Description: Wildland fire is a way of life in southern California and can be devastating to businesses, residential communities, and wildlife. Application of frequency and interval models is an important focus of regional wildland fire management. The San Diego Fire History map series, as seen in the 2007 ESRI Map Book, showcases significant fires in San Diego County, from 1910 to 2003. This presentation will describe the process used to produce this map, and explain how and why this process is important.

Agenda

- Introduction
- Camp Pendleton
  - Cumulative Fire Count
  - Year of Last Fire
- ESRI User Conference
- Data Sourcing
- Data Compilation
- Obstacles
- The Road Ahead

GEOFi West

25 September 2007

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-**Introduction** – A brief introduction and overview of the San Diego Fire History map.

-**Camp Pendleton Needs** – The genesis of the project.

-**Cumulative Fire Count** – A brief explanation of CFC.

-**Year of Last Fire** – A brief explanation of YoLF.

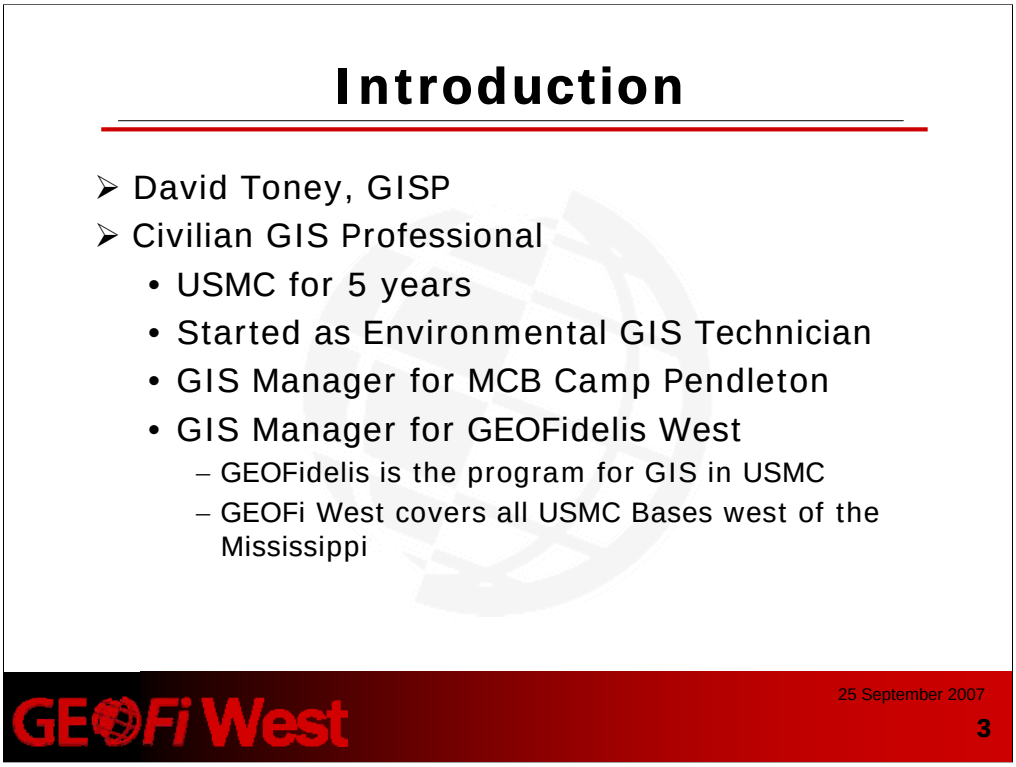
-**ESRI Conference** – Why San Diego and not Camp Pendleton?

-**Data Sourcing** – How did I obtain the data?

-**Data Compilation** – The steps to create the data for these maps.

-**Obstacles** – The obstacles for creating this data, and for using Camp Pendleton data.

-**The Road Ahead** – Future goals for this data – putting this into model builder, returning data back to SANGIS.



Started working for MCB Camp Pendleton in 2002, as the Environmental GIS Technician. In March 2007, named GIS Manager for MCB Camp Pendleton as well as GIS Manager for GEOFi West.

GEOFidelis is the program of record that covers GIS in the Marine Corps. GEOFi West is the regional entity that supports individual USMC installations west of the Mississippi.

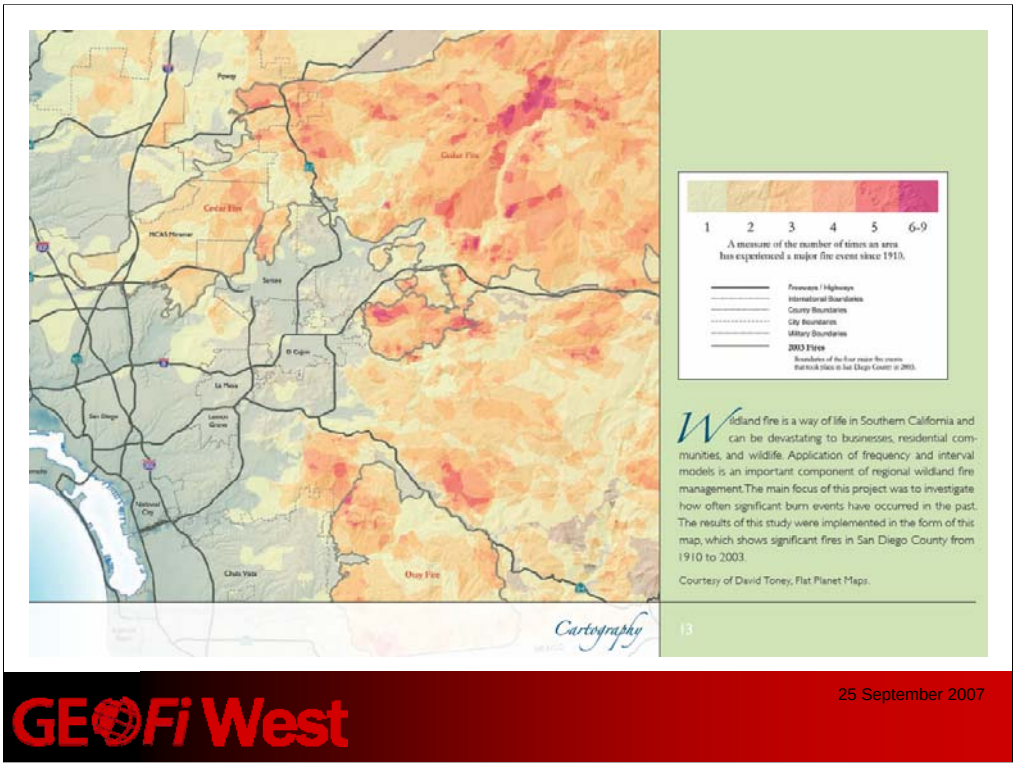
Introduction

- San Diego Fire History Map Series
  - Two maps:
    - Cumulative Fire Count
    - Year of Last Fire
- Created for 2006 ESRI User Conference
- Updating Camp Pendleton's Fire History Model
- Unable to secure authorization to utilize Camp Pendleton data
- Discovered similar data for San Diego County

San Diego Fire History Map Series consists of two maps: Cumulative Fire Count and Year of Last Fire.

The series was created specifically for the 2006 ESRI User Conference. I had a desire to display a map at the conference. At the time, I was updating Camp Pendleton's Fire History model.

I was unable to secure authorization to use Camp Pendleton's fire data. I discovered similar data for San Diego County, and felt it would be a compelling dataset to use for a map.



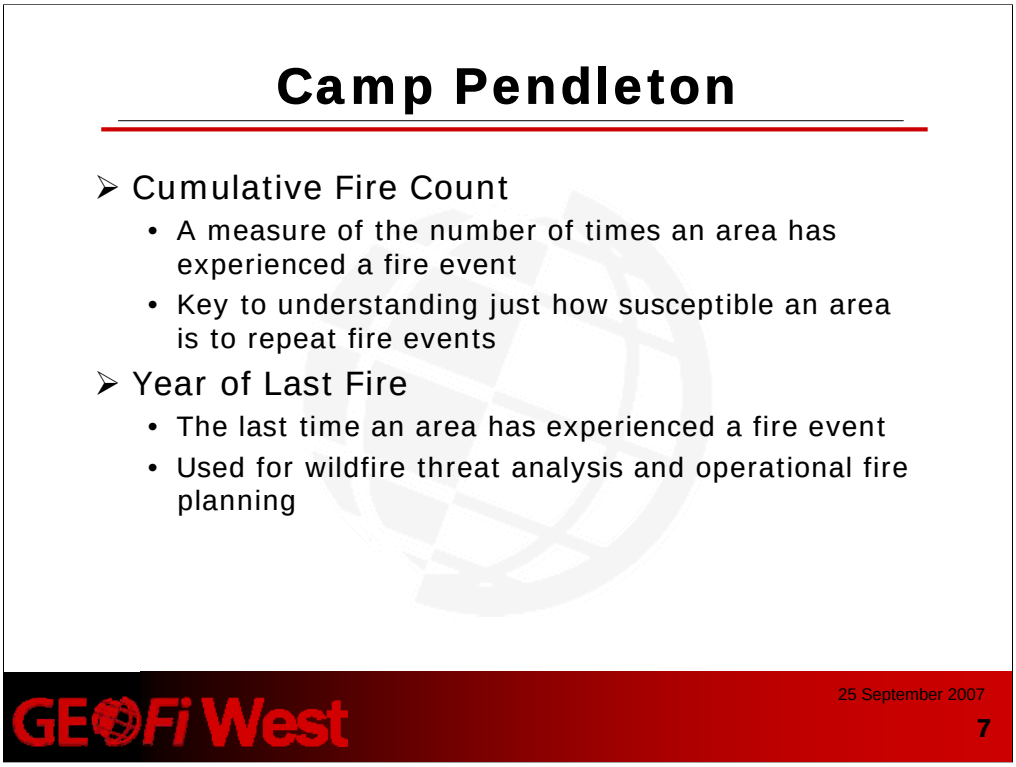
-The San Diego County - Cumulative Fire Count Map appears on page 13 of the 2007 ESRI Map Book (Volume 22).

-The maps were on display in the map gallery of the 2006 ESRI User Conference.

Camp Pendleton

- Environmental Office had developed a Fire History model
  - Model had been developed in ArcInfo command line by a contractor
  - Historical data from 1972 to 2002 present in model
  - Procedure on how to further the model had not been developed
  - Yearly fire mapping continued
  - Need was identified to incorporate data from 2003 to 2005 & bring data into SDE

A contractor had developed the original model. The model had been developed in ArcInfo command line, and utilized coverages. Historical data from 1972 to 2002 existed in the model. But, information on how to further the model had been lost. Yearly fire mapping continued, and a need had been identified to incorporate data from 2003 to 2005 into the model, as well as bring the data into SDE.



Camp Pendleton's Fire Model required two important pieces of information:

-Cumulative Fire Count

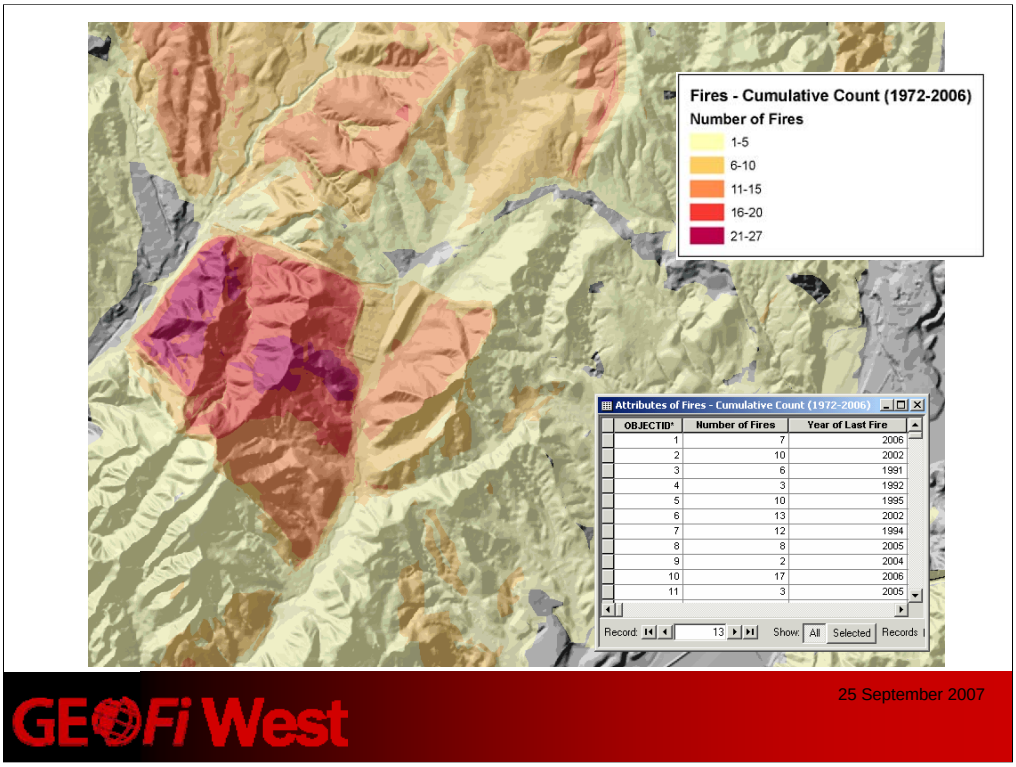
-Year of Last Fire

-Cumulative Fire Count is the measure of the number of times an area has experienced a fire event.

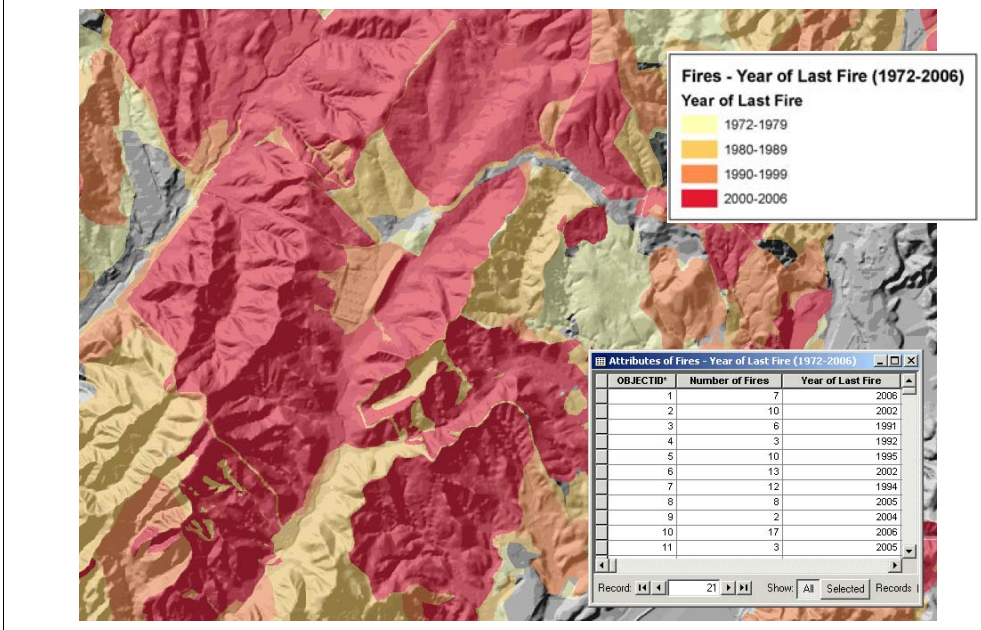
-Helps us understand just how susceptible an area is to repeat burns.

-Year of Last Fire shows the last time an area has experienced a fire event.

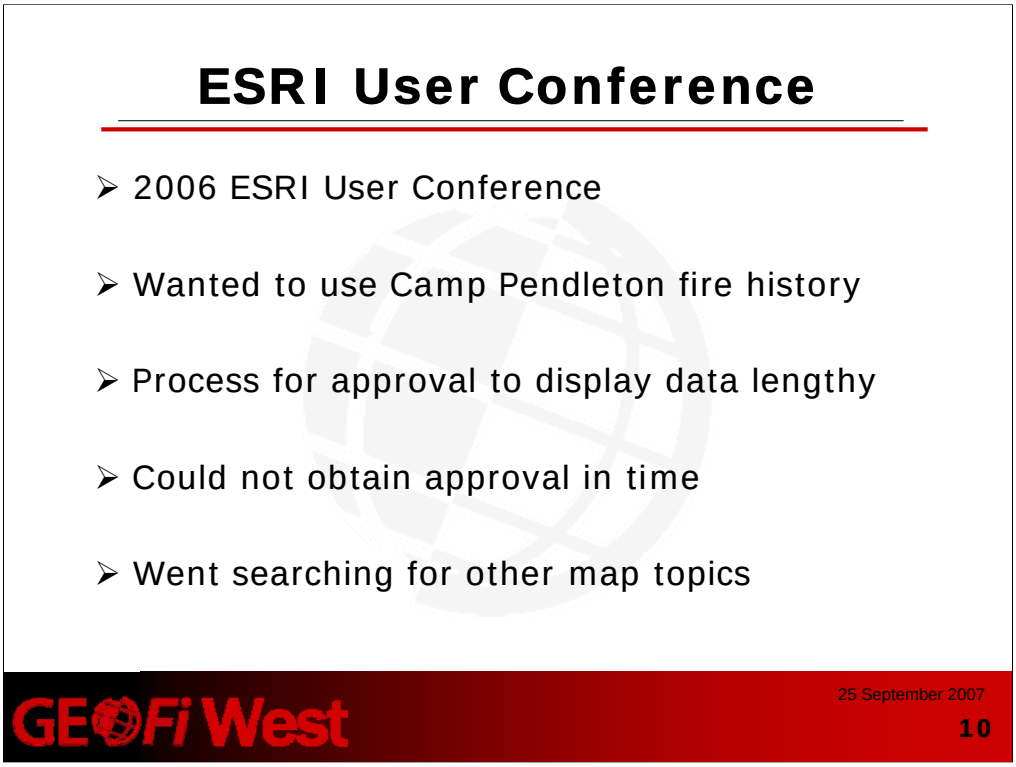
-Very useful for wildfire threat analysis, and helping with operational fire planning.



Cumulative Fire Count at Camp Pendleton, with legend and attribute table.



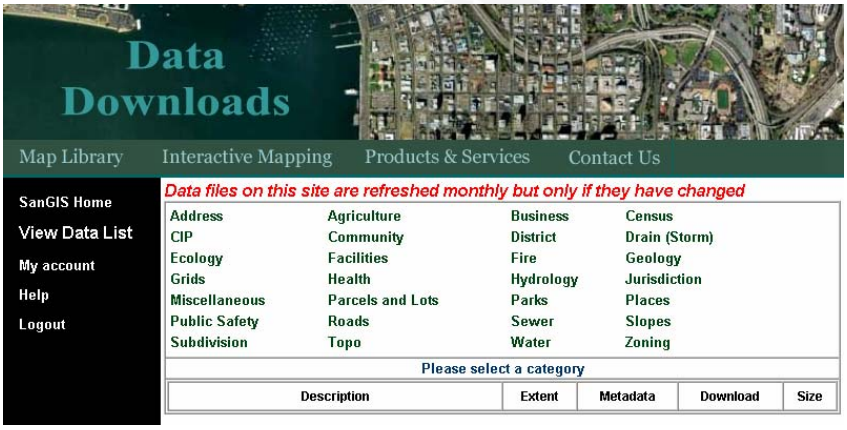
Year of Last Fire at Camp Pendleton, with legend and attribute table.



The 2006 ESRI User Conference was fast approaching. I wanted to use Camp Pendleton fire history data to display on a series of maps. The process for obtaining approval for display of maps is lengthy; I could not obtain approval in time to display at the ESRI Conference. To ensure that I had maps to display, I went searching for other data that I could use.

Data Sourcing

SanGIS: http://www.sangis.org



I visited the SanGIS website, which is full of San Diego GIS data. Fire Burn History is an available layer, with data from 1910 to 2003. Additionally, the perimeters of the three large fires that affected San Diego County in 2003 – Cedar, Otay, and Paradise Fires – are available as well.

Data Compilation

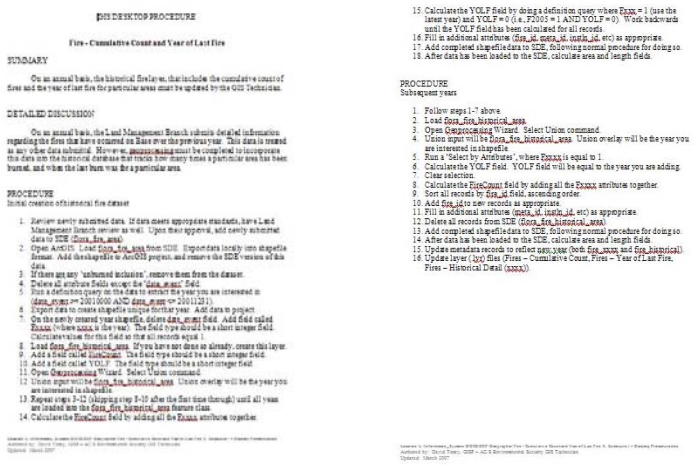
Original attribute table from SanGIS data

NAME	ACRES_CALC	AGENCY	YEAR	MONTH	DAY	CAUSECODE	CAUSE
DULZURA	75	USF	1984	5	13	9	Miscellaneous
DUNBAR	212	CDF	1978	7	14	14	Unknown/Unidentified
DUNBAR	197	CDF	1990	6	26	7	Arson
DUNBAR	43	CDF	2003	8	29	14	Unknown/Unidentified
DYE	525	CDF	1978	9	21	14	Unknown/Unidentified
DYE #2	2998	CDF	1978	9	23	14	Unknown/Unidentified
EAGLE	5204	CDF	1993	5	14	4	Campfire
EAGLE	129	CDF	1997	9	2	9	Miscellaneous
EAST SUNCREST	932	CDF	1950	11	11	14	Unknown/Unidentified
EASTWOOD	893	CDF	1964	10	20	9	Miscellaneous
EGG	804	CDF	1996	6	19	14	Unknown/Unidentified
EL MONTE	8564	USF	1995	8	27	14	Unknown/Unidentified
EL MONTE #2	481	CDF	1954	7	17	14	Unknown/Unidentified
ELFIN	46	USF	1980	9	14	9	Miscellaneous
ELLIOTT RESERVATIO	323	CDF	1950	7	4	14	Unknown/Unidentified
EUCLID	401	CDF	1983	7	13	2	Equipment Use
FALLBROOK DUMP	1766	CDF	1955	9	14	14	Unknown/Unidentified
FEATHERSTONE	121	CDF	1989	11	18	9	Miscellaneous

Selected | Records (0 out of 1296 Selected) | Options

Fire Burn History was downloaded from SanGIS, but it wasn't in a format that was compatible with my fire model. I had to spend some time working on the data to achieve the results I was looking for. This slide shows the attribute table from the original data. The data did have one very important field: Year

Data Compilation



GIS DESKTOP PROCEDURE

Fire - Cumulative Count and Year of Last Fire

SUMMARY

On an annual basis, the historical fire layer, that includes the cumulative count of fires and the year of last fire for particular areas must be updated by the GIS Technician.

DETAILED DISCUSSION

On an annual basis, the Land Management Branch submits detailed information regarding the fires that have occurred on Base over the previous year. This data is treated as any other data submittal. However, preprocessing must be completed to incorporate the data into the historical database that tracks how many times a particular area has been burned, and when the last burn was for a particular area.

PROCEDURE
Initial creation of historical fire dataset

1. Review newly submitted data. If data meets appropriate standards, have Land Management Branch review as well. Upon their approval, add newly submitted data to SDE (flora_fire_area)
2. Open ArcGIS. Load flora_fire_area from SDE. Import data locally into shapefile format. Add the shapefile to ArcGIS project, and remove the SDE version of the data.
3. If there are any 'unburned inclusions', remove them from the dataset.
4. Delete all attribute fields except the 'fire_event' field.
5. Run a definition query on the data to extract the year you are interested in (fire_event >= 20010000 AND fire_event <= 20011231).
6. Export data to create shapefile unique for that year. Add data to project.
7. On the newly created year shapefile, delete fire_event field. Add field called Fxxxx (where xxxx is the year). The field type should be a short integer field. Calculate value for the field so that all records equal 1.
8. Load flora_fire_historical_area. If you have not done so already, create this layer.
9. Add a field called FireCount. The field type should be a short integer field.
10. Add a field called YOLF. The field type should be a short integer field.
11. Open Geoprocessing Wizard. Select Union command.
12. Union input will be flora_fire_historical_area. Union overlay will be the year you are interested in shapefile.
13. Repeat steps 3-12 (skipping step 8-10 after the first time through) until all years are loaded into the flora_fire_historical_area feature class.
14. Calculate the FireCount field by adding all the Fxxxx attributes together.
15. Calculate the YOLF field by doing a definition query where Fxxxx = 1 (use the latest year) and YOLF = 0 (i.e., F2005 = 1 AND YOLF = 0). Work backwards until the YOLF field has been calculated for all records.
16. Fill in additional attributes (fire_id, metra_id, marin_id, etc) as appropriate.
17. Add completed shapefile data to SDE, following normal procedure for doing so.
18. After data has been loaded to the SDE, calculate area and length fields.

PROCEDURE
Subsequent years

1. Follow steps 1-7 above.
2. Load flora_fire_historical_area.
3. Open Geoprocessing Wizard. Select Union command.
4. Union input will be flora_fire_historical_area. Union overlay will be the year you are interested in shapefile.
5. Run a 'Select by Attributes', where Fxxxx is equal to 1.
6. Calculate the YOLF field. YOLF field will be equal to the year you are adding.
7. Clear selection.
8. Calculate the FireCount field by adding all the Fxxxx attributes together.
9. Sort all records by fire_id field, ascending order.
10. Add fire_id to new records as appropriate.
11. Fill in additional attributes (metra_id, marin_id, etc) as appropriate.
12. Delete all records from SDE (flora_fire_historical_area).
13. Add completed shapefile data to SDE, following normal procedure for doing so.
14. After data has been loaded to the SDE, calculate area and length fields.
15. Update metadata records to reflect new year (both fire_xxxx and fire_historical).
16. Update layer (.lyr) files (Fires – Cumulative Count, Fires – Year of Last Fire, Fires – Historical Detail (xxxx)).

I utilized the process I had created to handle Camp Pendleton's fire model to create a similar one for San Diego County.

Data Compilation

1. In ArcCatalog, create a new shapefile called 'fire_history'
2. Include in this new shapefile two fields:
   - FireCount (Short Integer)
   - YOLF (Short Integer)
3. Add the fire_history shapefile and the burn history shapefile to ArcMap
4. Open the attribute table for the burn history shapefile, and delete all attribute fields except 'YEAR'
   - When we get the finished product, it will be important to have clean attribute table. This will become obvious later.

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2. Include in this new shapefile two fields:

   - FireCount (Short Integer)

   - YOLF (Short Integer)

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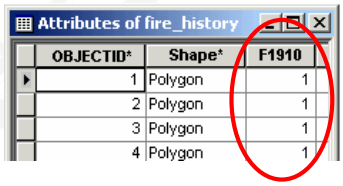
4. Open the attribute table for the burn history shapefile, and delete all attribute fields except 'YEAR'.

   - When we get the finished product, it will be important to have clean attribute table. This will become obvious later.

Data Compilation

5. Run a definition query to extract the data for the first year (i.e., YEAR = 1910)
6. Export the queried data to create a shapefile unique for that year (1910)
7. In the newly created shapefile, open the attribute table and add a field called Fxxxx where xxxx is the year (i.e., F1910)
8. Delete the 'YEAR' field
9. Calculate the value of Fxxxx so that all records have a value of 1



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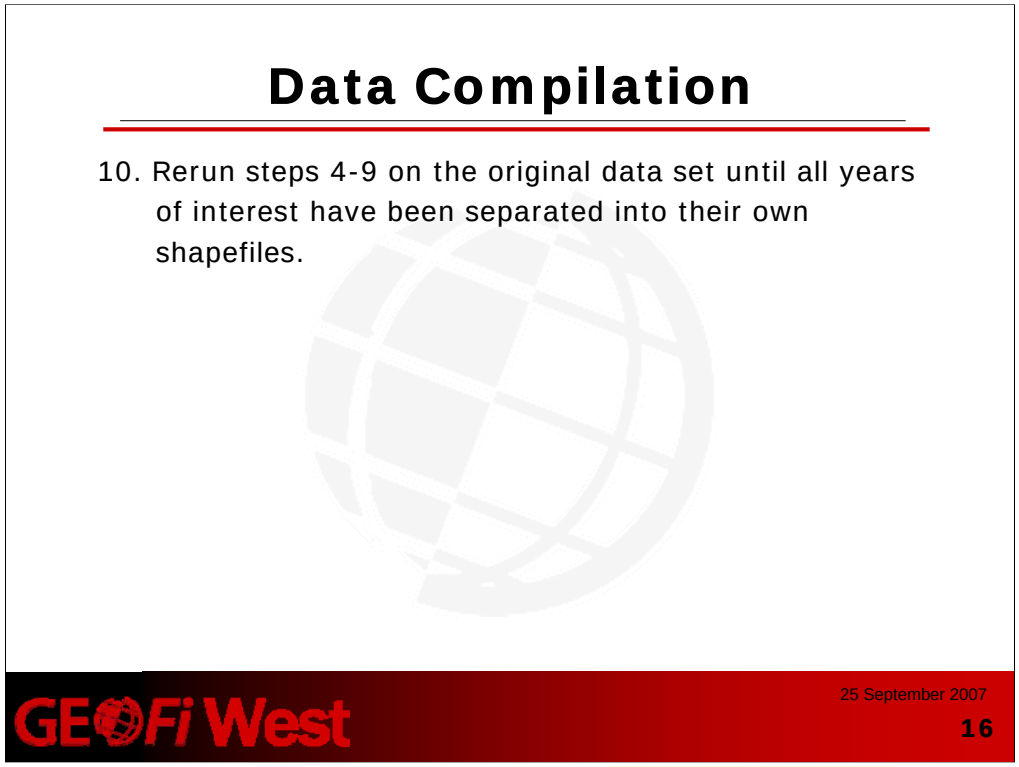
8. Delete the 'YEAR' field.

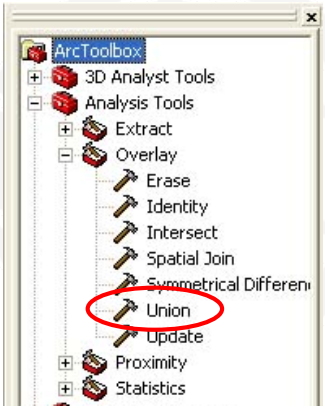
9. Calculate the value of Fxxxx so that all records have a value of 1.



10. Rerun steps 4-9 on the original data set until all years of interest have been separated into their own shapefiles.

Data Compilation

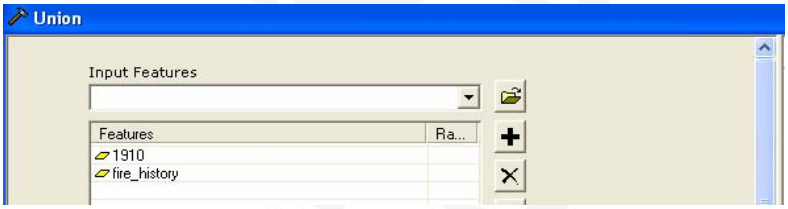
11. Open ArcToolbox. Select the Union command, which is located in the Analysis Tools -> Overlay toolbox.



11. Open ArcToolbox. Select the Union command, which is located in the Analysis Tools -> Overlay toolbox.

Data Compilation

12. Input Features will be the individual year shapefile, followed by the fire_history shapefile. Perform this task separately for each year you are incorporating. Continue in chronological order, from oldest to most recent.



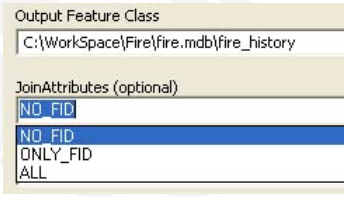
Note: Create a new shapefile each time, called fire_history_xxxx, and then use the new shapefile as your fire_history shapefile for each iteration of this step.

12. Input Features will be the individual year shapefile, followed by the fire_history shapefile. Perform this task separately for each year you are incorporating. Continue in chronological order, from oldest to most recent.

NOTE: Create a new shapefile each time, called fire_history_xxxx, and then use the new shapefile as your fire_history shapefile for each iteration of this step.

Data Compilation

13. Output feature class can be to a personal geodatabase
14. Set the 'JoinAttributes' option to NO_FID
    - This will bring only the Fxxxx attribute into the Union shapefile



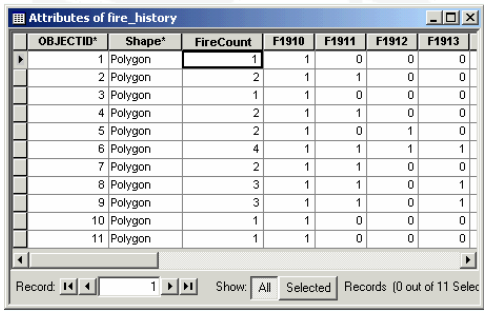
15. Open the attribute table for the new geodatabase feature class

13. Output feature class can be to a personal geodatabase.
14. Set the 'JoinAttributes' option to NO_FID.
    - This will bring only the Fxxxx attribute into the Union shapefile.
15. Open the attribute table for the new geodatabase feature class.

Data Compilation

16. Calculate FireCount by adding all the Fxxxx attributes together.

- Since all the Fxxxx fields have a values of either 0 or 1, this will give you the accurate count of fires that have occurred within that polygon.



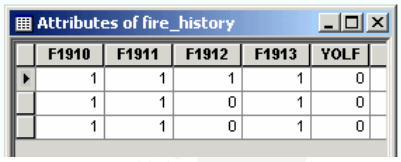
16. Calculate FireCount by adding all the Fxxxx attributes together.

- Since all the Fxxxx fields have a values of either 0 or 1, this will give you the accurate count of fires that have occurred within that polygon. Remember, this isn't the full extent of a particular fire event; rather, this counts the overlap – the number of times a particular place has burned.

Data Compilation

17. Calculate the YOLF field by first performing a definition query where Fxxxx = 1 and YOLF = 0

F1913 = 1 and YOLF = 0



F1910	F1911	F1912	F1913	YOLF
1	1	1	1	0
1	1	0	1	0
1	1	0	1	0

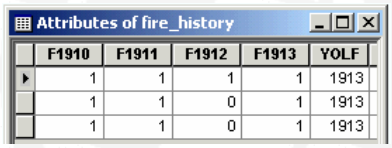
Start in the most recent year.

17. Calculate the YOLF field by first performing a definition query where Fxxxx = 1 and YOLF = 0.
-Start in the most recent year; for example 1913

Data Compilation

17. Calculate the YOLF field by first performing a definition query where Fxxxx = 1 and YOLF = 0

Calculate YOLF



F1910	F1911	F1912	F1913	YOLF
1	1	1	1	1913
1	1	0	1	1913
1	1	0	1	1913

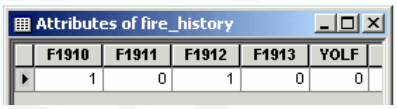
Calculate YOLF for that year.

-Calculate the YOLF that particular year (in this case, 1913).

Data Compilation

17. Calculate the YOLF field by first performing a definition query where Fxxxx = 1 and YOLF = 0

Next most recent year (1912)



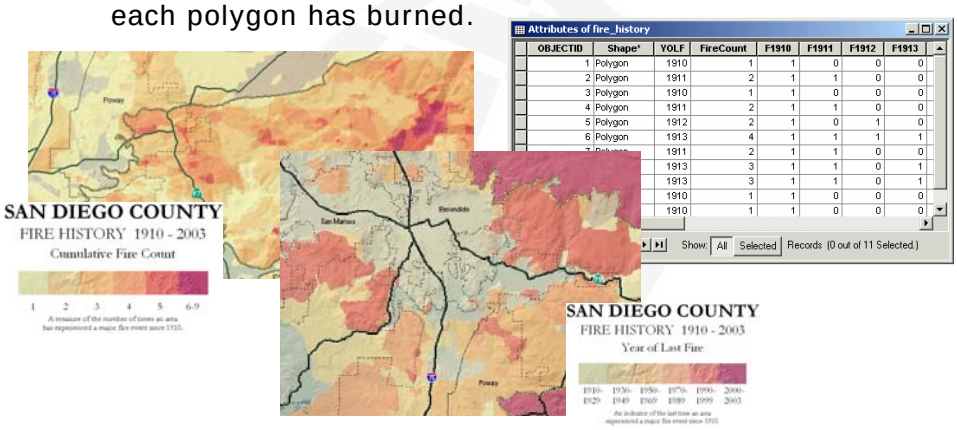
Continue through all years, working backwards.

-Continue through the years, working backwards. (In this example, moving onto 1912)

-By moving backwards, and resetting the Fxxxx field to the current year you are working on, and the YOLF to 0, you will capture those polygons that have not burned again since this 'current' year.

Data Compilation

End result – A spatial layer that shows cumulative fire count, year of last fire, and the individual years that each polygon has burned.

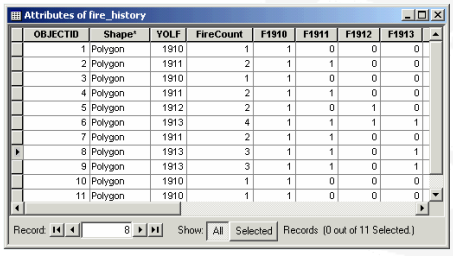


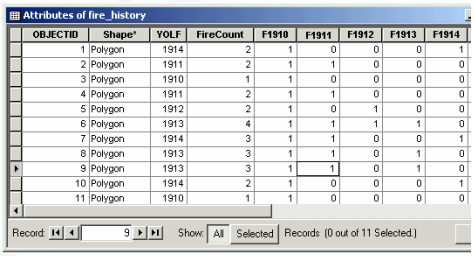
End result – A spatial layer that shows cumulative fire count, year of last fire, and individual years that a place has burned.

Remember our goal of a clean attribute table? As you union layers, attributes fields are carried – the less attributes that are carried over, the cleaner the table. The goal for the final attribute table is to only contain the YOLF, FireCount and Fxxxx fields. The Fxxxx field shows that a fire burned in that polygon in that particular year.

Data Compilation

- Subsequent years completed in similar fashion
- Follow steps 4-15
- Recalculate FireCount as in step 16
- Recalculate YOLF as in step 17
  (Fxxxx = 1 only; YOLF will be calculate in this step)





Subsequent years are completed in a similar fashion. As new data comes in, it is easy to add it to the existing data.

Follow steps 4-15.

Recalculate FireCount as in step 16, to get a new count for fires within a polygon

Recalculate YOLF as in step 17, to get an updated year of last fire for a polygon. (Fxxxx = 1 only; YOLF will be calculated in this step)

As you can see in the example, in the following year, some polygons burned again. The YOLF and FireCount attributes have been updated, and a new attribute F1914, has been added.

Obstacles

- This process was developed in ArcGIS 8.3
- ArcGIS 8.3 was the only software available to run on USMC computers until this year.
- This process had to be updated to run in ArcGIS 9.2
- No opportunity to use ModelBuilder
- Time consuming to repeat this process for 94 years worth of data.
- Data reliability – how reliable are fire polygons from 94 years ago?
- Where are the most recent years?

Developed in ArcGIS 8.3, because ArcGIS 9.x was not available to me, at development time, as a USMC user.

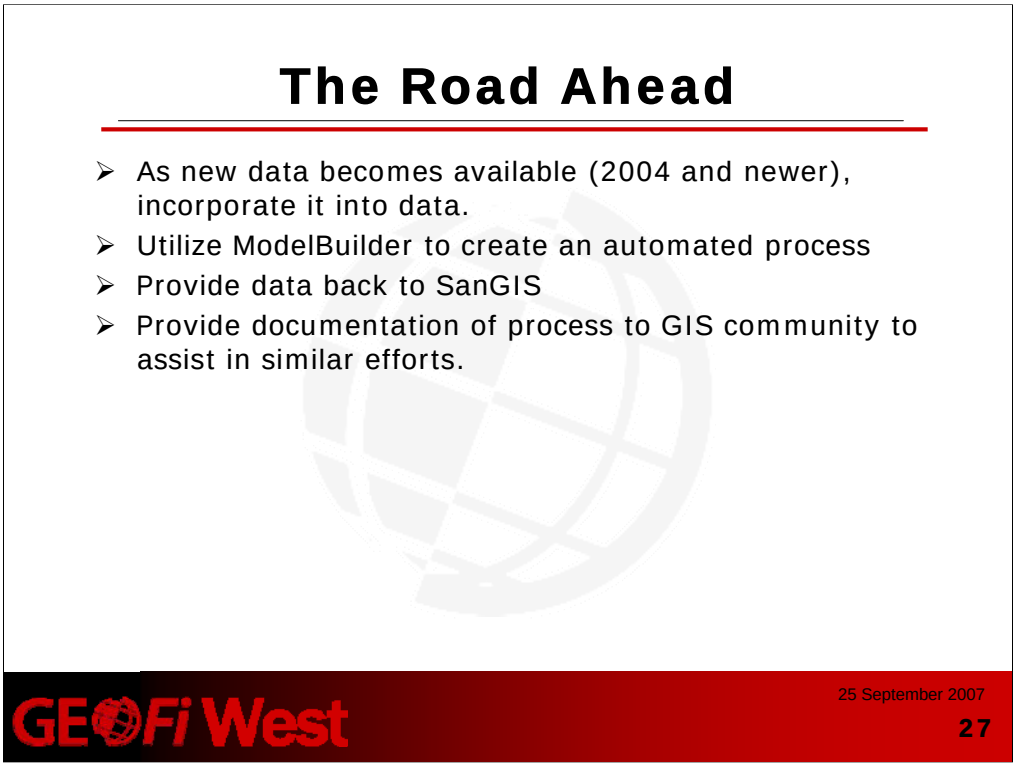
This process / list of instructions had to be updated to run under 9.2.

I believe the process would have been much quicker to run, if I could have spent some time using ModelBuilder.

It is a time consuming process to do this for 94 years worth of data.

Data reliability is a question – how reliable is a fire polygon from 1910?

Where are the 2004, 2005, and 2006 datasets? They have not been released to SanGIS as of this writing.



As new data becomes available, from 2004 and beyond, incorporate it into the data.

Utilize ModelBuilder to create an automated process for performing these functions.

Provide this data back to SanGIS.

Provide documentation of process to GIS community to assist in their efforts.

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