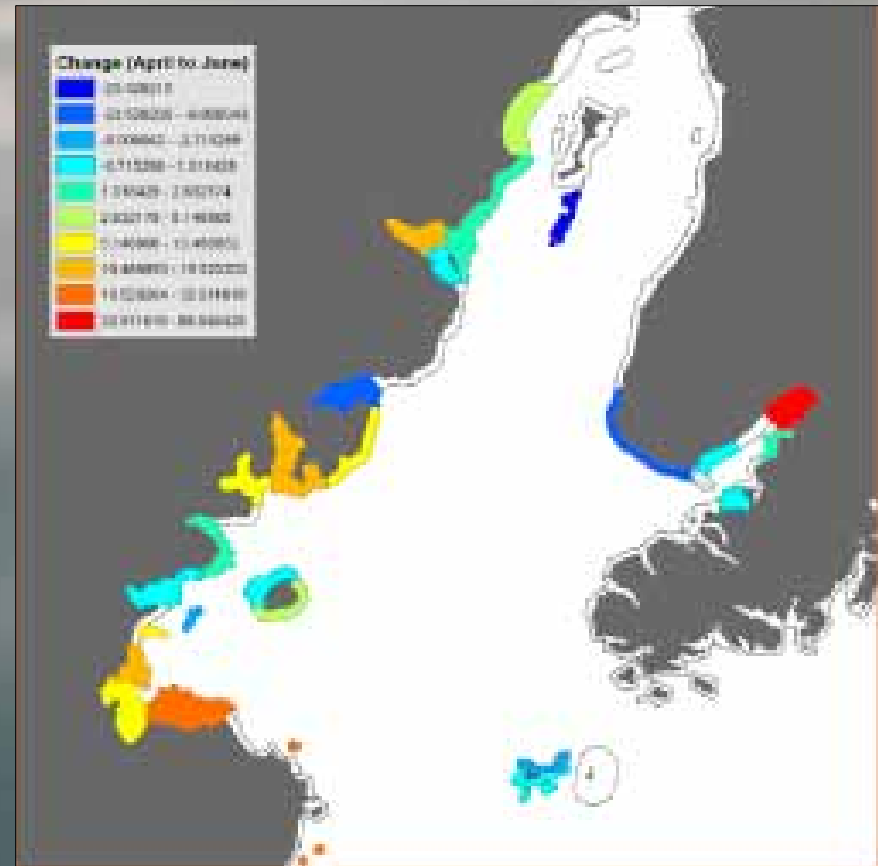
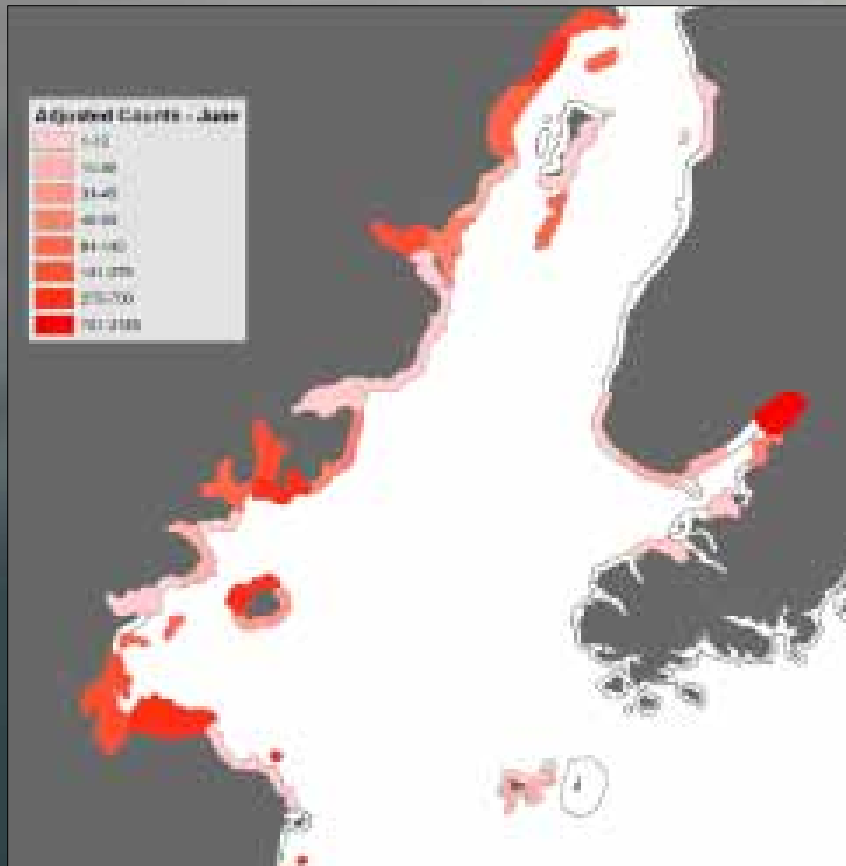
# Study Area



# Objectives

- Develop database
- Develop models to analyze data
  - Extract survey count totals
  - Depict distribution and changes
  - Assess environmental variables
- Provide GIS to NOAA scientists with User Manual
- Use information from other harbor seal research

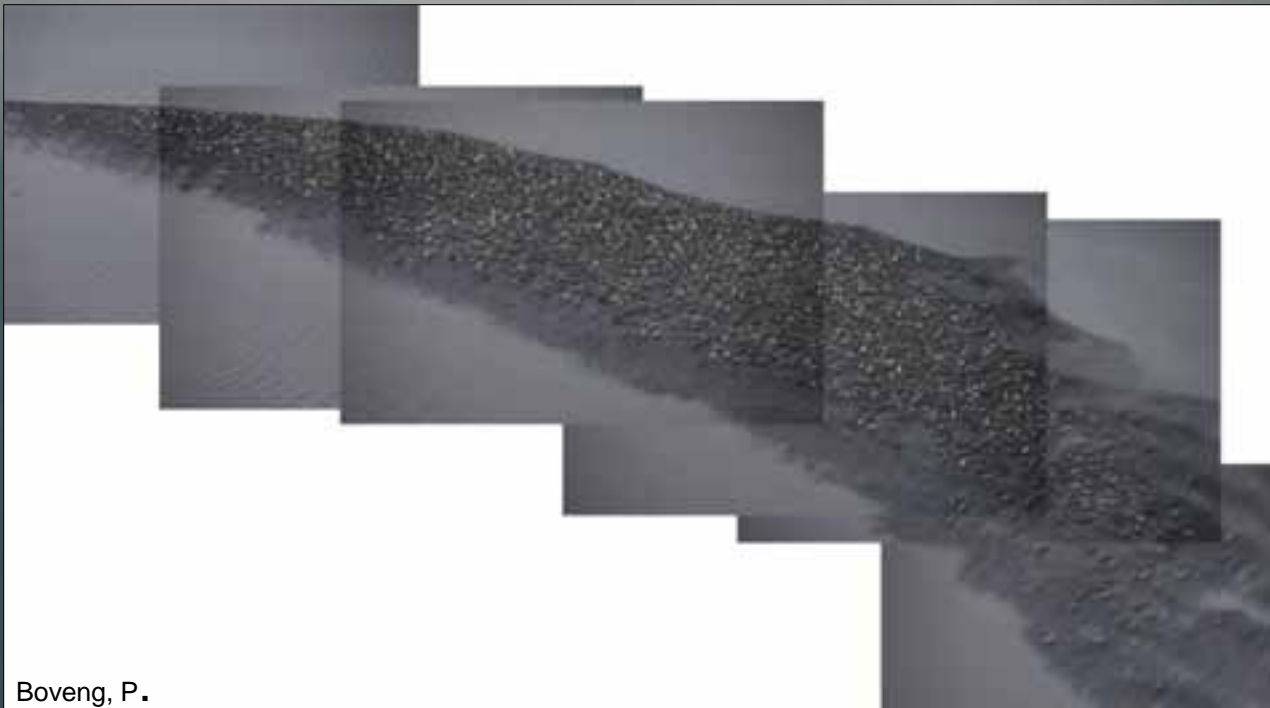
# Alaska Harbor Seals



Boveng, P. (2004)

# Alaska Harbor Seals

- Long term study
- Well funded
- Variables affect haulout behavior



Boveng, P.



# Environmental Variables

- Wind speed
- Temperature
- Low Tide

## Other Variables

- Time of year
- Site-specific weather conditions
- Competition with gray seals

# Constraints

- ArcView
- Access → Personal Geodatabase
- Spatial Analyst
- Simple data entry and analysis

# Database

- Access → Personal Geodatabase
- Very crude initial database
- Complete redesign
- Data cleaning!
- Data entry forms
- Data acquisition

# Database

- Tables for aerial survey data:
  - Flight Information
  - Site Specific Information
  - Seal Counts
- Tables for environmental data:
  - Tide
  - Weather
- Tables for relating data:
  - Haulout, Tide, Weather

# Database: Forms

Flight Information

## Flight Informaton

Date  | Alt Date  0 Enter date in YYYYMMDD format.  
Example: 2/20/2005 would be 20050220

Off Blocks  On Blocks

Pilot  Copilot

Data Recorder  Photographer

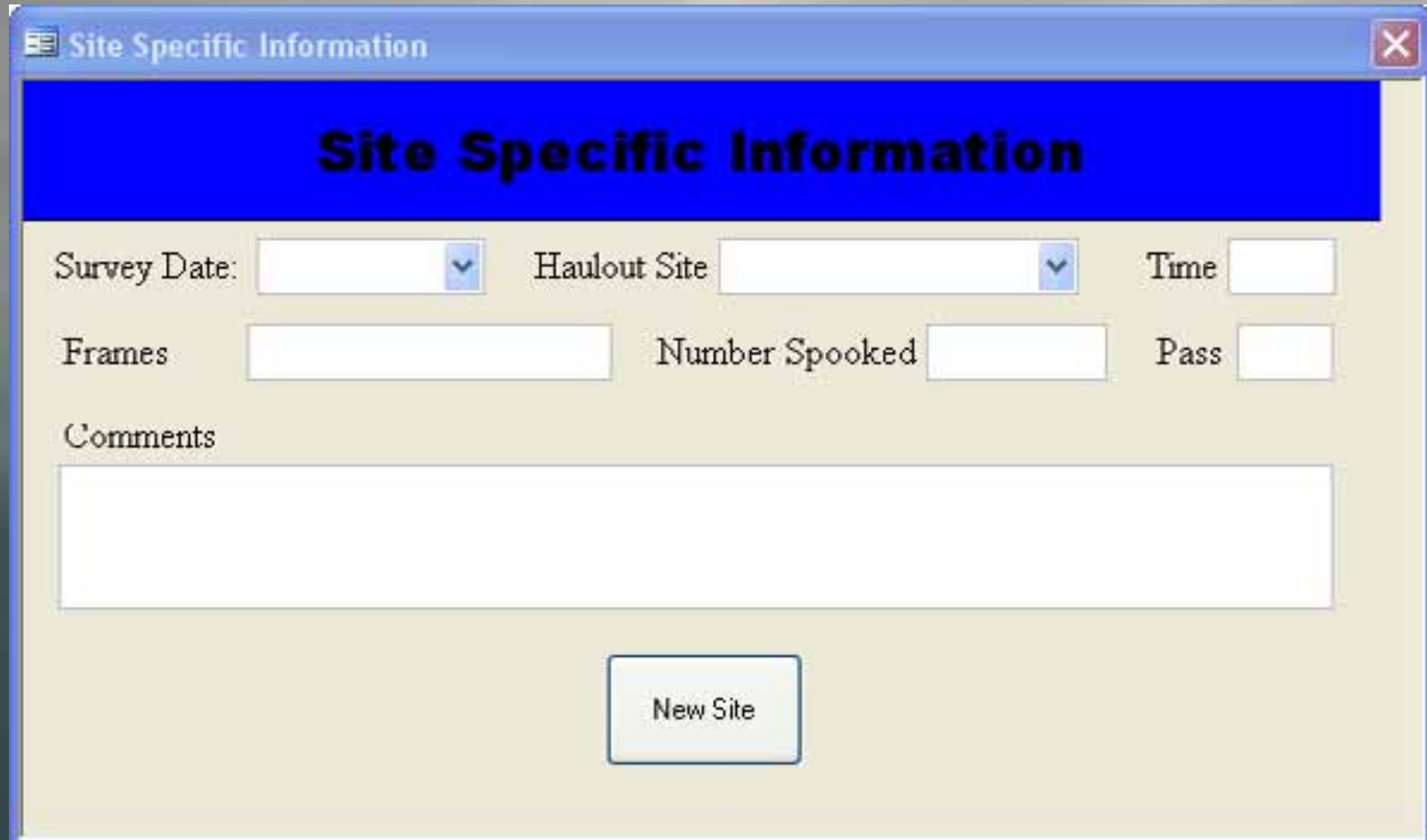
Camera Information:

Altitude  Cloud Cover  Precipitation

Comments:

New Flight

# Database: Forms



The image shows a screenshot of a software window titled "Site Specific Information". The window has a blue title bar with a close button (X) in the top right corner. Below the title bar is a blue header area with the text "Site Specific Information" in white. The main content area is light beige and contains several input fields and a button. The fields are arranged in two rows: "Survey Date" (with a dropdown arrow), "Haulout Site" (with a dropdown arrow), and "Time" in the first row; "Frames", "Number Spooked", and "Pass" in the second row. Below these fields is a large text area labeled "Comments". At the bottom center of the window is a button labeled "New Site".

Site Specific Information

**Site Specific Information**

Survey Date:  Haulout Site  Time

Frames  Number Spooked  Pass

Comments

New Site

# Database: Forms

Seal Counts

**Seal Counts**

Photo Date  Haulout Site

ImageNumber  Counted by  on 4/15/2009

Photo Notes


Harbor Seals	Gray Seals	Harbor/Gray	Ice Seals
Nonpups <input type="text"/> 0	Nonpups <input type="text"/> 0	Hauled out <input type="text"/> 0	Harp <input type="text"/> 0
Pups <input type="text"/> 0	Pups <input type="text"/> 0	In water <input type="text"/> 0	Hooded <input type="text"/> 0
In water <input type="text"/> 0	In water <input type="text"/> 0		Unidentified <input type="text"/> 0
	Males <input type="text"/> 0	<small>(enter the number you can id, so the nonpups field is those you can't sex)</small>	

Human Interaction

Other Observations

New Photo

# Database: Forms



The image shows a screenshot of a web-based form titled "Tides". The form is contained within a window with a blue title bar and a close button in the top right corner. The form itself has a blue header with the word "Tides" in white. Below the header, there are several input fields and a button. The "Tide Station" field is a dropdown menu with "Woods Hole Oceanographic Institution" selected. The "Date" field is an empty dropdown menu. The "Time of Low Tide" field is an empty text input box, with a note to the right stating "Enter time in 24hr format. Example: 3:32PM would be 15:32". The "TideHeight" field consists of two adjacent text input boxes, the first containing "0" and the second containing "L". At the bottom center of the form is a button labeled "Next Tide".

**Tides**

Tide Station

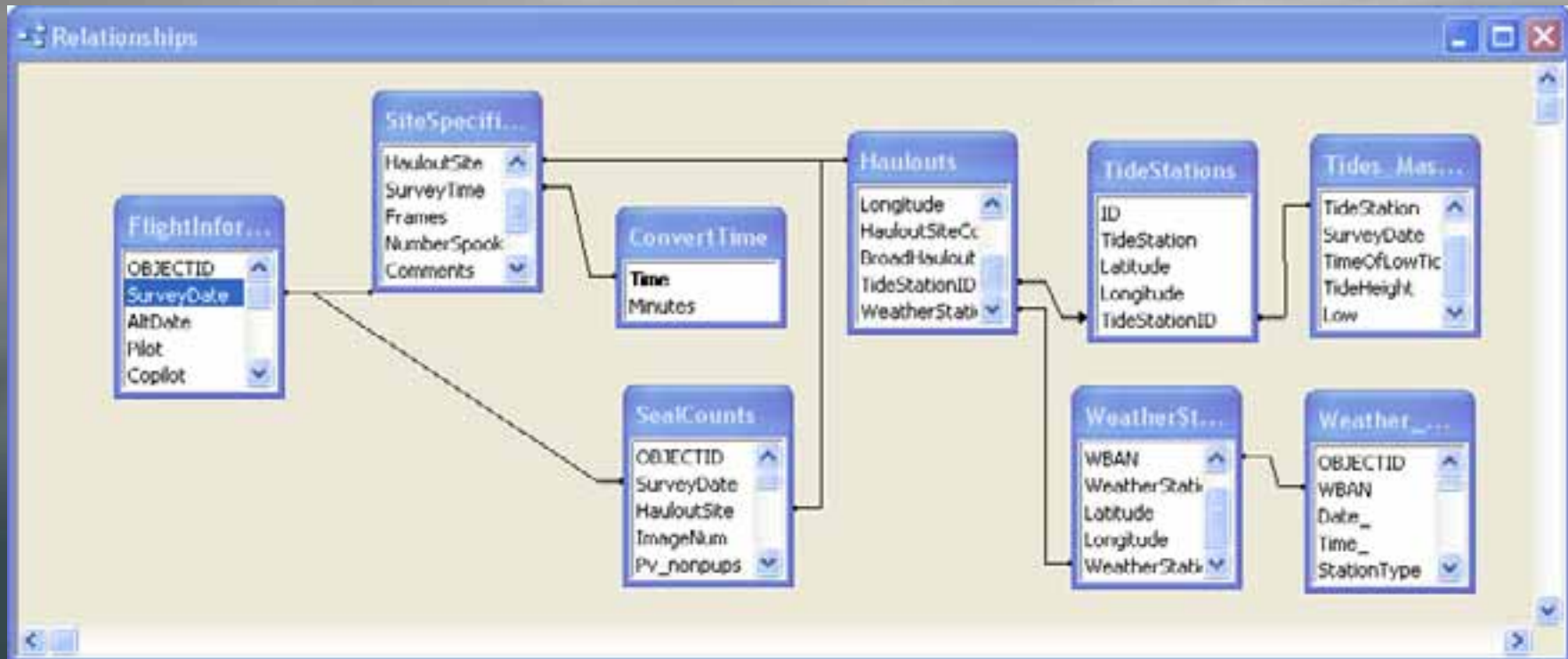
Date

Time of Low Tide  Enter time in 24hr format.  
Example: 3:32PM would be 15:32

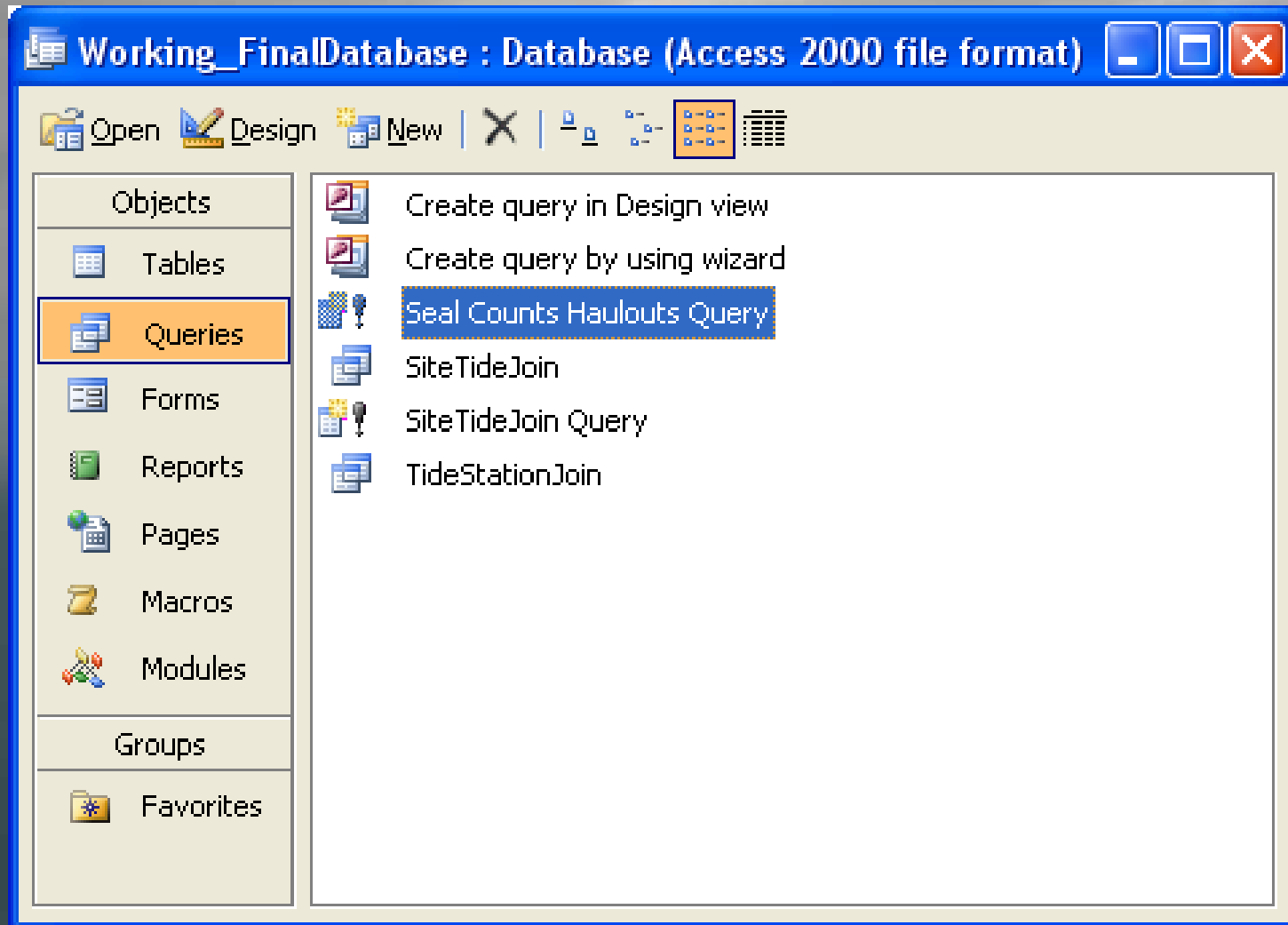
TideHeight



# Database: Relationships



# Database: Queries



# Database: Data Acquisition

- Photo counts
- Tide data
- Weather data

# Data Acquisition: Tide Data

The screenshot shows the NOAA Tides & Currents website. At the top, there is a search bar and navigation links for Home, Products, Programs, Partnerships, Education, and Help. Below this is a navigation bar with a search box for NOS Stations and a NOAA NOS/CO-OPS logo. The main heading is "Center for Operational Oceanographic Products and Services" with the tagline "Turning operational oceanographic data into meaningful information for the Nation". A map of the United States is displayed in the center, with numerous blue pins indicating data stations along the coastlines. Below the map is a caption: "Click map to access data and products". To the left of the map are several sidebar panels: "News and Alerts" with three entries, "Tides/Water Levels" with a list of data types, and "Hazardous Algal Blooms (HAB)" with one entry. To the right of the map are three more sidebar panels: "PORTS" with a dropdown menu, "Currents" with a list of data types, and "Operational Forecast Systems" with a dropdown menu. At the bottom right, there is a "Tides/Web Services" panel with a list of links. The footer contains links for Documents, Contact Us, Privacy Policy, About CO-OPS, For CO-OPS Employees Only, Revised 04/03/2009, and NOAA / National Ocean Service.

**News and Alerts**

- [2009-11-04] 2009 Tide Predictions are now online!
- [2009-11-04] 2009 Current Predictions are now online!
- [2009-09-29] Hurricane Gustav Water Levels and Waterways of Data Report is now available on the publication page (PDF)

**Tides/Water Levels**

- Preliminary Data
  - Coastal Stations
  - Great Lakes
- Verified Data
  - Coastal Stations
  - Great Lakes
- 1 min. Water Level Data
- Tide Tables
- Graphical Predictions
- Harmonic Constituents
- Datasets
  - Present Epoch
  - Superseded Epoch
- Benchmarks
  - Present Epoch
  - Superseded Epoch
- Sea Level Trends
  - CO-OPS Stations
  - Global Stations

**Hazardous Algal Blooms (HAB)**

- Gulf of Mexico

**PORTS**

- PORTS
  - Select a PORT
- MyPORTS: Create a Custom View [View!](#)

**Currents**

- Current Observations
- Tidal Current Tables

**Operational Forecast Systems**

- OFS
  - Select an OFS

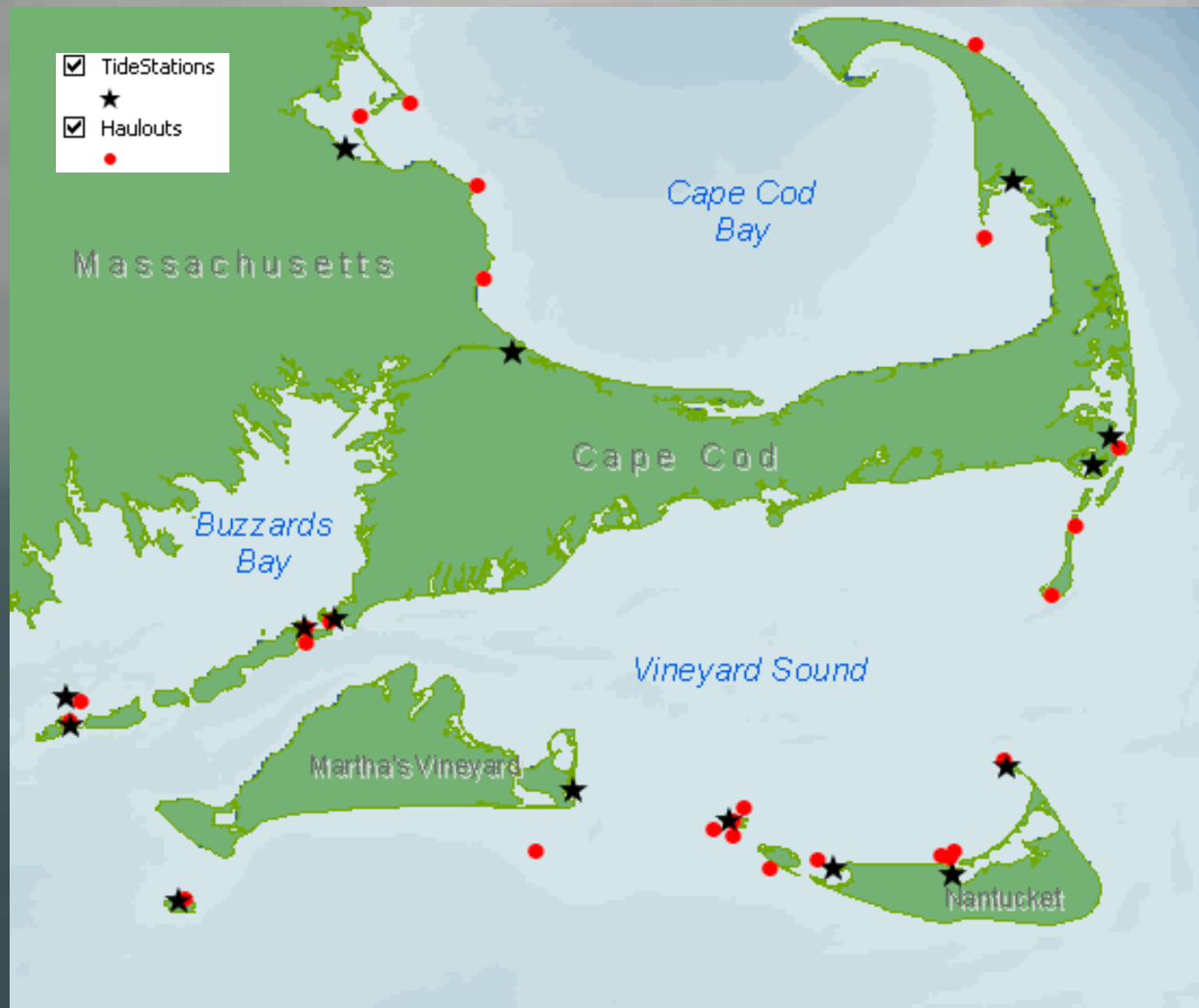
**Tides/Web Services**

- Tides Online
- Great Lakes Online
- SOOS Data Portal
- newCOAST
- CO-OPS Publications
- Storm-Quicklooks
- Google Earth/KML Files


CO-OPS provides the national infrastructure, science, and technical expertise to monitor, assess, and distribute tide, current, water level, and other coastal oceanographic products and services that support NOAA's mission of environmental stewardship and environmental assessment and prediction. CO-OPS provides operationally sound observations and monitoring capabilities coupled with operational Nowcast Forecast modeling.


Documents | Contact Us | Privacy Policy | About CO-OPS | For CO-OPS Employees Only | Revised 04/03/2009 | NOAA / National Ocean Service

# Acquisition: Tide Data




# Data Acquisition: Weather Data

 NOAA Satellite and Information Service  
National Environmental Satellite, Data, and Information Service (NESDIS)

 National Climatic Data Center  
U.S. Department of Commerce

[DOC](#) > [NOAA](#) > [NESDIS](#) > [NCDC](#)

[NCDC](#) / [Climate-Radar Data Inventories](#) / [Locate Station](#) / [Search](#) / [Help](#)



*WebClimate Version 2.5*

## Locate Weather Observation Station Record

*U.S. Controlled Stations Only At This Time*

### Locate Station by:

- [Latitude/Longitude](#)
- [State/Division/County/City](#)
- [List Radar Stations by Name / by Map](#)
- Search By: *Select the field you wish to search*
  - Station Name  / City  *(city not identified in some records)*
  - Zip Code
  - State  *(use two character abbreviation)*
  - County  *(county not identified in some records)*
  - WBAN #
  - Call Sign
  - Cooperative Station ID#
  - World Meteorological Organization ID#

*Enter the value you wish to find,*

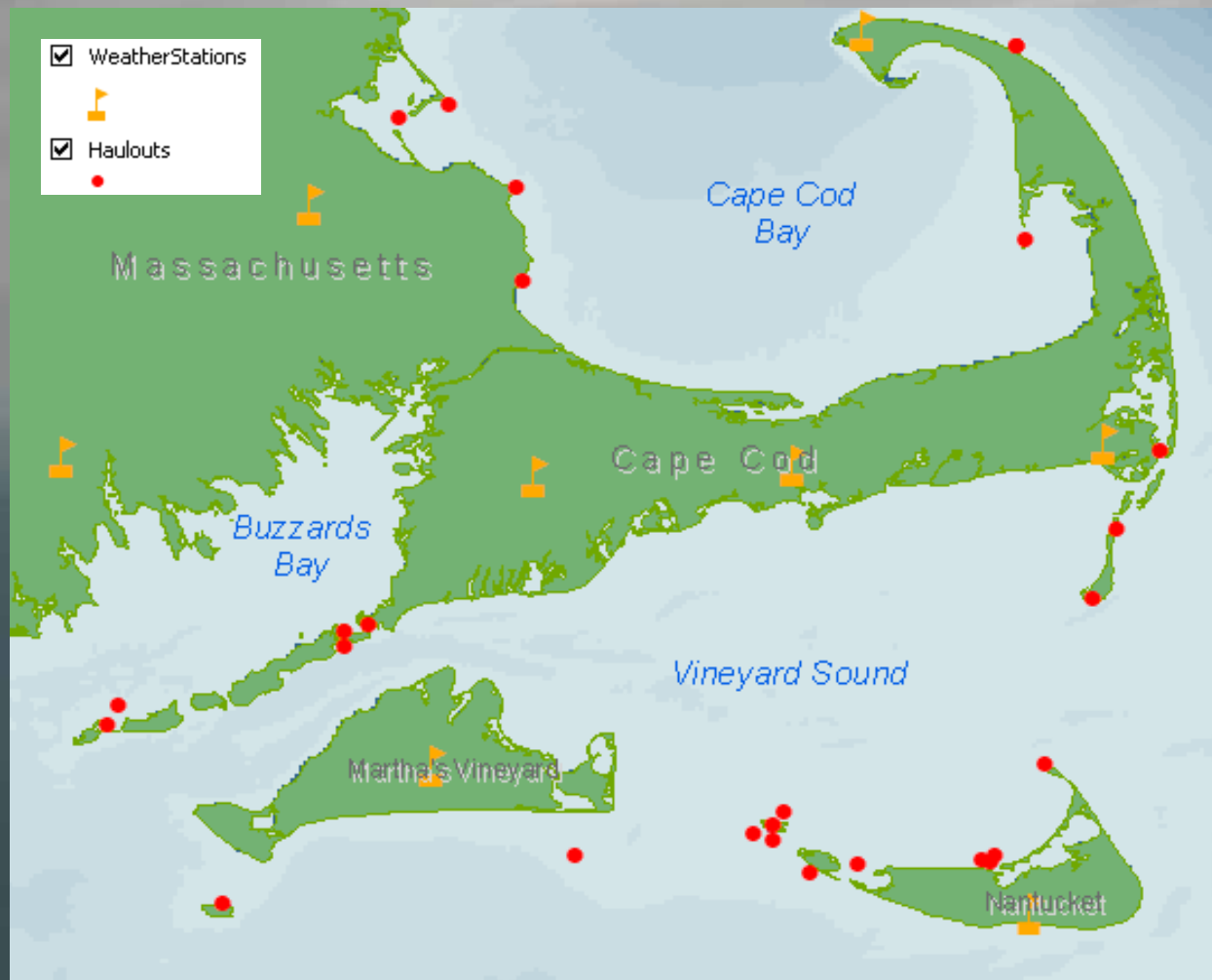
[List of Stations with Photographs Available On Line](#)

[Station Metadata \(MMS\)](#)

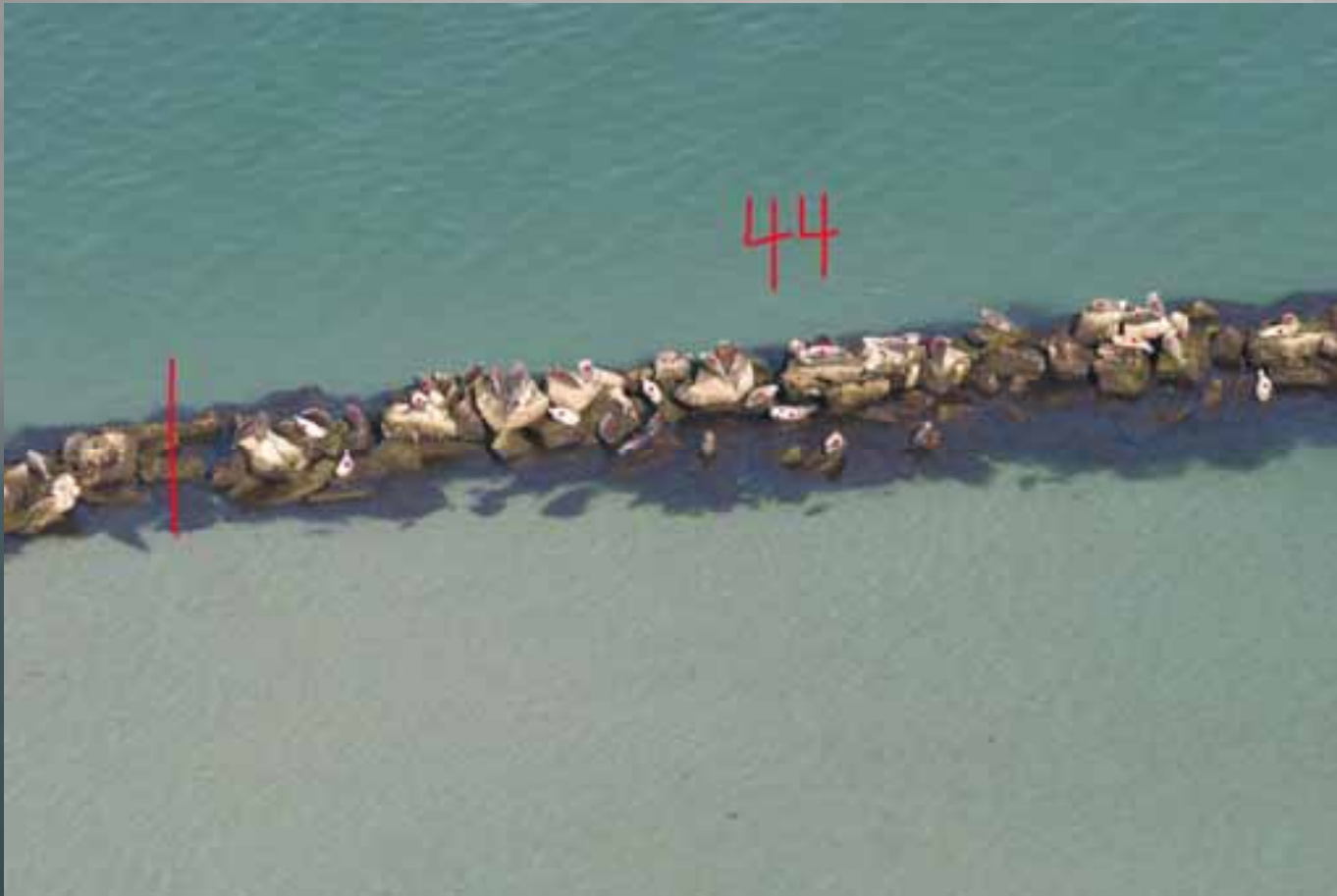
[Observers Privacy Policy](#)

*Additional [Options](#) are available.*

# Acquisition: Weather Data

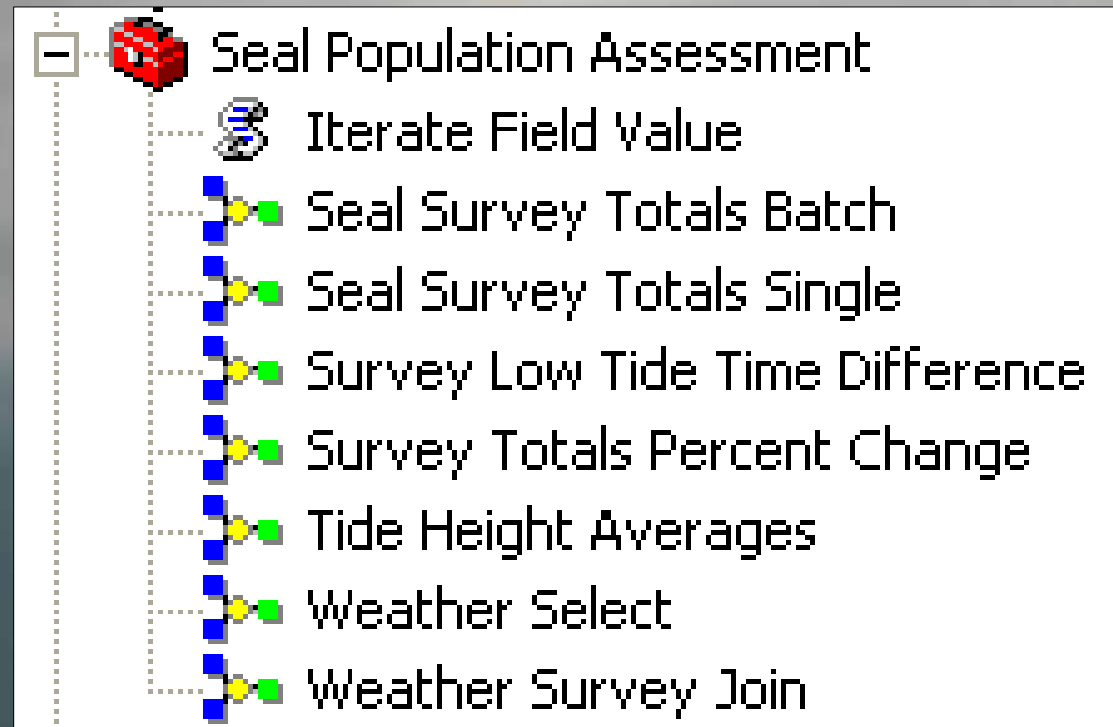


# Data Acquisition: Seal Counts

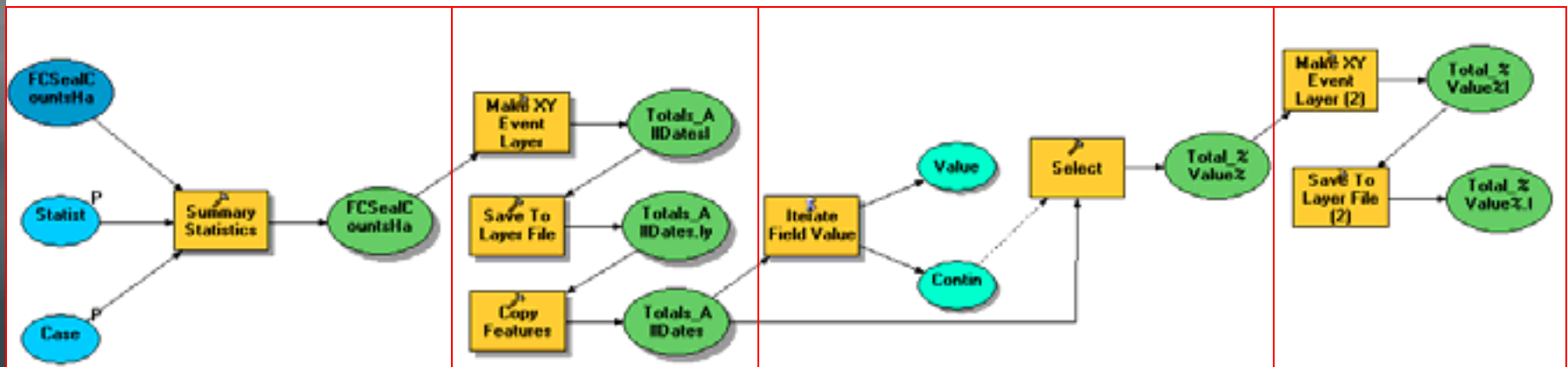




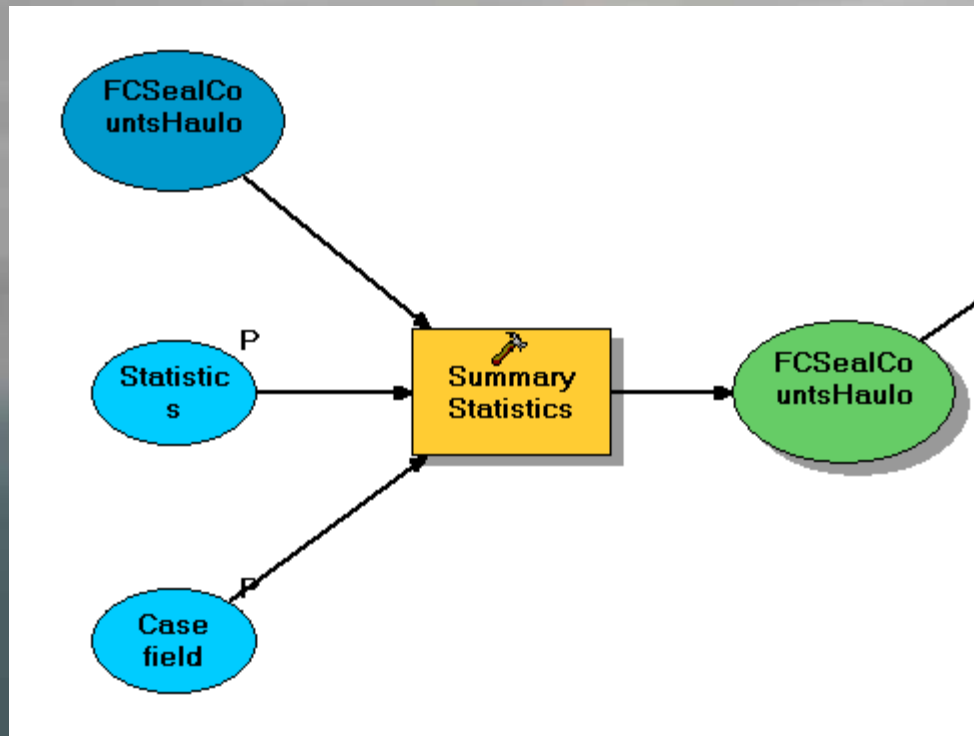
# GIS: Models



# Model: Seal Survey Totals Batch



# Batch: Summary Statistics



# Batch: User Parameters

Seal Survey Totals Batch

Case field (optional)

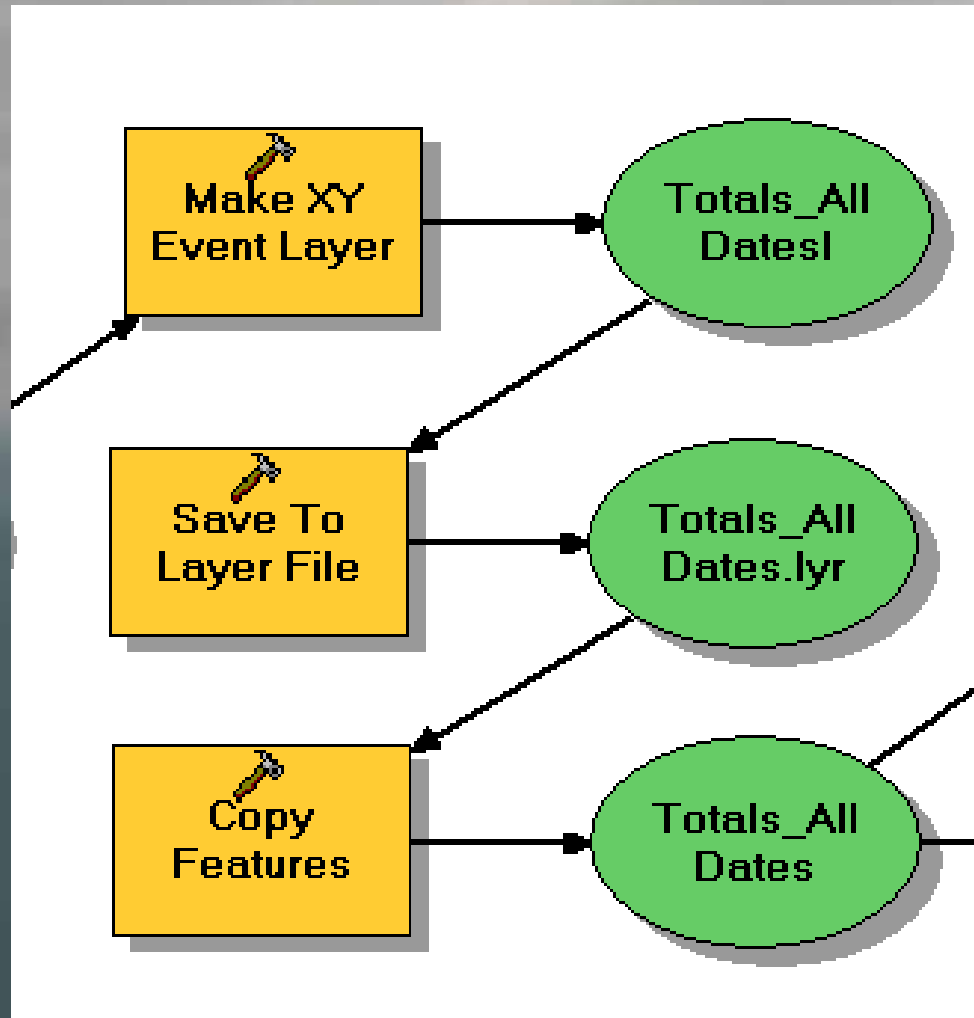
SurveyDate  
HauloutSite

Statistics Field(s)

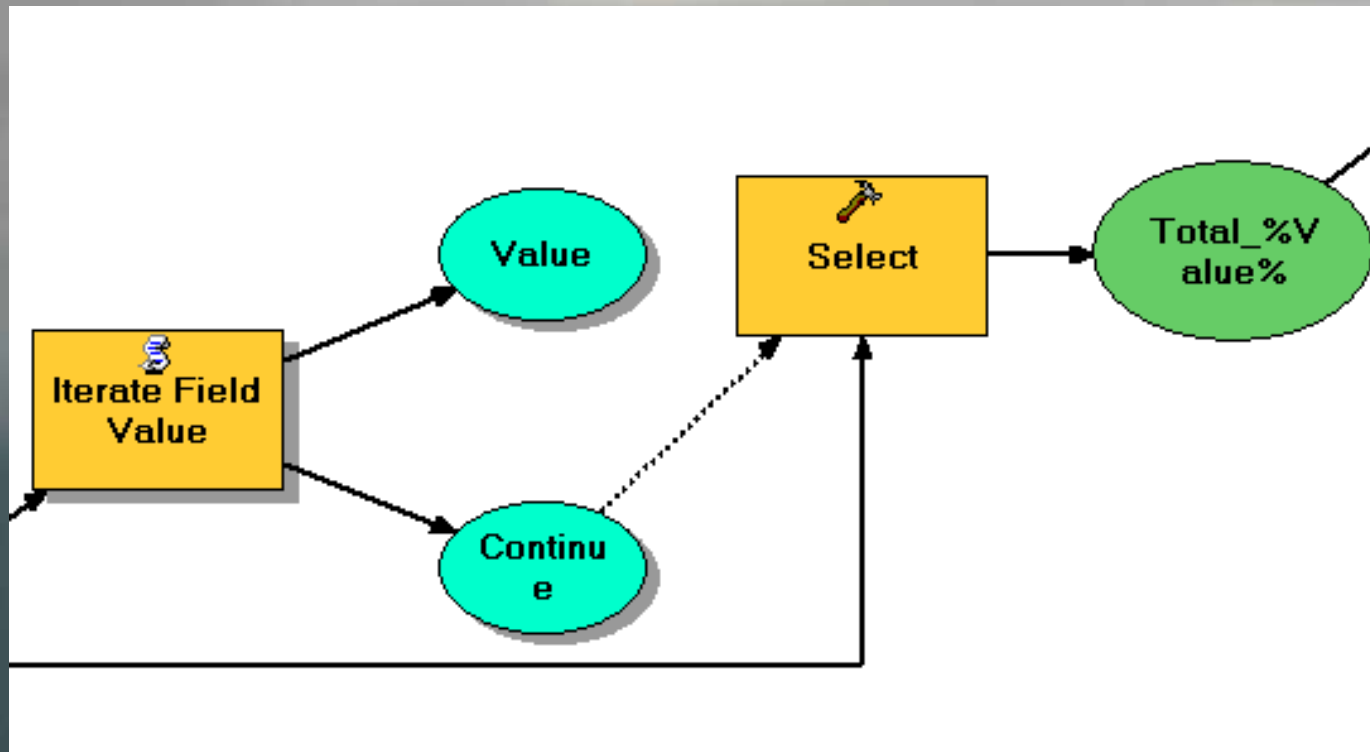
Pv_nonpups	SUM
Pv_Pups	SUM
Pv_in_H2O	SUM
Hg_Pups	SUM
Hg_nonpups	SUM
Unid_Pv_Hg	SUM
Harp	SUM
Hooded	SUM
Uld_ice seals	SUM

OK Cancel Environments... Show Help >>

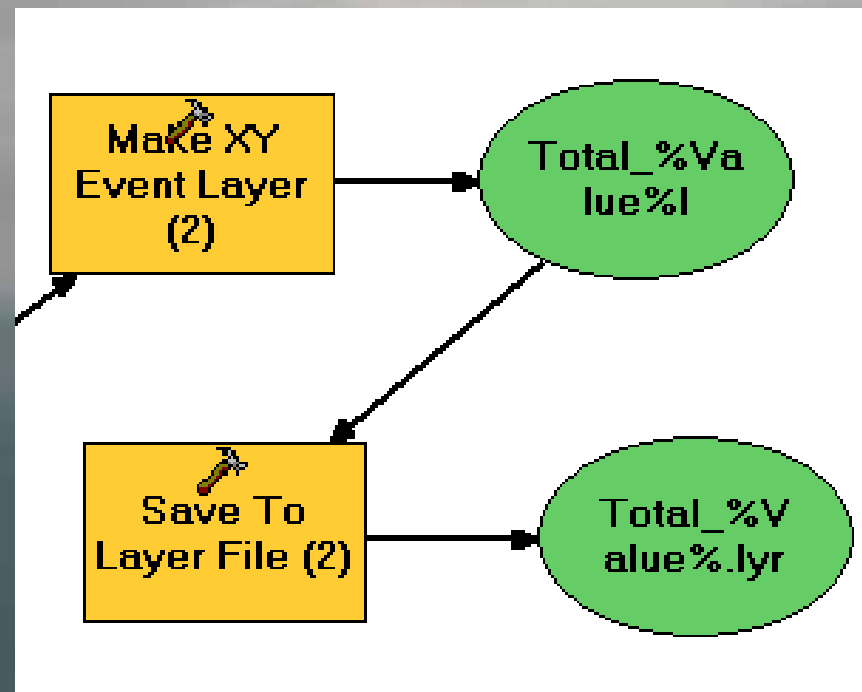
# Batch: Create FC & Layer



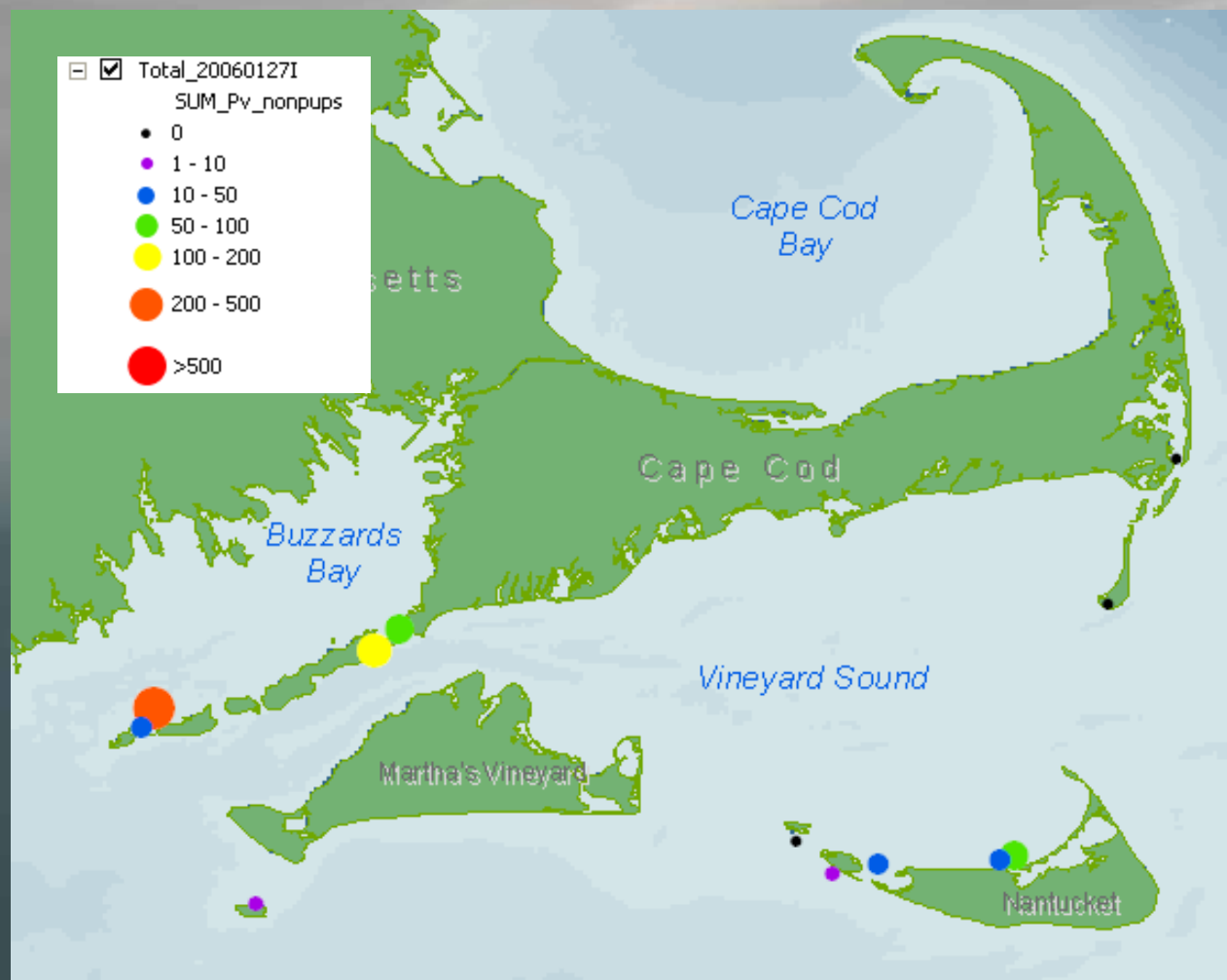
# Batch: Iterate Field



# Batch: Create FCs & Layers

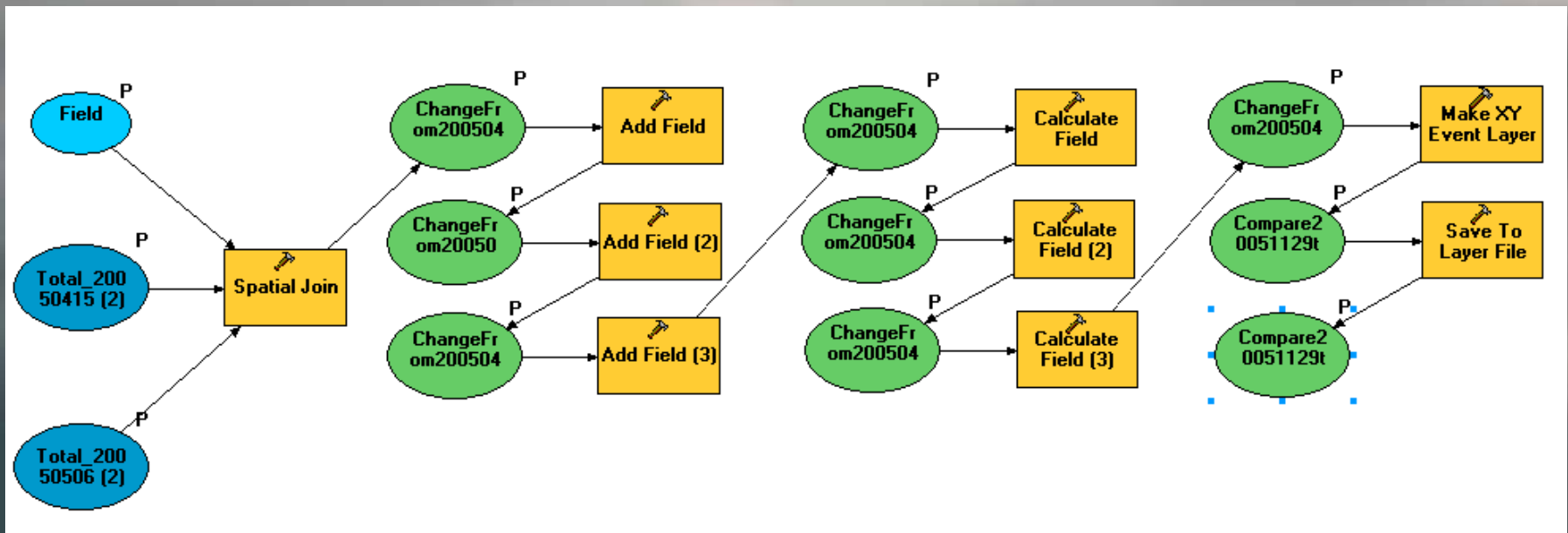


# Batch: Output

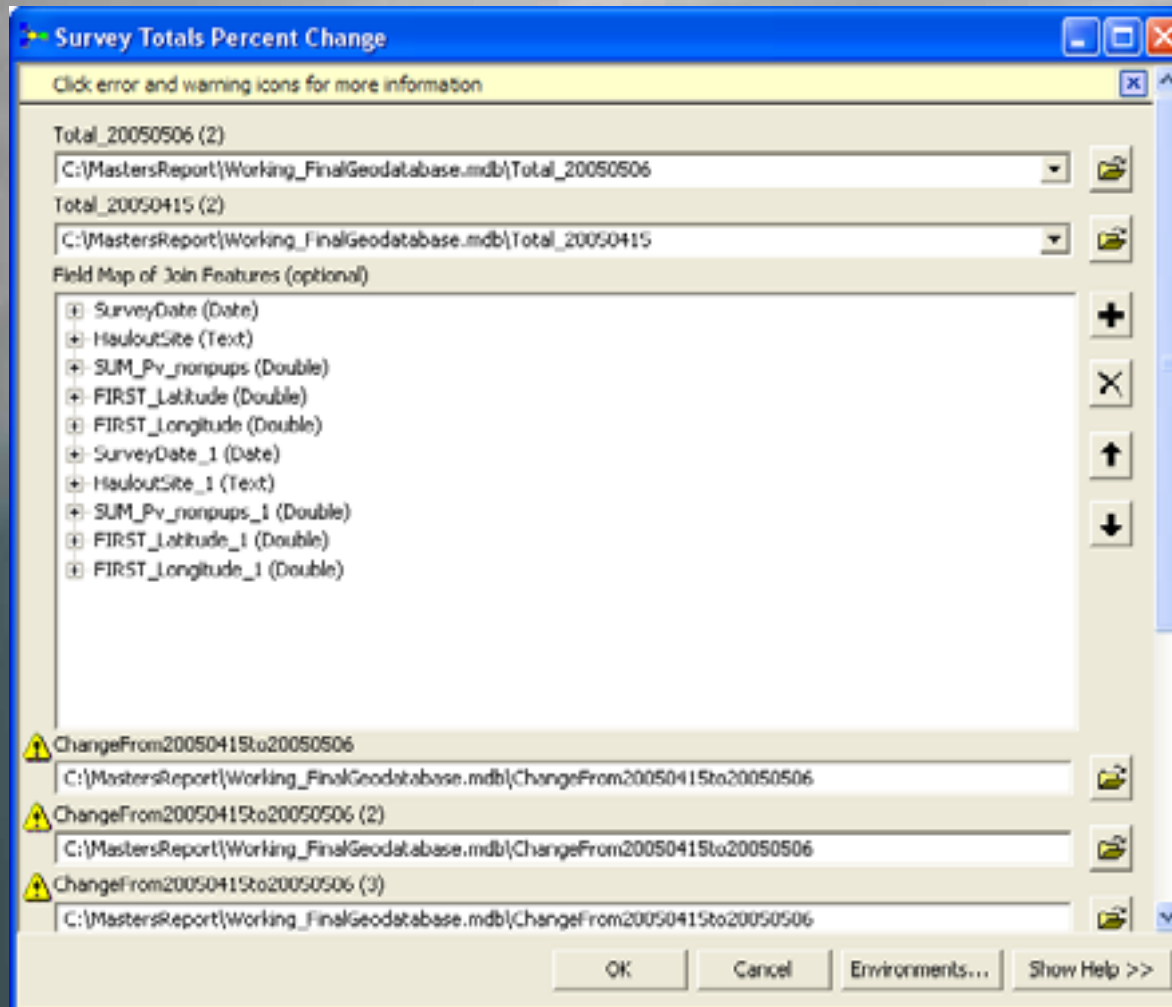




# Survey Totals Percent Change



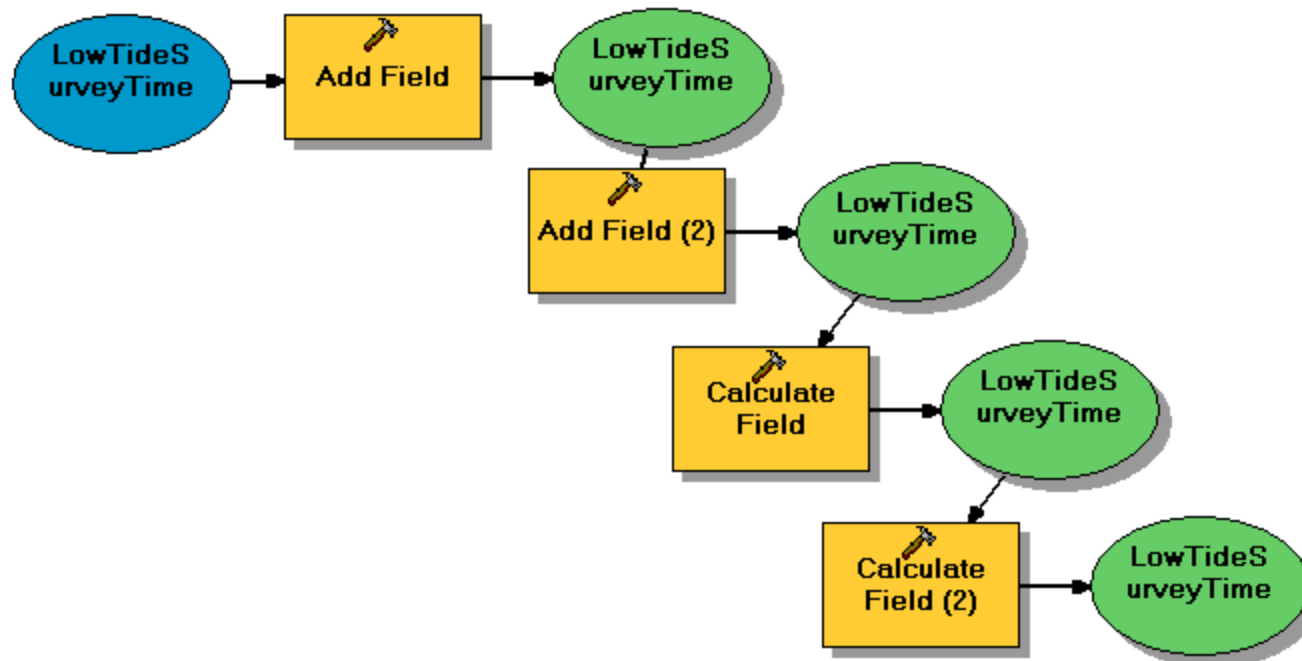
# Percent Change: User Parameters



# Percent Change: Output



# Survey Low Tide Time Difference



# Other Models

- Tide Height Averages
- Weather Select
- Weather Survey Join

# Analysis

- Limited seal count data available
- Nantucket Harbor Jetties only complete set



# Analysis

- Expectation 1:  
More seals haul out  $\pm 2$  hours of low tide
- Expectation 2:  
More seals haul out between 1100-1400
- Expectation 3:  
More seals haul out when winds  $< 35$ kts

# Expectation 1: Tide

<b>Survey Date</b>	<b>Count</b>	<b>Time Diff. Hours</b>
2/17/2008	229	-0.1833333
1/19/2008	412	-0.4833333
11/10/2008	2	-0.5333333
11/19/2007	73	-0.6
3/29/2007	31	-0.7833333
4/20/2007	32	-0.8333333
11/29/2005	513	-1.1166667
10/10/2008	8	-1.1666667
3/12/2008	177	-1.2833333
2/20/2005	95	-2.4666667



# Expectation 2: Time

Date	Count	Time
2/20/2005	95	13:29
10/10/2005	8	13:48
11/19/2007	73	12:05

Date	Count	Time
4/20/2007	32	8:10
3/12/2008	177	9:08
11/10/2008	2	14:37
1/19/2008	412	14:37
2/17/2008	229	14:42
11/29/2005	513	15:05
3/29/2007	31	15:28

# Analysis

- Result 1:  
No correlation with survey
- Result 2:  
Slight(?) correlation with time of day
- Result 3:  
No surveys were flown with winds  $>35$ kts

# Weather Analysis

Date	Count	Wind Direction	Wind Speed	Temp	Visibility
11/29/2005	513	South (140-150)	~15kts	53	8nm mist, clear
1/19/2008	412	West (260)	~10kts	36	10nm, clear
2/17/2008	229	South (160)	~13kts	38	10nm, clear
3/12/2008	177	South (160-190)	~14kts	41	6-9nm light rain mist, ovc 3000
1/17/2008	0	North (350)	~18-22kts, gusty	20	10nm, clear
2/28/2006	0	Northwest (290-350)	~16-22kts, gusty	30	10nm, clear
10/24/2007	0	North (330-350)	~18-20kts, gusty	21	10nm, clear

Strong correlation with weather

# Additional Analysis: Seasonal Distribution

- Expectation:

Highest numbers

Dec-Jan-Feb-Mar

Medium numbers

Nov-Apr

Low numbers

Oct-May

# Additional Analysis: Seasonal Distribution

Date	Count
1/19/2008	412
2/17/2008	229
3/12/2008	177
12/30/2005	158
1/27/2006	123
12/21/2007	122
3/23/2005	110
2/20/2005	106
3/27/2006	95
2/13/2007	92
3/29/2007	31
3/4/2005	24
1/17/2007	0
2/28/2006	0

Date	Count
11/29/2005	513
11/19/2007	73
4/25/2006	33
4/20/2007	32
11/10/2008	2
4/14/2008	0

Date	Count
10/10/2008	8
10/24/2007	0
5/14/2007	0

# Percent Change: Seasonal Distribution



November - December

# Percent Change: Seasonal Distribution



December - January

# Percent Change: Seasonal Distribution



March - April



# Percent Change: Seasonal Distribution



April - May

# Future Analysis

- Count data
- Distribution model
- Share data via Internet

# Conclusion

- Durable, versatile database and GIS
- Manual will allow users with limited knowledge to effectively use GIS
- Powerful models and environmental assessments will assist in future population modeling

# Data

- Northeast Fisheries Science Center
- NOAA: Coastline, Tide data
- USGS Bathymetry data
- ESRI State Boundary data
- NGDC: Weather data
- Iterate Value Script: Shitij Mehta
- Alaska Harbor Seal Images: Peter Boveng

Thanks to Dr. Gordon Waring and Elizabeth Josephson for use of the seal count data.

Thanks also to AOC.

Questions?

