

GIS Basics

SPATIAL STATISTICS WORKSHOP

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Acknowledgement:

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What is a Geographic Information System?

A GIS is

- ◆ A computer-based system designed for the collection, storage, and analysis of phenomena where geographic (spatial) location is an important characteristic or critical to the analysis.

Components

- ◆ Spatial Data
-
- ◆ Attributes

Spatial Data

- ◆ Landscape elements that have physical dimensions and geographical location. These elements can be represented in two different ways:
 - ◆ Vectors
 - ◆ Rasters

Vector Data

- Points
- Lines
- ▭ Polygons

Vector Data

- Points
- ◆ locations of buildings
- ◆ wood duck boxes
- ◆ water control structures

Vector Data

Lines

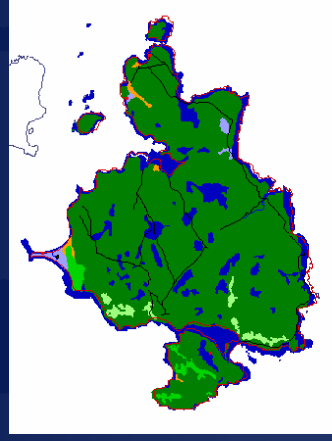
- ◆ roads
- ◆ boundaries
- ◆ streams
- ◆ power lines

Vector Data

Polygons

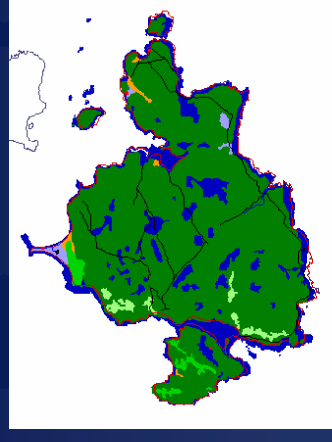
- ◆ lakes
- ◆ cover types
- ◆ timber stands

Vector Data



Overview

Vector Data



Overview



Close-up

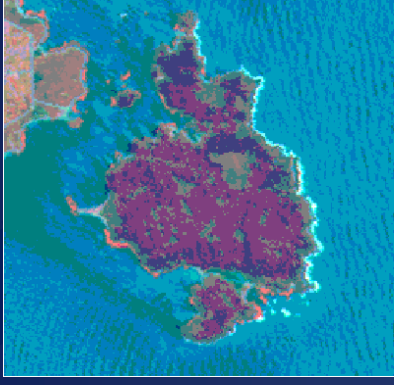
Raster Data



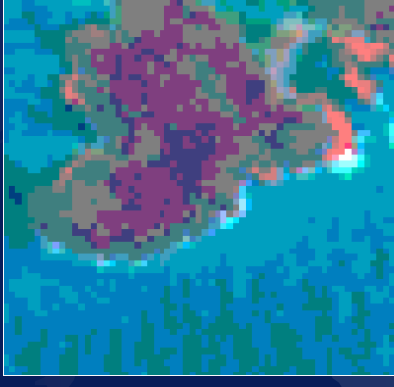
Cells or Pixels

- ◆ Landscape elements represented as rows and columns of continuous cells
- ◆ Each cell has a location
- ◆ Each cell has a value or attribute

Raster Data



Overview



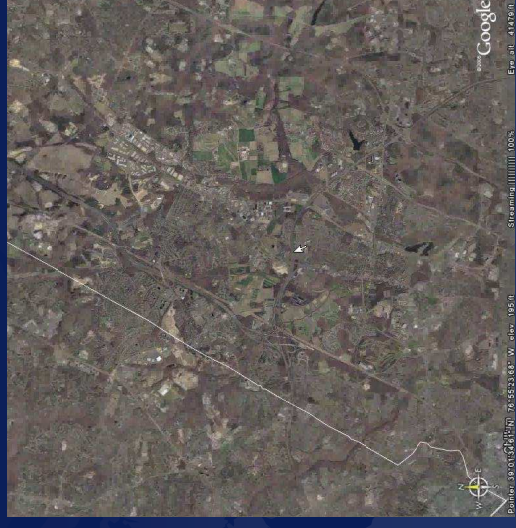
Close-up

Raster Data

◆ Considerations:

Each cell is a rectangle or square of a constant size. The size of the cells determines the resolution of the map. As the cell size decreases the map resolution increases, but so does the storage requirement in the computer.

Raster Data



Overview

Attributes

- ◆ The number of eggs in wood duck box number 27.
- ◆ The level of water at Lake Sepik on 27 June 1994.
- ◆ The name of a road.
- ◆ The volume of red oak saw logs in timber stand number 4.
- ◆ The number of black duck broods in Hayes Flowage in 1994.

How do we put it all together?

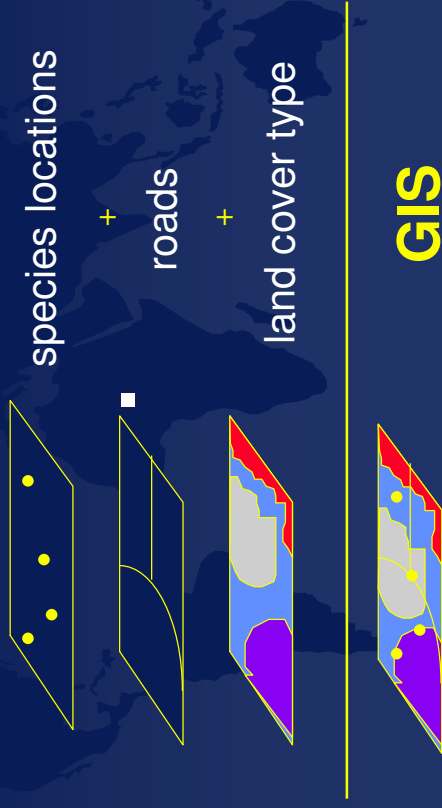
To use spatial data in a GIS you need to know:

- ◆ Where each feature is located (**Coordinates**)
Geographical Coordinates, X and Y
- ◆ What each feature represents (**Attributes**)
Can be any number of descriptive characteristics, but there must be at least one.
- ◆ Relationships among features (**Topology**)
The logic that connects the features to each other, for example, how the location of a wood duck box relates to the location of the nearest wetland. Topology is internally managed by the GIS software.

Spatial data and its attributes must be arranged in a logical order to create a GIS.

This arrangement is a series of layers, or **THEMES**, each which share a common coordinate system.

A GIS consists of *Data Layers or Themes*



The ultimate purpose of a GIS is to answer spatial questions...

...NOT necessarily to make 'PRETTY' maps!

Typical questions include:

- ◆ What is at?
- ◆ Where is?
- ◆ What has changed since?
- ◆ What spatial patterns exist?
- ◆ What if?

An important thing to remember...

The questions must be asked before the data are developed.

GIS Software



<http://esri.com/>



<http://imgs.intergraph.com/>



<http://www.mapinfo.com/location/integration>



<http://www.genaware.com/products/genamap/>

Who is ESRI ?

- Environmental Systems Research Institute, Redlands, CA

<http://www.esri.com/index.html>

ArcGIS

What is ArcGIS?

- ◆ An *integrated collection of GIS software products* for building a complete GIS. The ArcGIS framework enables you to deploy GIS functionality—in desktops, servers (including the Web), or mobile devices

Why ArcGIS?

- ◆ The defacto GIS software standard within the FWS

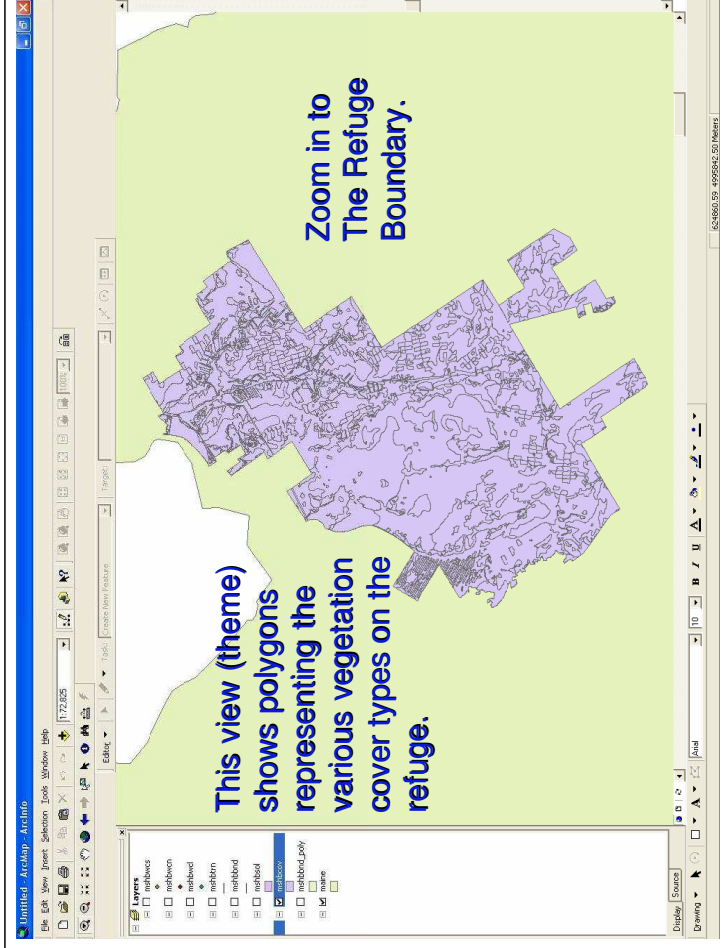
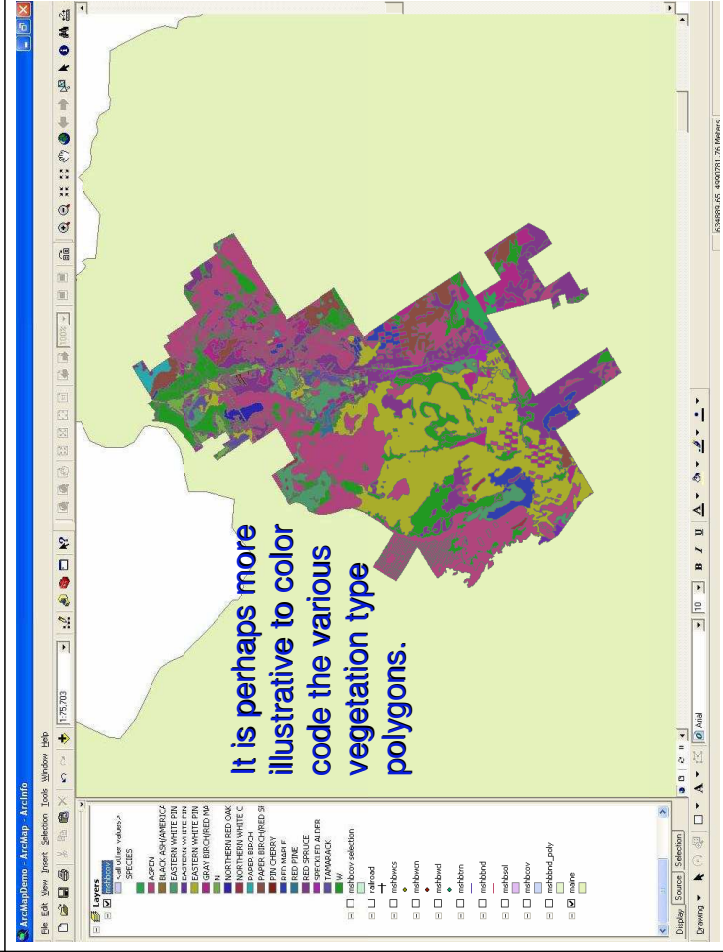
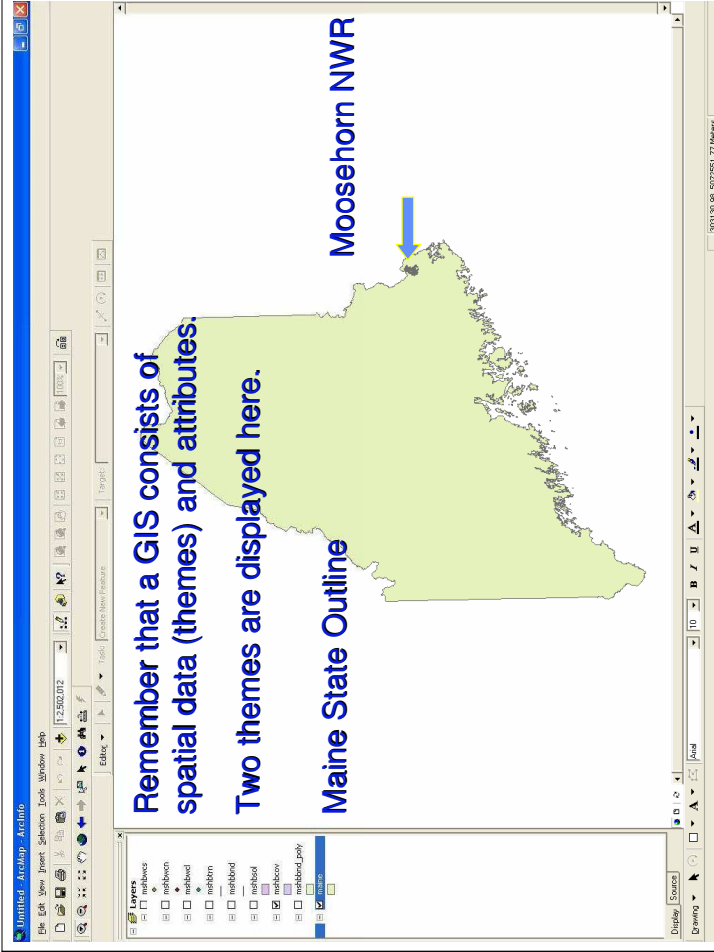
Who else uses ArcGIS?

- ◆ Most Federal & State Land Management Agencies
- ◆ USGS, Forest Service, NPS, BLM, FWS

Spatial Analysis Exercises

Using ArcMap

- ◆ Perform simple Descriptive Statistical Analyses
- ◆ Conduct Complex Spatial Analyses



We want to determine the number of acres for each of the vegetation species listed in the attribute table of the cover type theme.

ID	Shape	AREA	PERIMETER	UNIT	LDMTYPE	FCODE	SARCCLASS	SIZE	STOCKING	SPECIES	WCODE
1	Polygon	34625.80625	532.73402	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
2	Polygon	4110.81625	218.82688	BARING	FOREST	18P	32	P	WELL	PAPER BIRCH	F
3	Polygon	1101.81625	218.82688	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
4	Polygon	2463.90625	395.12827	BARING	NONFOREST	N	N	N	N	N	N
5	Polygon	12.100375	37.79259	BARING	FOREST	12P	32	P	WELL	RED SPRUCE	F
6	Polygon	2730.171625	582.75952	BARING	WETLAND	W	W	W	W	W	W
7	Polygon	2730.171625	582.75952	BARING	WETLAND	W	W	W	W	W	W
8	Polygon	39.75	108.12489	BARING	FOREST	12P	32	P	WELL	RED SPRUCE	F
9	Polygon	612.5625	134.32652	BARING	NONFOREST	N	N	N	N	N	N
10	Polygon	2253.71875	530.29082	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
11	Polygon	7777.88625	613.38827	BARING	WETLAND	W	W	W	W	W	W
12	Polygon	7777.88625	613.38827	BARING	WETLAND	W	W	W	W	W	W
13	Polygon	44245.54625	1830.07212	BARING	NONFOREST	N	N	N	N	N	N
14	Polygon	44245.54625	1830.07212	BARING	NONFOREST	N	N	N	N	N	N
15	Polygon	95.70325	53.81612	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
16	Polygon	18881.646875	4598.29186	BARING	WETLAND	W	W	W	W	W	W
17	Polygon	18881.646875	4598.29186	BARING	WETLAND	W	W	W	W	W	W
18	Polygon	342.55375	53.81612	BARING	WETLAND	W	W	W	W	W	W
19	Polygon	2182.35625	4638.74189	BARING	WETLAND	W	W	W	W	W	W
20	Polygon	6345.64625	1089.92011	BARING	NONFOREST	N	N	N	N	N	N
21	Polygon	4224.21625	370.44698	BARING	ALDER	200	200	A	A	SPECIATED ALDER	A
22	Polygon	10957.89325	598.21215	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
23	Polygon	10957.89325	598.21215	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
24	Polygon	6233.8425	3897.19070	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
25	Polygon	5909.62375	3704.98662	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
26	Polygon	307.711875	240.05862	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
27	Polygon	6579.21875	2483.11307	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
28	Polygon	791.546875	115.52398	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
29	Polygon	115.52398	115.52398	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
30	Polygon	2443.05375	64.44459	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F
31	Polygon	1413.64625	218.42024	BARING	FOREST	15M	15	M	UNDER	RED PINE	F
32	Polygon	1413.64625	218.42024	BARING	FOREST	15M	15	M	UNDER	RED PINE	F
33	Polygon	1413.64625	218.42024	BARING	FOREST	15M	15	M	UNDER	RED PINE	F
34	Polygon	1413.64625	218.42024	BARING	FOREST	15M	15	M	UNDER	RED PINE	F
35	Polygon	2843.70325	1582.60215	BARING	ALDER	200	200	A	A	SPECIATED ALDER	A
36	Polygon	2843.70325	1582.60215	BARING	ALDER	200	200	A	A	SPECIATED ALDER	A
37	Polygon	8177.7175	479.87361	BARING	FOREST	18P	32	P	WELL	RED SPRUCE	F

Click the SPECIES Header

Stepping through the details one time...

A wide range of statistical and summarization functions can be performed using the Graphical User Interface options in ArcMap.

Choose to Summarize

ID	AREA	PERIMETER	UNIT	COUNTY	FCODE	SAFCCLASS	SIZE	STOCKING	SPECIES
0	11472.5	532.23842	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
1	3979.02826	1090	10	P	OVERL		P	PAPER BIRCH	
2	210.82586	238	238	238	238	238	238	238	238
3	1100.025	395.12842	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
4	2843.98625	395.12842	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
5	12.102978	27.79752	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
6	2002.17195	362.25684	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
7	39.75	101.12458	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
8	612.8529	194.23252	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
9	777.68625	813.38262	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
10	6553.20725	586.37042	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
11	2521.7195	520.26382	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
12	894.64625	153.91512	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
13	19881.54625	4500.29112	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
14	2181.9525	4833.74192	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
15	894.64625	153.91512	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
16	2181.9525	4833.74192	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
17	2003.625	1103.14292	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
18	2003.625	1103.14292	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
19	2181.9525	4833.74192	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
20	894.64625	153.91512	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
21	18571.95215	300.21212	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
22	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
23	307.17195	2403.11072	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
24	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
25	307.17195	2403.11072	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
26	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
27	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
28	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
29	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
30	6553.20725	3957.02762	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
31	1413.64625	218.42624	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
32	625.02974	1049.81625	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
33	625.02974	1049.81625	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
34	1433.30625	546.88958	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
35	2843.70215	1580.09174	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
36	2843.70215	1580.09174	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
37	702.74375	122.62622	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE
38	1877.70261	497.07368	BARRING	FOREST	150P	32	P	WELL	RED SPRUCE

ID	SPECIES	Count	Sum Acres
1	ASPEN	29	524.872
2	AMERICAN REDWOOD	28	737.941
3	EASTERN WHITE PINE	2	26.546
4	EASTERN WHITE PINE RED MAPLE	17	353.397
5	EASTERN WHITE PINE RED MAPLE	17	353.397
6	EASTERN WHITE PINE RED MAPLE	17	353.397
7	NORTHERN RED OAK	2	74.794
8	NORTHERN RED OAK	2	74.794
9	NORTHERN WHITE CEDAR	7	42.796
10	NORTHERN WHITE CEDAR	7	42.796
11	PAPER BIRCH	25	698.036
12	PINE SPRUCE	3	18.393
13	PINE SPRUCE	3	18.393
14	RED SPRUCE	16	51.936
15	RED SPRUCE	16	51.936
16	RED SPRUCE	16	51.936
17	SPOILED ALDER	60	214.866
18	SPOILED ALDER	60	214.866
19	TAMARACK	1	362.981
20	TAMARACK	1	362.981
21	TAMARACK	1	362.981
22	TAMARACK	1	362.981
23	TAMARACK	1	362.981
24	TAMARACK	1	362.981
25	TAMARACK	1	362.981

The next thing we want to do is combine a Query with a Summary.

Question: What is the acreage of each species that are understocked?

There is a "Stocking" entry in the attribute table that can be queried to select the pertinent records.

Polygons associated with the selected table entries are highlighted.

Selected records in the attribute table are also highlighted.

Now we repeat the Summarize procedure, but this time choose to use only the selected records.

ID	AREA	PERIMETER	UNIT	COMTYPE	FCODE	SATECLASS	SIZE	WOODCODE
1	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
2	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
3	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
4	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
5	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
6	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
7	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
8	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
9	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
10	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
11	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
12	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
13	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
14	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
15	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
16	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
17	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
18	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
19	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
20	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
21	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
22	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
23	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
24	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
25	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
26	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
27	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
28	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
29	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
30	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
31	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
32	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
33	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
34	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
35	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
36	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
37	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE
38	11472.5	532.23842	BARING	FOREST	159A	15	M	RED SPRUCE

Select "Statistics"

It is also possible to collect a complete range of statistics on numeric fields.

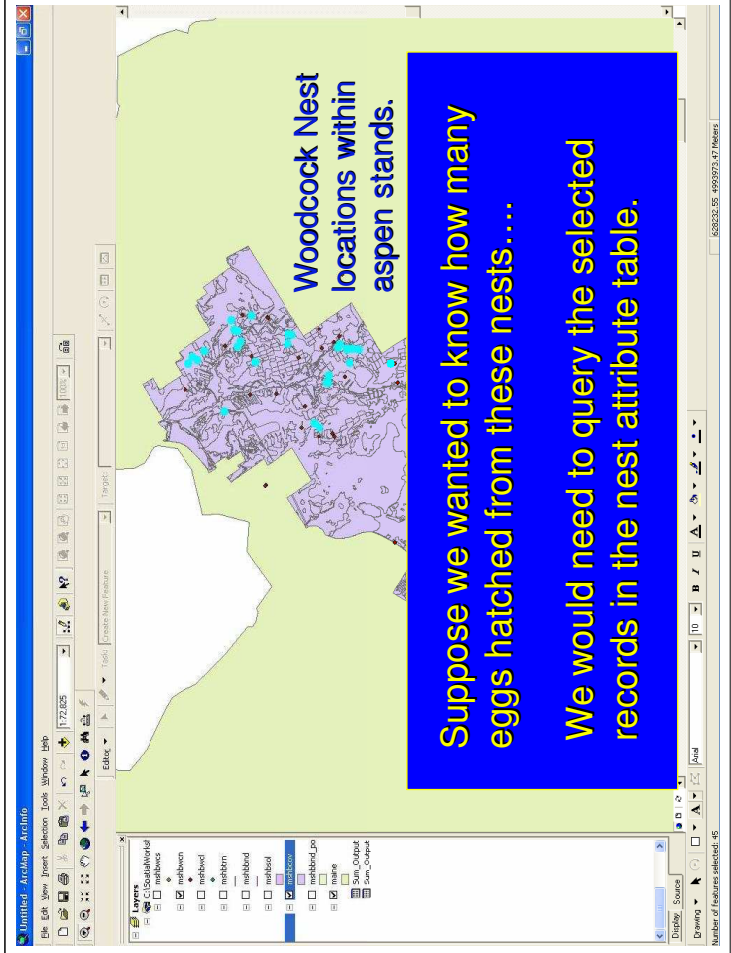
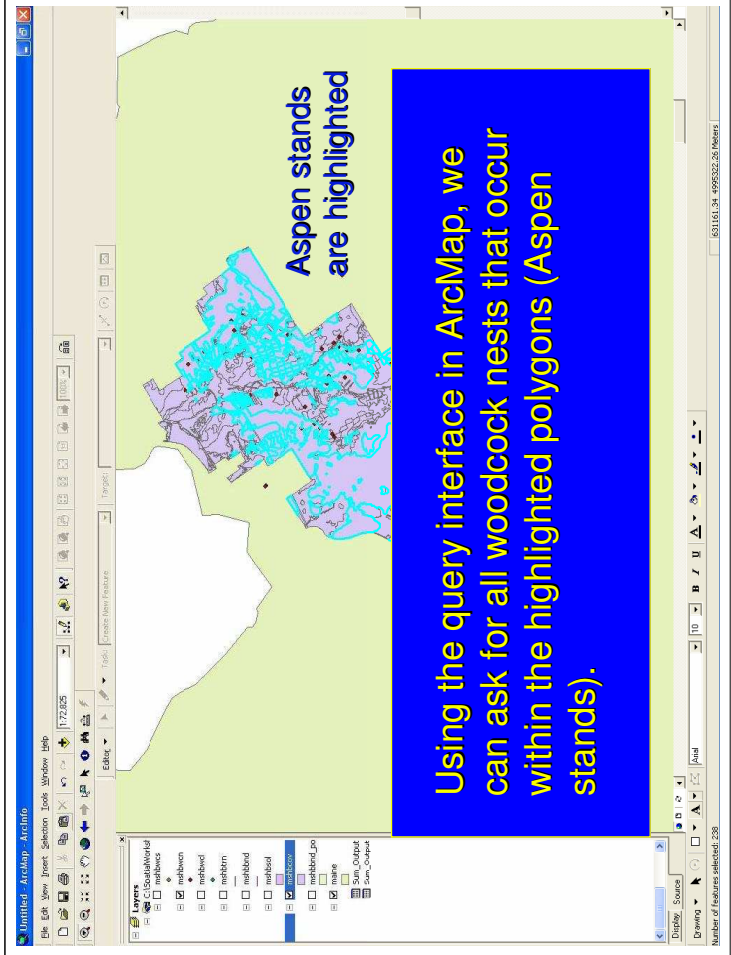
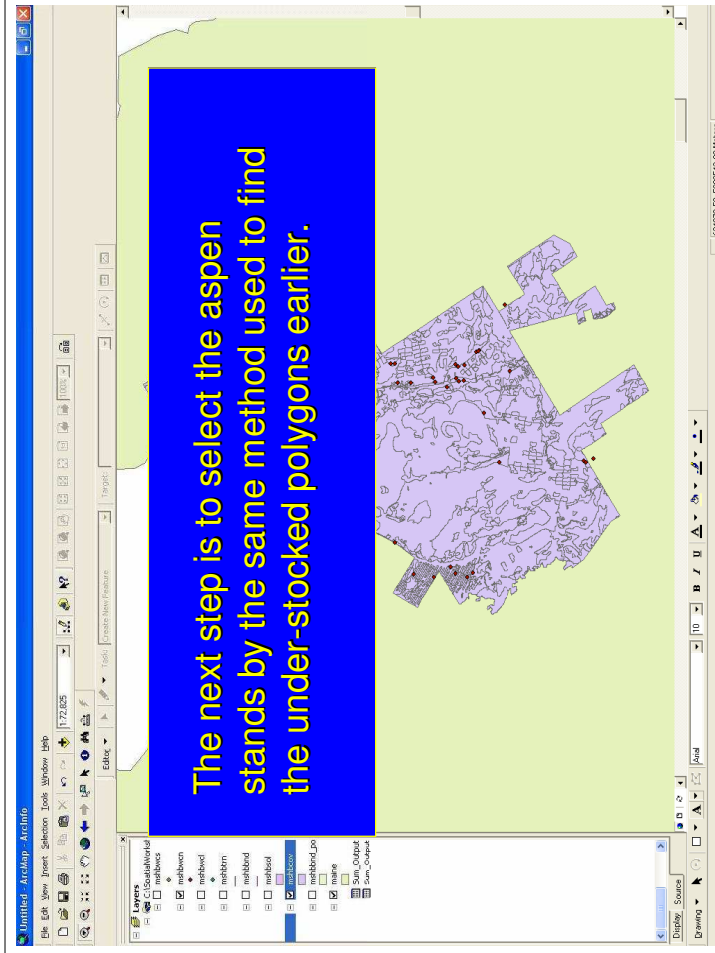
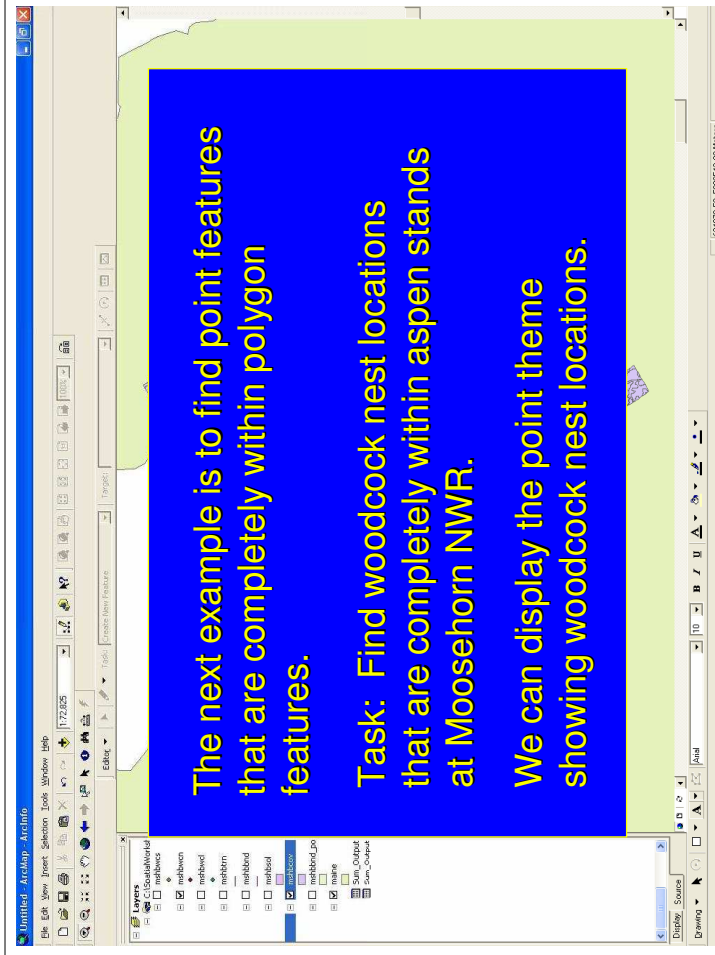
Select a field – ACRES in this case.

UID	SPECIES	Count	SUM ACRES
1	EASTERN WHITE PINE	31	227.064
2	GRAY BIRCH/RED MAPLE	2	3.20
3	GRAY BIRCH/RED MAPLE	36	260.176
4	RED PINE	9	10.545
5	RED PINE	9	3.779
6	RED PINE	12	17.975
7	TAUGAHEEK	3	33.674

FIELD	WOODCODE	SYSTEM	CLASS	SUBCLASS	WTR	MODIFIER	WOODCODE	ACRES
RED SPRUCE	F	F	F	F	F	F	F	3.082
RED SPRUCE	F	F	F	F	F	F	F	0.957
RED SPRUCE	F	F	F	F	F	F	F	1.922
RED SPRUCE	F	F	F	F	F	F	F	0.778
RED SPRUCE	F	F	F	F	F	F	F	1.4
RED SPRUCE	F	F	F	F	F	F	F	10.574
RED SPRUCE	F	F	F	F	F	F	F	47.848
RED SPRUCE	F	F	F	F	F	F	F	0.014
RED SPRUCE	F	F	F	F	F	F	F	0.006
RED SPRUCE	F	F	F	F	F	F	F	16.878
RED SPRUCE	F	F	F	F	F	F	F	18.888
RED SPRUCE	F	F	F	F	F	F	F	1.42
RED SPRUCE	F	F	F	F	F	F	F	0.095
RED SPRUCE	F	F	F	F	F	F	F	0.024
RED SPRUCE	F	F	F	F	F	F	F	53.301
RED SPRUCE	F	F	F	F	F	F	F	21.814
RED SPRUCE	F	F	F	F	F	F	F	17.777
RED SPRUCE	F	F	F	F	F	F	F	4.326
RED SPRUCE	F	F	F	F	F	F	F	0.313
RED SPRUCE	F	F	F	F	F	F	F	2.619
RED SPRUCE	F	F	F	F	F	F	F	1.106
RED SPRUCE	F	F	F	F	F	F	F	2.924
RED SPRUCE	F	F	F	F	F	F	F	3.954
RED SPRUCE	F	F	F	F	F	F	F	0.224
RED SPRUCE	F	F	F	F	F	F	F	0.091
RED SPRUCE	F	F	F	F	F	F	F	16.242
RED SPRUCE	F	F	F	F	F	F	F	6.573
RED SPRUCE	F	F	F	F	F	F	F	0.076
RED SPRUCE	F	F	F	F	F	F	F	0.188
RED SPRUCE	F	F	F	F	F	F	F	0.076
RED SPRUCE	F	F	F	F	F	F	F	0.025
RED SPRUCE	F	F	F	F	F	F	F	0.062
RED SPRUCE	F	F	F	F	F	F	F	0.351
RED SPRUCE	F	F	F	F	F	F	F	0.142
RED SPRUCE	F	F	F	F	F	F	F	0.382
RED SPRUCE	F	F	F	F	F	F	F	0.154
RED SPRUCE	F	F	F	F	F	F	F	3.852
RED SPRUCE	F	F	F	F	F	F	F	1.494
RED SPRUCE	F	F	F	F	F	F	F	7.025
RED SPRUCE	F	F	F	F	F	F	F	2.843
RED SPRUCE	F	F	F	F	F	F	F	7.107
RED SPRUCE	F	F	F	F	F	F	F	0.018

Statistics of acres

Count: 988
 Minimum: 0.006
 Maximum: 53.301
 Sum: 17410.34000
 Standard Deviation: 119.52847



From the table we see that 45 of 88 total nests were found in aspen stands.

We also note that the table has fields for the # of eggs found and the # hatched.

We can use the Statistics function shown earlier to query these fields.

Eggs hatched.

Count: 45
 Minimum: 0.000000
 Maximum: 4.000000
 Sum: 72.000000
 Mean: 1.600000
 Standard Deviation: 1.830604

Eggs laid.

Count: 45
 Minimum: 0.000000
 Maximum: 4.000000
 Sum: 152.000000
 Mean: 3.377778
 Standard Deviation: 1.179244

Eggs Laid

Count: 45
 Minimum: 0.000000
 Maximum: 4.000000
 Sum: 152.000000
 Mean: 3.377778
 Standard Deviation: 1.179244

Eggs Hatched

Count: 45
 Minimum: 0.000000
 Maximum: 4.000000
 Sum: 72.000000
 Mean: 1.600000
 Standard Deviation: 1.830604

72 out of 152 = 47.37% hatched

Suppose we want to know the success of nests not in the aspen stands...

We can switch the selection and repeat the statistics function.

SHAPE*	AREA	PERIMETER	MCBRUCHVAL	MCBRUCHVAL	MESTNO	ETICL	MONHE	DAVIDO	YEALD	MOEGER	MONTIHI	DAVOLI	YERAMT	MURGHTI	DATE	OBJ	
Point	0	0	0	0	17	17	88.18	154.294	5	4	88	4	5	10	88	3	H
Point	0	0	0	0	18	18	88.18	154.294	5	6	88	2	5	27	88	2	H
Point	0	0	0	0	19	19	88.18	154.294	5	6	88	2	5	27	88	2	H
Point	0	0	0	0	20	20	88.21	154.8921	5	10	88	4	5	28	88	4	H
Point	0	0	0	0	21	21	88.22	155.311	4	22	88	4	5	14	88	3	H
Point	0	0	0	0	22	22	88.23	155.729	4	22	88	4	4	0	0	0	P
Point	0	0	0	0	23	23	88.24	156.147	4	13	88	4	4	0	0	0	P
Point	0	0	0	0	24	24	88.25	156.565	3	5	31	88	3	14	88	3	H
Point	0	0	0	0	25	25	88.26	156.983	24	24	88	0	0	0	0	0	P
Point	0	0	0	0	26	26	88.27	157.401	24	24	88	0	0	0	0	0	P
Point	0	0	0	0	27	27	88.28	157.819	24	24	88	0	0	0	0	0	P
Point	0	0	0	0	28	28	88.29	158.237	1	88	0	0	0	0	0	0	P
Point	0	0	0	0	29	29	88.30	158.655	10	88	4	4	0	0	0	0	P
Point	0	0	0	0	30	30	88.31	159.073	10	88	4	4	0	0	0	0	P
Point	0	0	0	0	31	31	88.32	159.491	0	0	0	0	0	0	0	0	P
Point	0	0	0	0	32	32	88.33	159.909	0	0	0	0	0	0	0	0	P
Point	0	0	0	0	33	33	88.34	160.327	10	88	3	6	19	88	3	14	H
Point	0	0	0	0	34	34	88.35	160.745	10	88	3	6	19	88	3	14	H
Point	0	0	0	0	35	35	88.36	161.163	2	88	2	0	0	0	0	0	P
Point	0	0	0	0	36	36	88.37	161.581	2	88	2	0	0	0	0	0	P
Point	0	0	0	0	37	37	88.38	162.0	1	88	4	5	14	88	4	14	H
Point	0	0	0	0	38	38	88.39	162.418	5	88	4	0	0	0	0	0	P
Point	0	0	0	0	39	39	88.40	162.836	5	88	4	0	0	0	0	0	P
Point	0	0	0	0	40	40	88.41	163.254	5	88	4	0	0	0	0	0	P

Eggs Laid

Count: 43

Minimum: 0.000000

Maximum: 4.000000

Sum: 122.000000

Mean: 2.837209

Standard Deviation: 1.539106

Eggs Hatched

Count: 43

Minimum: 0.000000

Maximum: 4.000000

Sum: 70.000000

Mean: 1.627907

Standard Deviation: 1.804687

70 out of 122 = 57.38% eggs hatched in other cover types

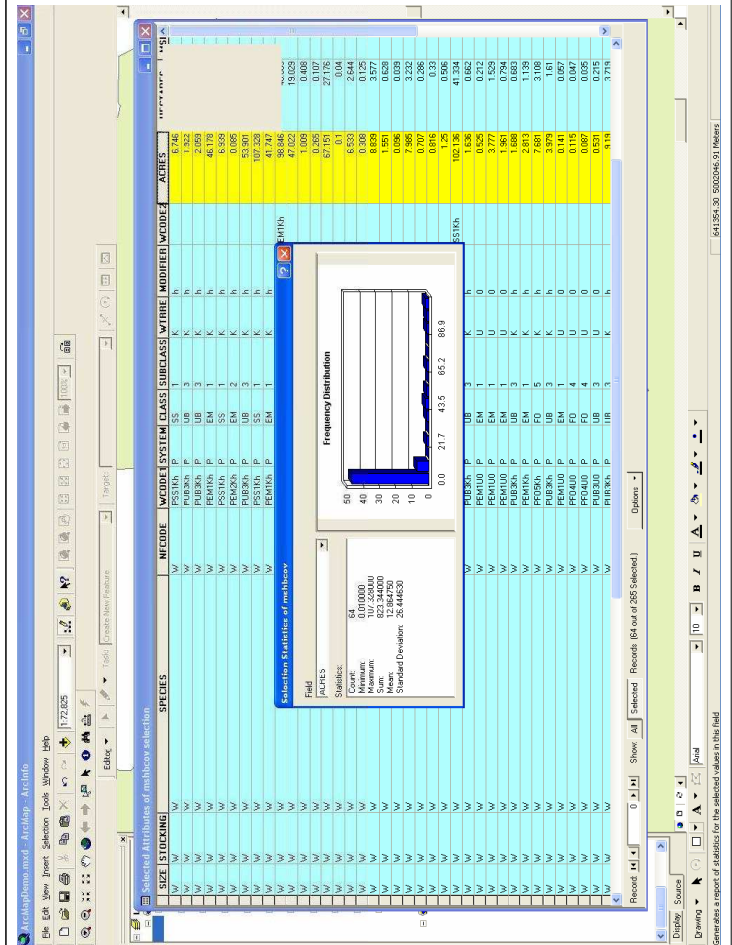
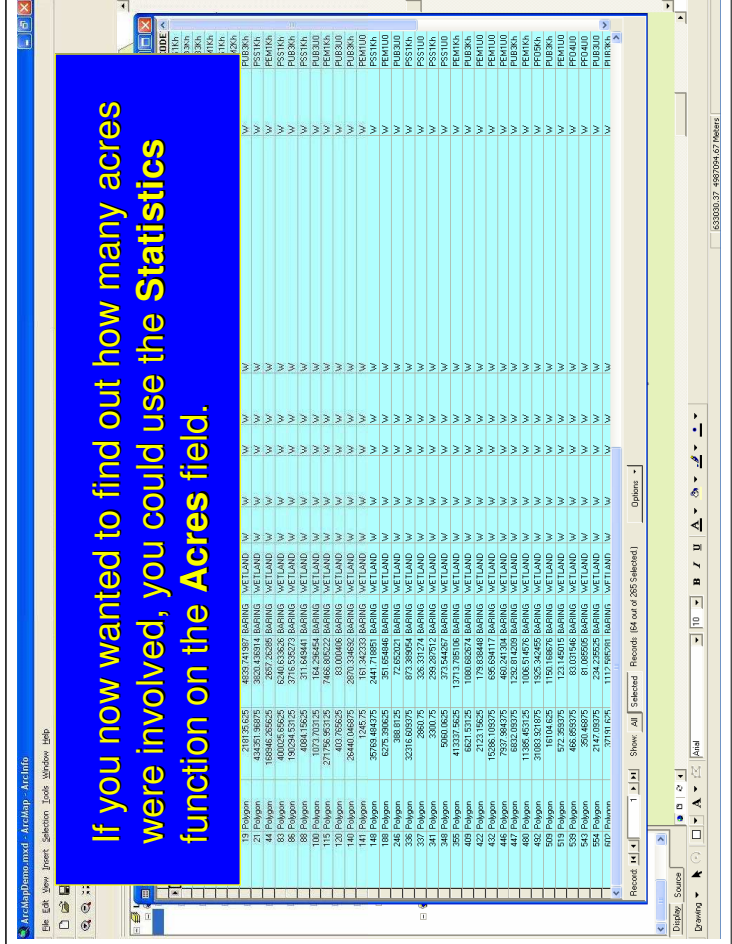
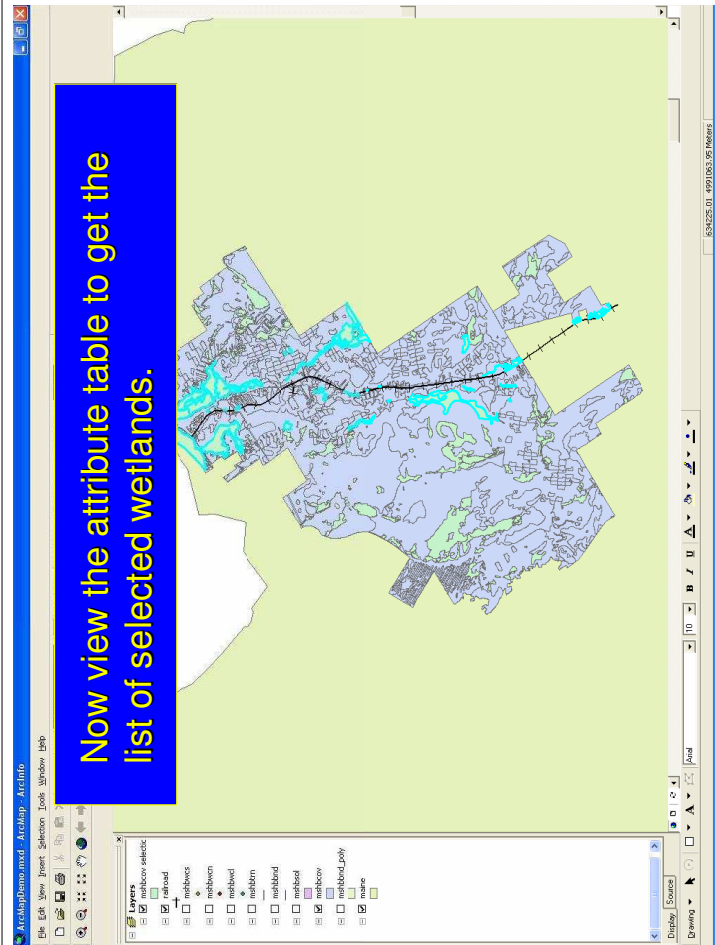
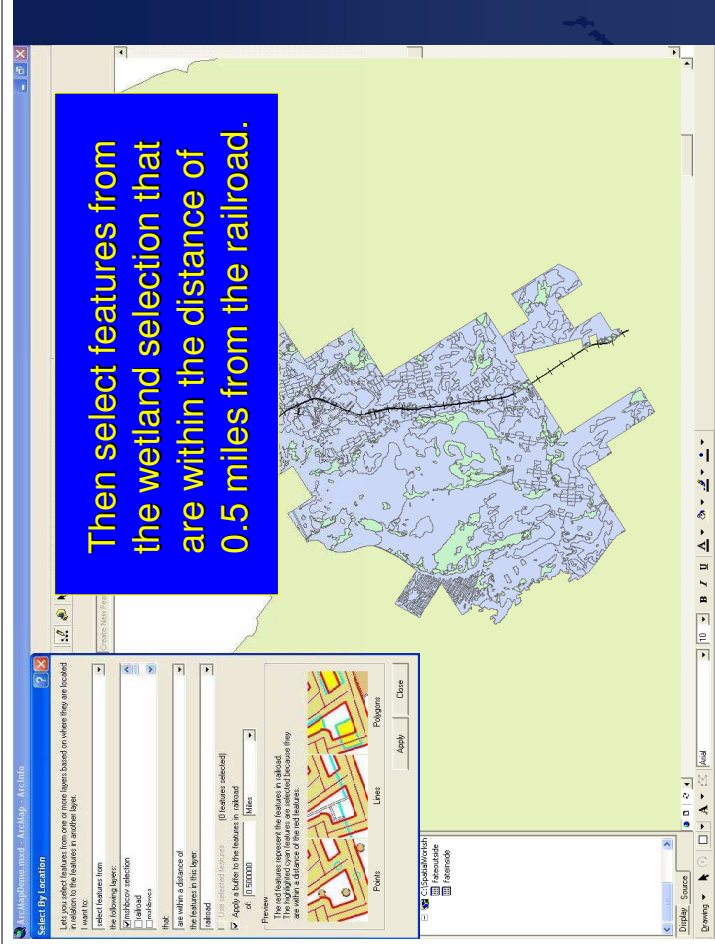
20 out of 43 = 46.5% nests successful in other cover types

72 out of 152 = 47.37% eggs hatched in Aspen stands

23 out of 45 = 51.1% nests successful in Aspen stands

Get a list of all wetlands with boundaries half a mile or less from the railroad....

First step is to Identify the Wetlands by selecting the "Wetland" cover type.

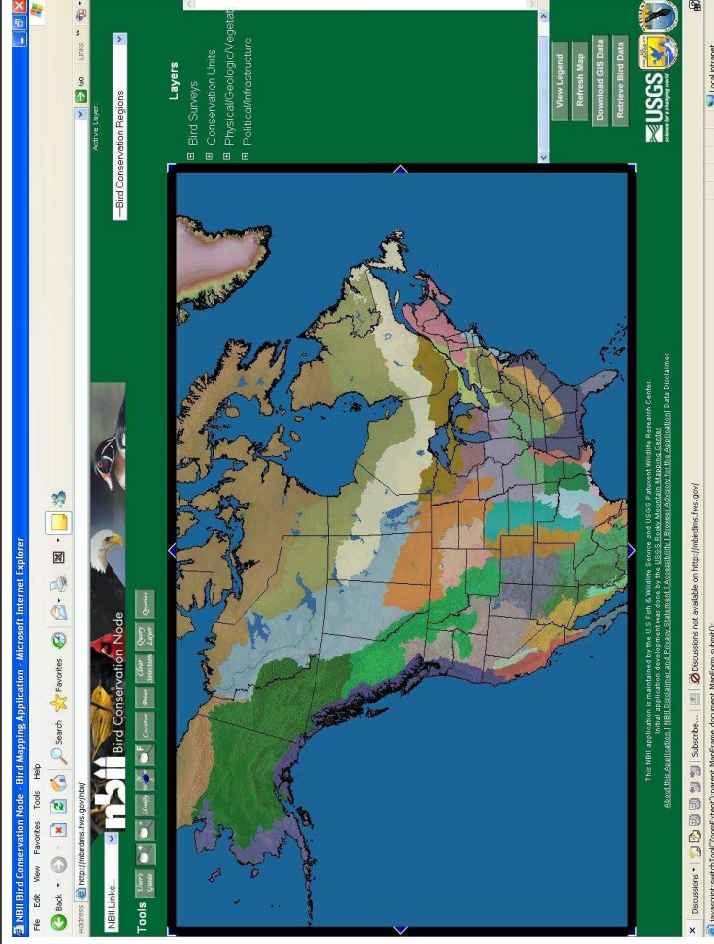


ArcIMS

- ◆ Internet **M**ap **S**erver
- ◆ Provides for viewing and manipulation of spatial data over the Internet.
- ◆ Our office hosts an ArcIMS application for the Bird Conservation Node of the NBI (National Biological Information Infrastructure)
- ◆ The application is reachable through the URL: <http://mbirdims.fws.gov>

ArcIMS

- ◆ The next screen is the initial view presented when the web site is accessed. It shows most of North America. The shaded areas represent bird conservation regions. You can click on a “View Legend” button to view the key.



Aerial Surveys

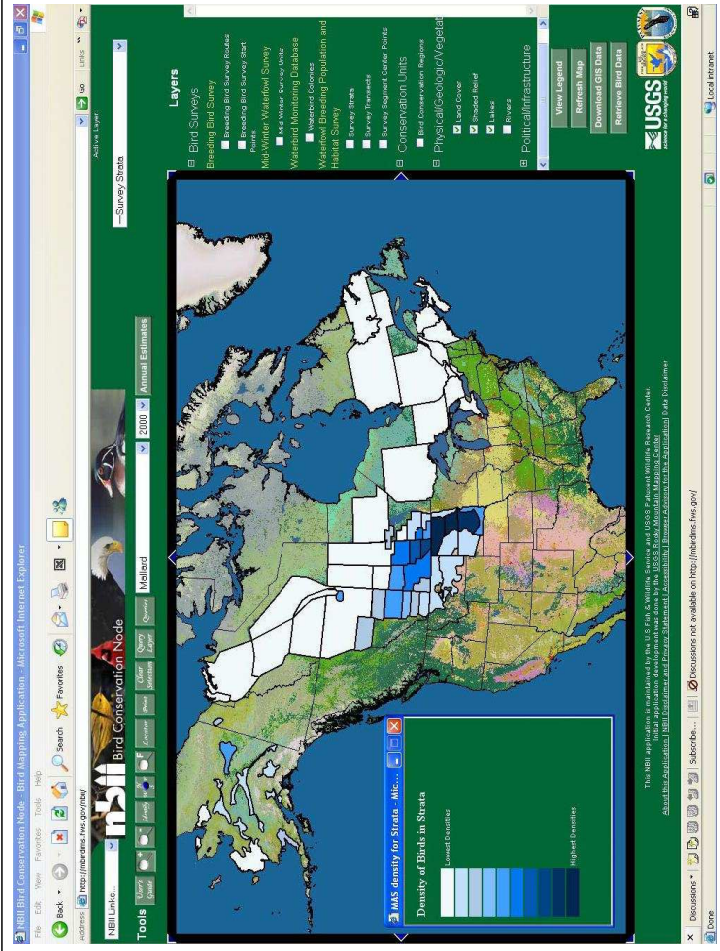
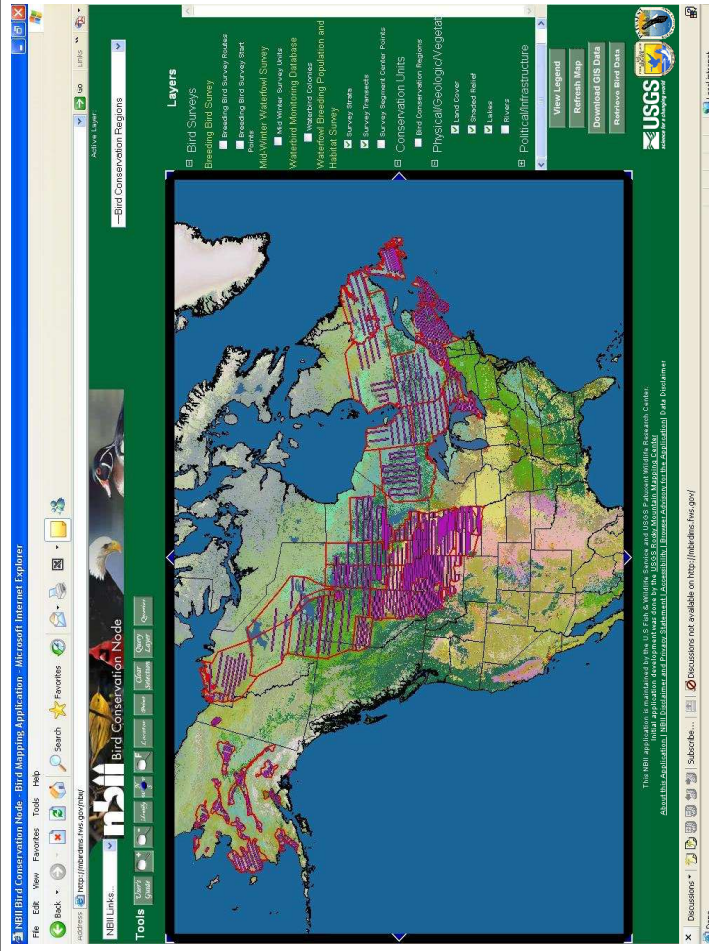
- ◆ One of the major functions of our office is to sample the breeding grounds to estimate waterfowl populations annually.
- ◆ The next view shows the flight lines that are surveyed each year in May.

Aerial Surveys (cont'd)

- ◆ An example of survey results is shown on the next slide.
- ◆ It shows the results of a query on Mallard Duck abundance by survey stratum.
- ◆ You may have noticed that the background has been replaced by a layer showing land cover types.

Aerial Surveys (cont'd)

- ◆ The next example illustrates the changes in the population estimate for Mallards from 1995 to 2000.

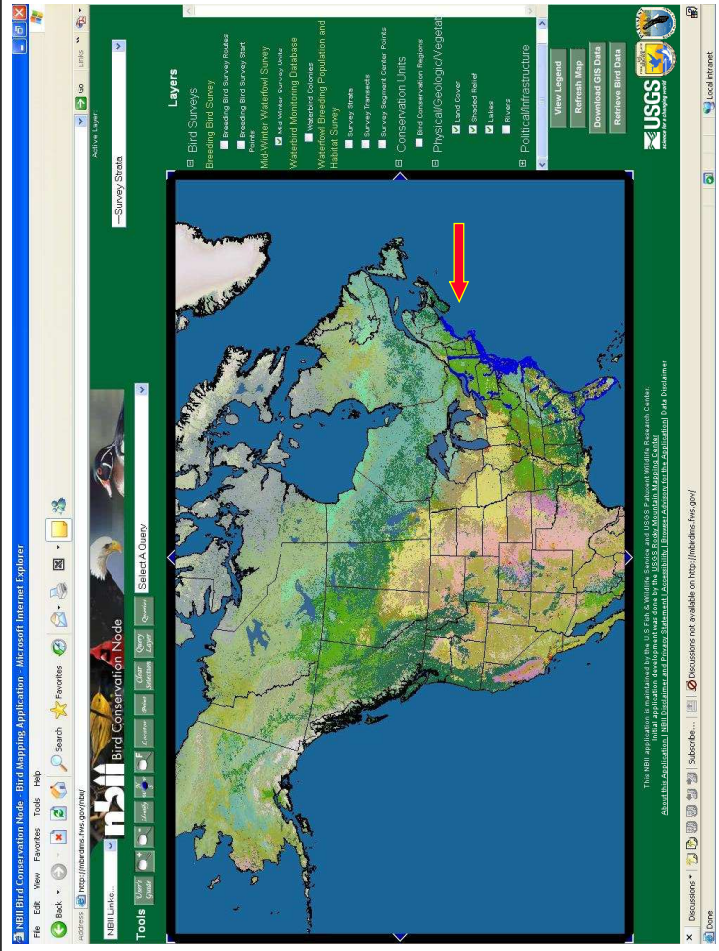
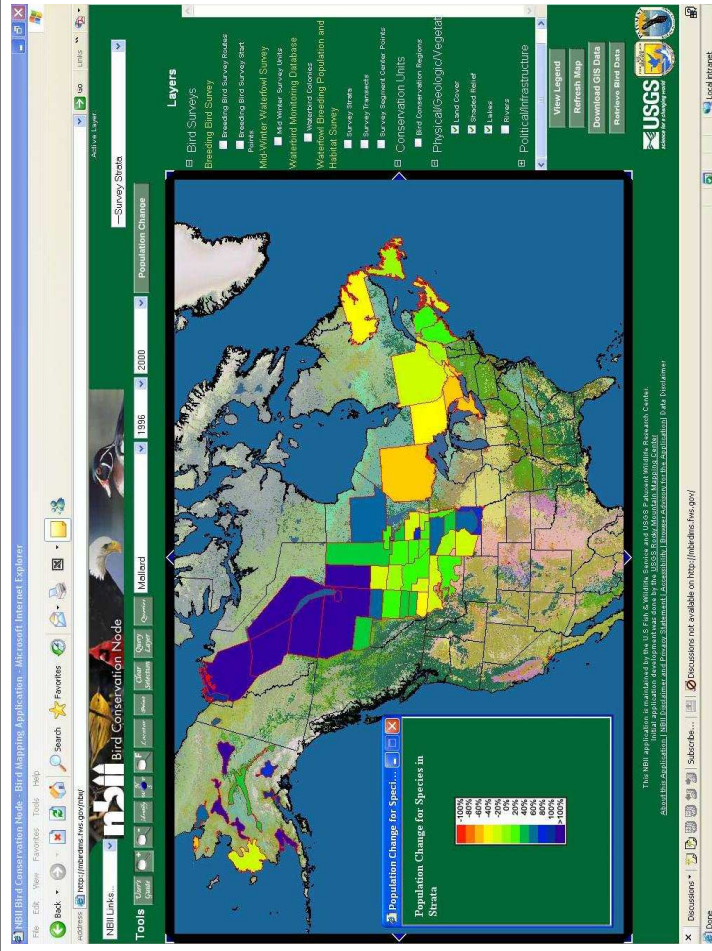


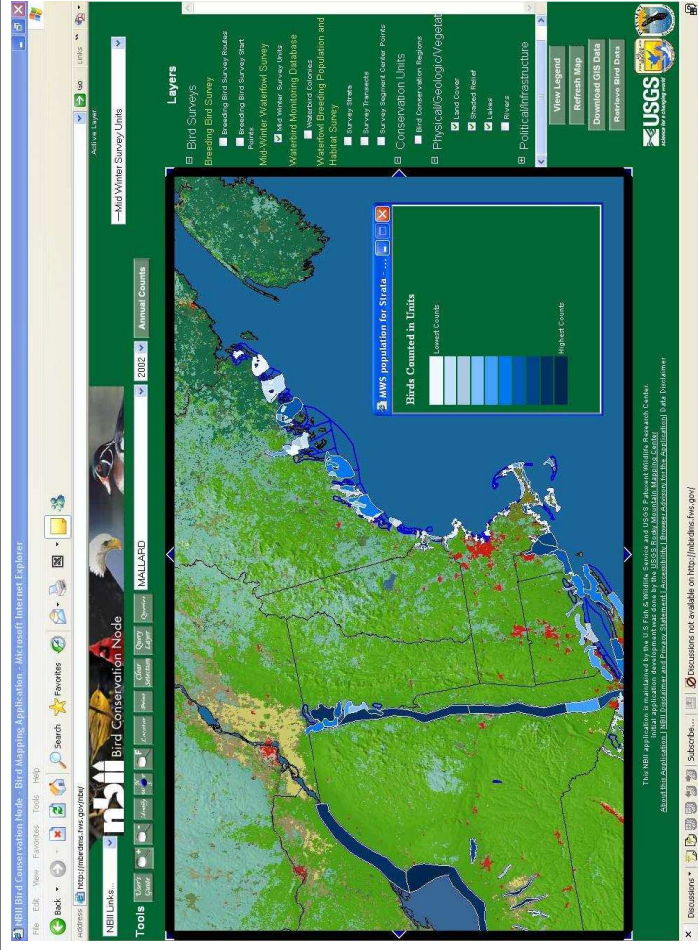
Aerial Surveys (cont'd)

- ◆ In the next view the outlines for the Mid-Winter waterfowl survey zones have been displayed. This is a late December – January survey of wintering waterfowl, primarily along the Atlantic coast but covering inland waters of Atlantic coastal states.

Aerial Surveys (cont'd)

- ◆ The next view shows counts of Mallards by survey unit for 2002.





Polygons and Lines can be digitized from maps or other sources. Once initialized to known reference points, digitizing software automatically generates the correct geographic coordinates.

Points can be collected using GPS receivers.

Raster data is generated by photographs or satellite imagery.

Next up is a simple example of using satellite imagery as a background reference.

Summary

This little demonstration hardly does justice to what can be done using a GIS to analyze data, but hopefully it has exposed the potentials.

But remember that you can't do anything unless you have the data necessary to answer the questions.

We'll finish up exploring a few methods for getting data into a GIS.

This is a satellite image, 978 pixels wide and 598 pixels high. The origin, (0,0), is in the lower left corner.



In order to use this image effectively in a GIS, the coordinates of each pixel must be transformed to match the other layers being used.



Original Image from previous slide



Transformed Image



Overlaid with Moosehorn cover type polygon outlines



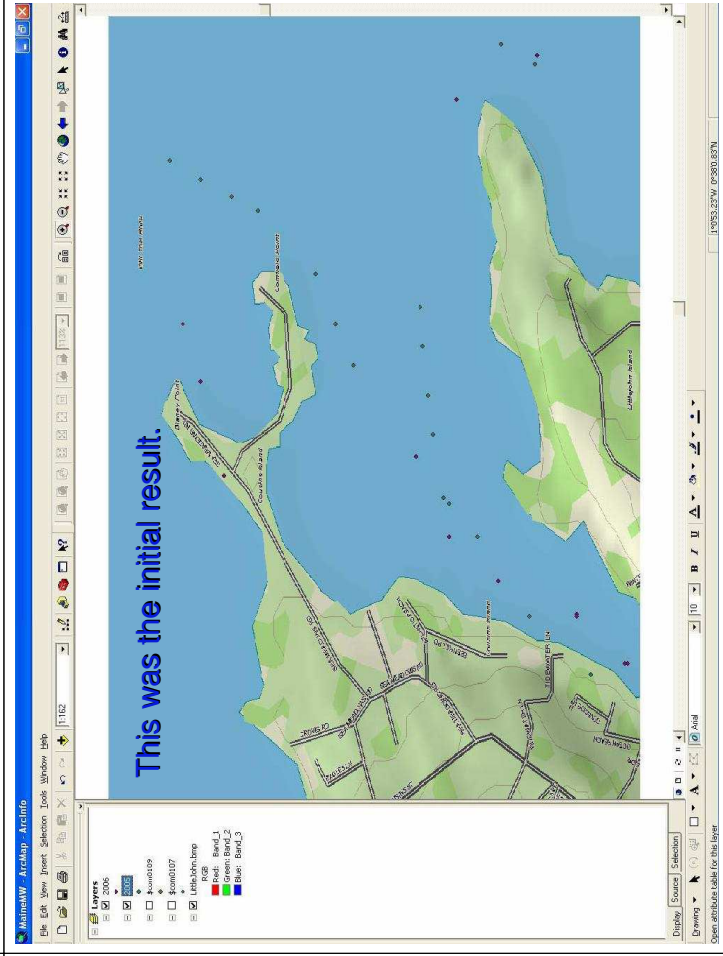
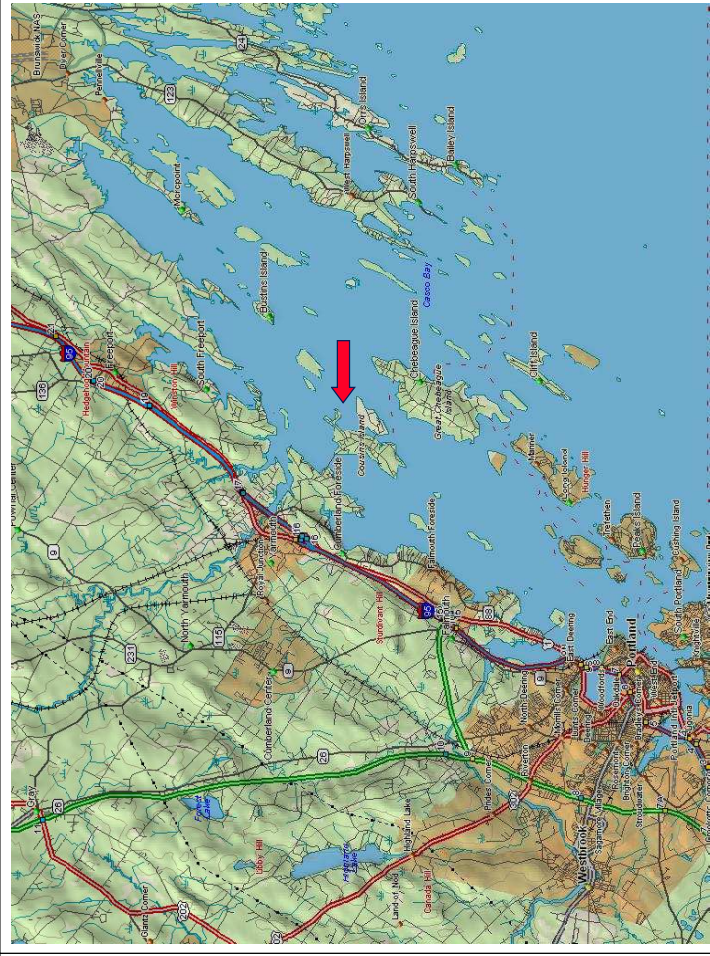
Aerial Surveys

Aerial Surveys

- ◆ In January of this year I received a request through one of our pilot/biologists from a biologist in Maine who was interested in some specific data. There was concern about some development plans on Little John Island off the coast of Maine east of Yarmouth. He wondered if we could provide information about waterfowl species and counts in the area from the last two mid-winter waterfowl surveys.

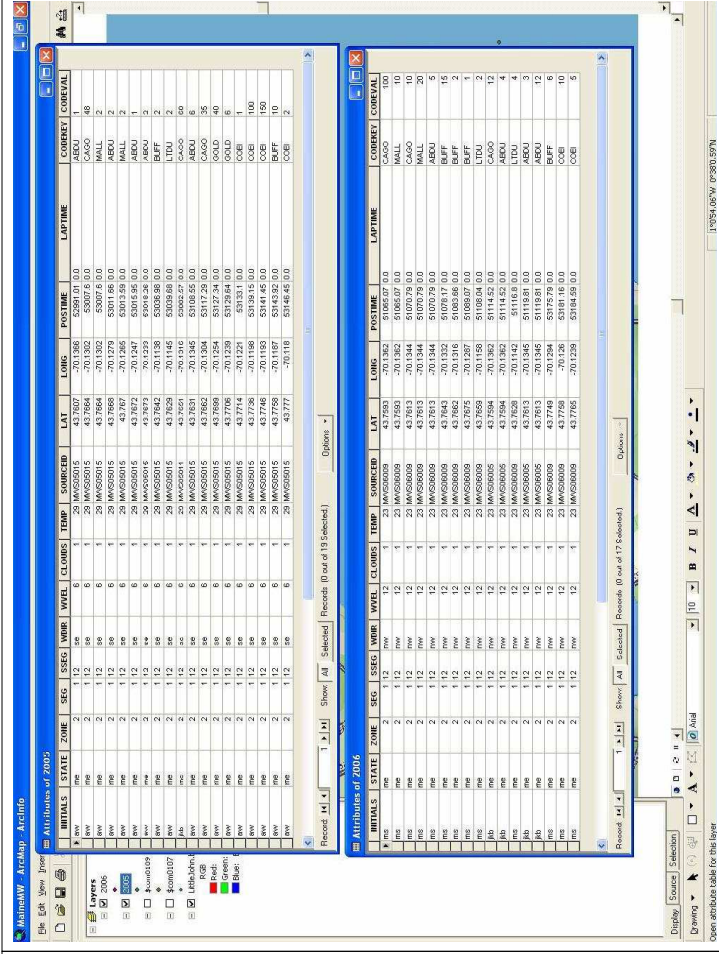
How to display “raw” survey data in a meaningful manner?

- ◆ The first thing was to create a base layer map to define the area of interest. Then the survey data points were plotted and those in the area of interest were selected using a “Select Features” tool which allowed me to “box” the area of interest and extract the attribute information for the points of interest.



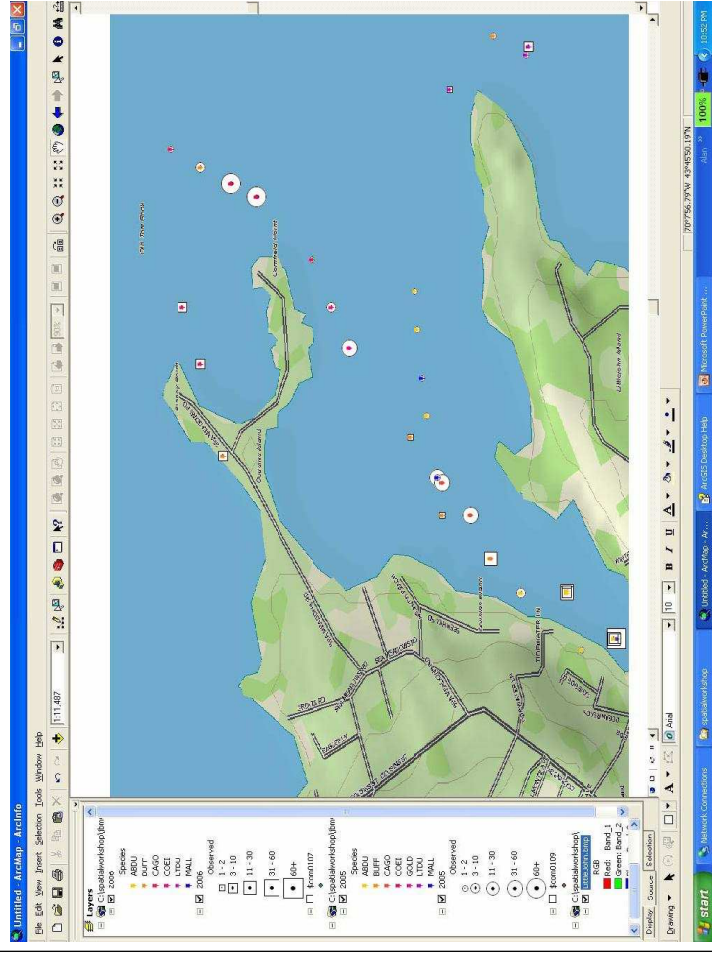
How to display “raw” survey data in a meaningful manner? (cont'd)

- ◆ There were not really many observations in the “target” area.
- ◆ Next we look at the attribute tables for the selected observations each year.



How to display “raw” survey data in a meaningful manner? (cont'd)

- ◆ Finally, symbology was selected to try and display the information in a more meaningful way than just as dots on a map.



But how was this information actually collected?

■ The next slide shows a simulation of part of the 2005 survey flight in the selected area.

Aerial Survey Data Collection

◆ Going back to the specific area of interest, we'll now see the data plots followed by an overlay of the flight path.

