Long Term Fire History Monitoring and Analysis with ArcGIS

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GEOFidelis West and MCB Camp Pendleton

6 August 2008
Agenda

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

- David Toney, GISP
- Civilian GIS Professional
  - USMC for 6 years
  - Started as Environmental GIS Technician
  - GIS Manager for MCB Camp Pendleton
  - GIS Manager for GEOFidelis West
    - GEOFidelis is the program for GIS in USMC
    - GEOFI WEST covers all USMC Bases 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
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 component of regional wildland fire management. The main focus of this project was to investigate how often significant burn events have occurred in the past. The results of this study were implemented in the form of this map, which shows significant fires in San Diego County from 1910 to 2003.

Courtesy of David Toney, Flat Planet Maps.
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
Camp Pendleton

- **Cumulative Fire Count**
  - A measure of the number of times an area has experienced a fire event
  - Key to understanding just how susceptible an area is to repeat fire events

- **Year of Last Fire**
  - The last time an area has experienced a fire event
  - Used for wildfire threat analysis and operational fire planning
ESRI User Conference

- 2006 ESRI User Conference
- Wanted to use Camp Pendleton fire history
- Process for approval to display data lengthy
- Could not obtain approval in time
- Went searching for other map topics
Data Sourcing

SanGIS: http://www.sangis.org
Data Sourcing

California Department of Forestry and Fire Protection: http://frap.cdf.ca.gov/data/
## Data Compilation

### Original attribute table

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**Data Compilation**

**DESKTOP PROCEDURE**

**SUMMARY**

On a weekly 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 fires that have occurred on BLM land for the previous year. This data is entered as any other data submitted. However, a copy of the layer must be completed to incorporate this data into the historical database that tracks how many times a particular area has been burned, and when the last time that was the particular area.

**PROCEDURE**

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 GIS Data Base layer.
2. Open ARCVHL Data Base layer from X:
3. Expand data into ARCVH_SArea layer. Add this data to ARCVH Project, and remove the SDK version of this area.
4. If there is any additional data, remove them from the dataset.
5. Delete all attributes except the "data_area" field.
6. Run a definition query on the data to extract the year you are interested in (e.g., "1990:1990, 2001:2001, 2002:2002").
7. Export data to create a separate data set for this year. Add data to project.
8. On the newly created layer, create a new field, "data_area" field. Add field called "last_1990", where year is the 1990. The field type should be a short integer field.
9. Calculate the "last_1990" field.
10. Add a field called "last_1990" field to a new record.
11. Open ARCVH_SArea, select Union command.
12. Use "data_area" field to a new record.
13. Add all records to ARCVH_SArea, Union record will be the year you are interested in.
14. Repeat steps 1-13, (keeping a step 1-13 after the first time), until all years are loaded into the layer.

15. Calculate the WOLF field by doing a definition query where WOLF = 1 (use the current year) and WOLF = 2 (i.e., FFOV = 1 AND WOLF = 1). Work backwards until the WOLF field has been calculated for all records.
16. Fill in additional attributes (e.g., area, acreage, area, etc.) as applicable.
17. Add completed attributes to X:
18. Following normal procedure for doing so.
19. After data has been loaded to the X:

**PROCEDURE**

Subsequent years:

1. Follow steps 1-13 above.
2. Load data first.
3. Open ARCVH_SArea, select Union command.
4. Use "data_area" field to a new record.
5. Add field called "data_area" field to a new record.
6. Calculate the WOLF field. WOLF field will be equal to the year you are adding.
7. Repeat steps 1-13, (keeping a step 1-13 after the first time), until all years are loaded into the layer.
8. Add all records to ARCVH_SArea, Union record.
9. Add completed attributes to X:
10. Fill in additional attributes (e.g., area, acreage, etc.) as applicable.
11. Delete all records from X:
12. Load data first.
13. Add completed attributes to X:
14. Following normal procedure for doing so.
15. After data has been loaded to the X:
16. Add completed attributes to X:
17. Delete all records from X:
18. Load data first.
19. Add completed attributes to X:
20. Following normal procedure for doing so.

6 August 2008
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.
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
Data Compilation

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.
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.
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
16. Calculate FireCount by adding all the Fxxxx attributes together.
- Since all the Fxxxx fields have values of either 0 or 1, this will give you the accurate count of fires that have occurred within that polygon.

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

\[ F1913 = 1 \text{ and } YOLF = 0 \]

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

Calculate YOLF for that year.
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.
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.
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)
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 almost 100 years worth of data.
- Data reliability – how reliable are fire perimeters from almost 100 years ago?
The Road Ahead

- As new data becomes available, incorporate it into dataset.
- Utilize ModelBuilder to create an automated process.
- Provide data back to the community.
- Provide documentation of process to GIS community to assist in similar efforts.
Contact Information

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