Long Term Fire History Monitoring and Analysis with ArcGIS

Presented by: David Toney, GISP
GIS Manager
GEO*Fidelis* West and MCB Camp Pendleton

6 August 2008

Agenda

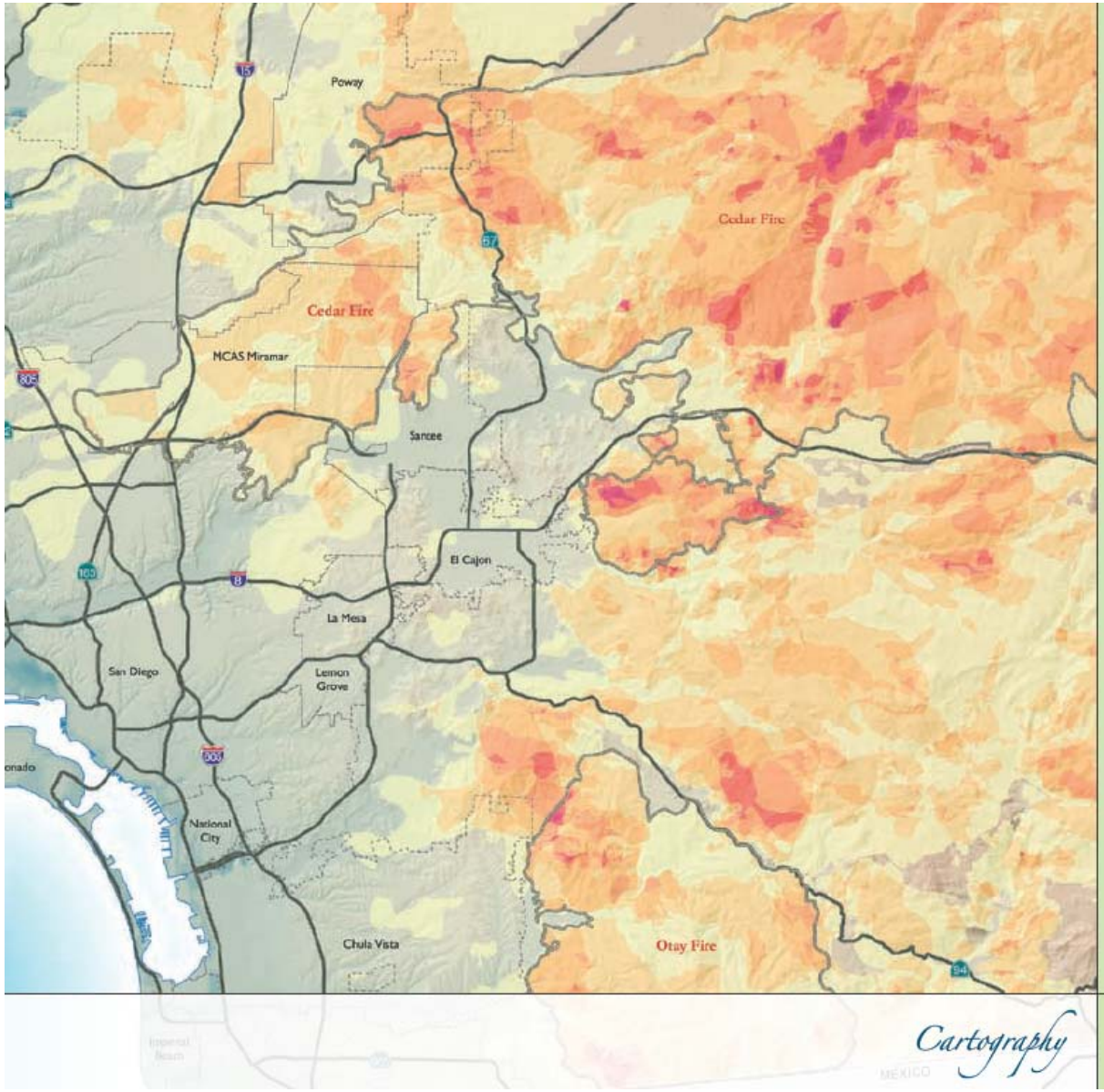
- Introduction
- Camp Pendleton
  - Cumulative Fire Count
  - Year of Last Fire
- ESRI User Conference
- Data Sourcing
- Data Compilation
- Obstacles
- The Road Ahead

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
    - GEO*Fidelis* 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



1 2 3 4 5 6-9

A measure of the number of times an area has experienced a major fire event since 1910.

Freeways / Highways
International Boundaries
County Boundaries
City Boundaries
Military Boundaries
2003 Fires

Boundaries of the four major fire events that took place in San Diego County in 2003.

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.

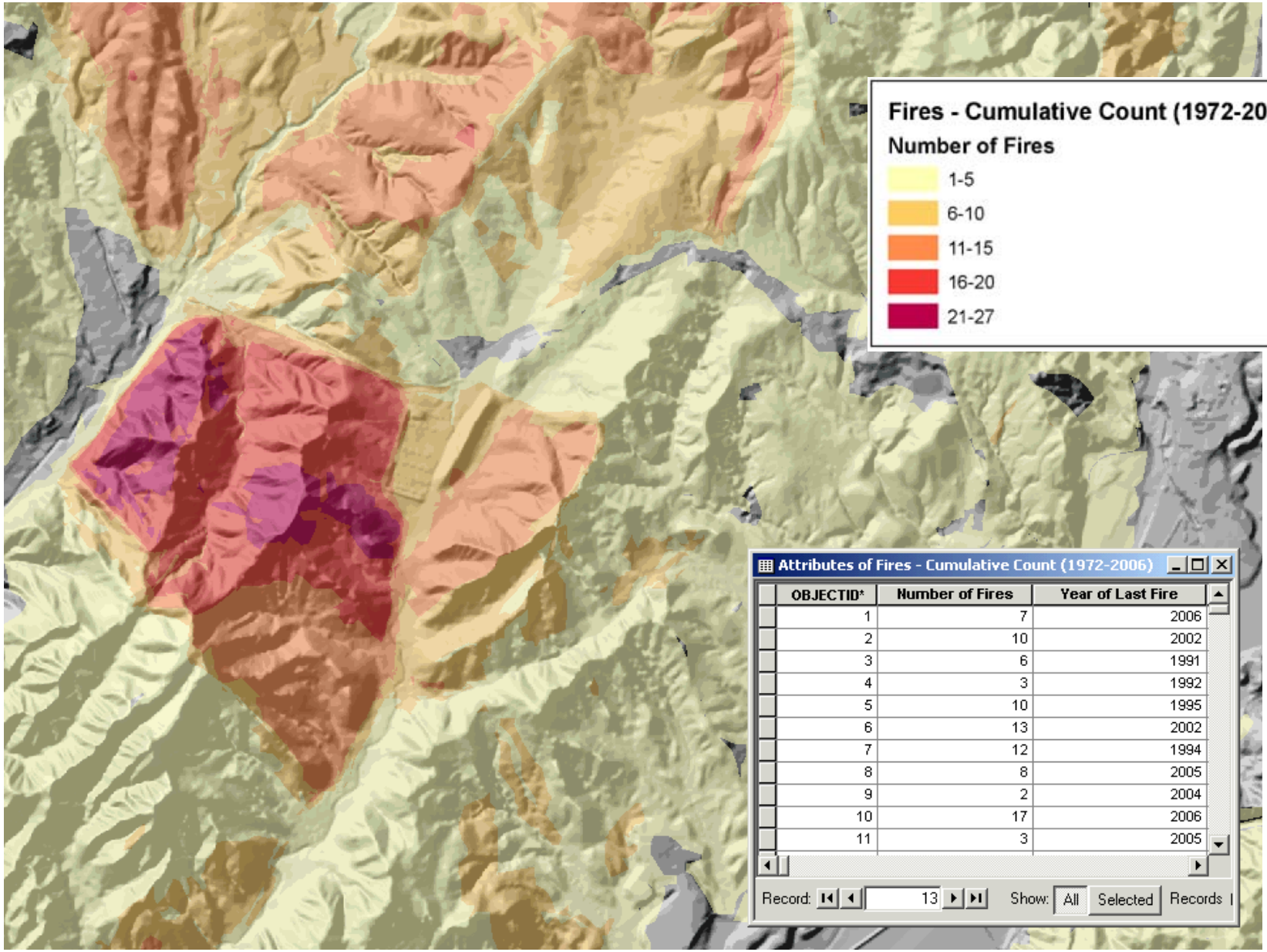
Courtesy of David Toney, Flat Planet Maps.

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

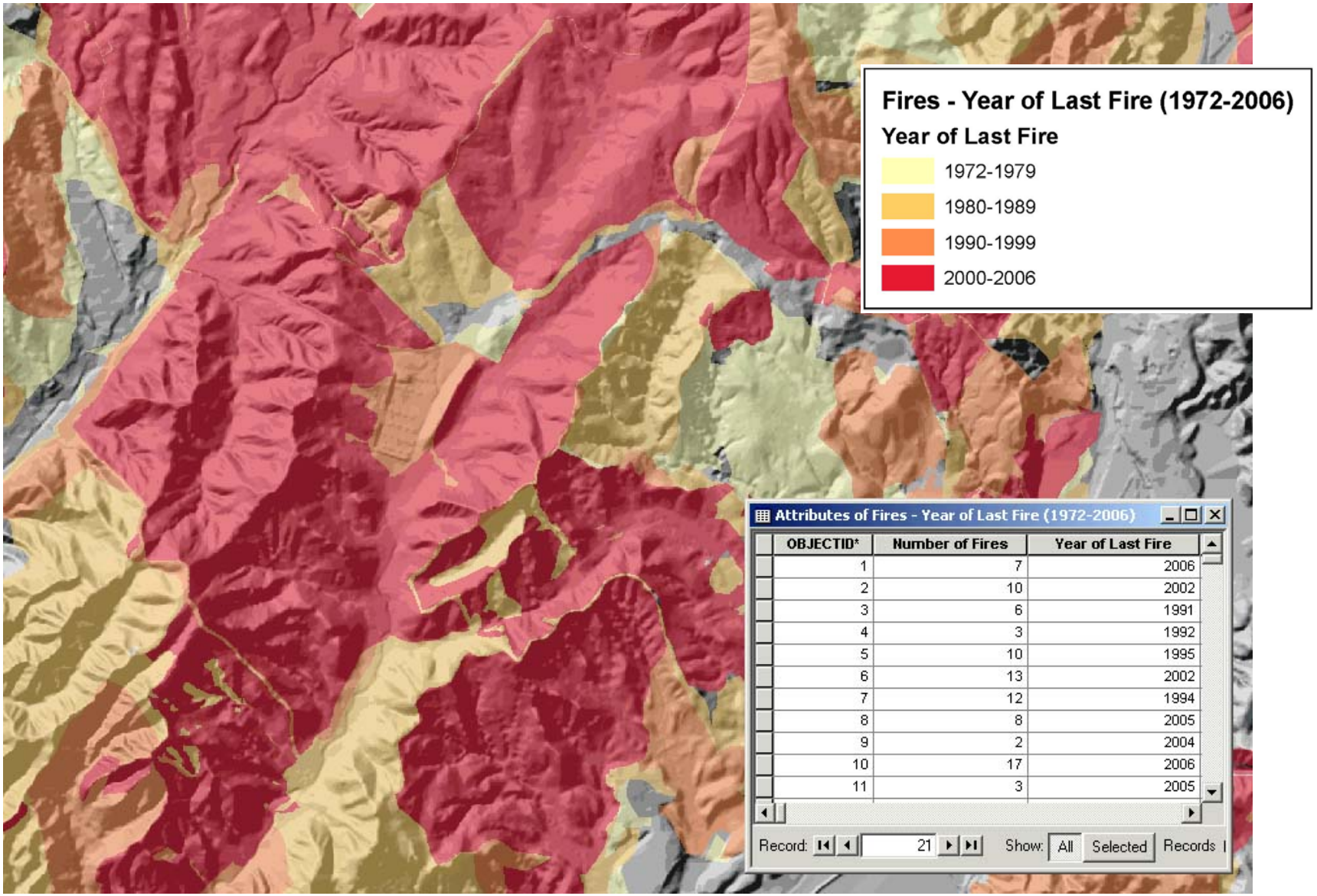
- Cumulative Fire Count
  - A measure of the number of times an area has experienced a fire event
  - Key to understanding just how susceptible an area is to repeat fire events
- Year of Last Fire
  - The last time an area has experienced a fire event
  - Used for wildfire threat analysis and operational fire planning



Attributes of Fires - Cumulative Count (1972-2006)

OBJECTID*	Number of Fires	Year of Last Fire
1	7	2006
2	10	2002
3	6	1991
4	3	1992
5	10	1995
6	13	2002
7	12	1994
8	8	2005
9	2	2004
10	17	2006
11	3	2005

Record: 13 Show: All Selected Records

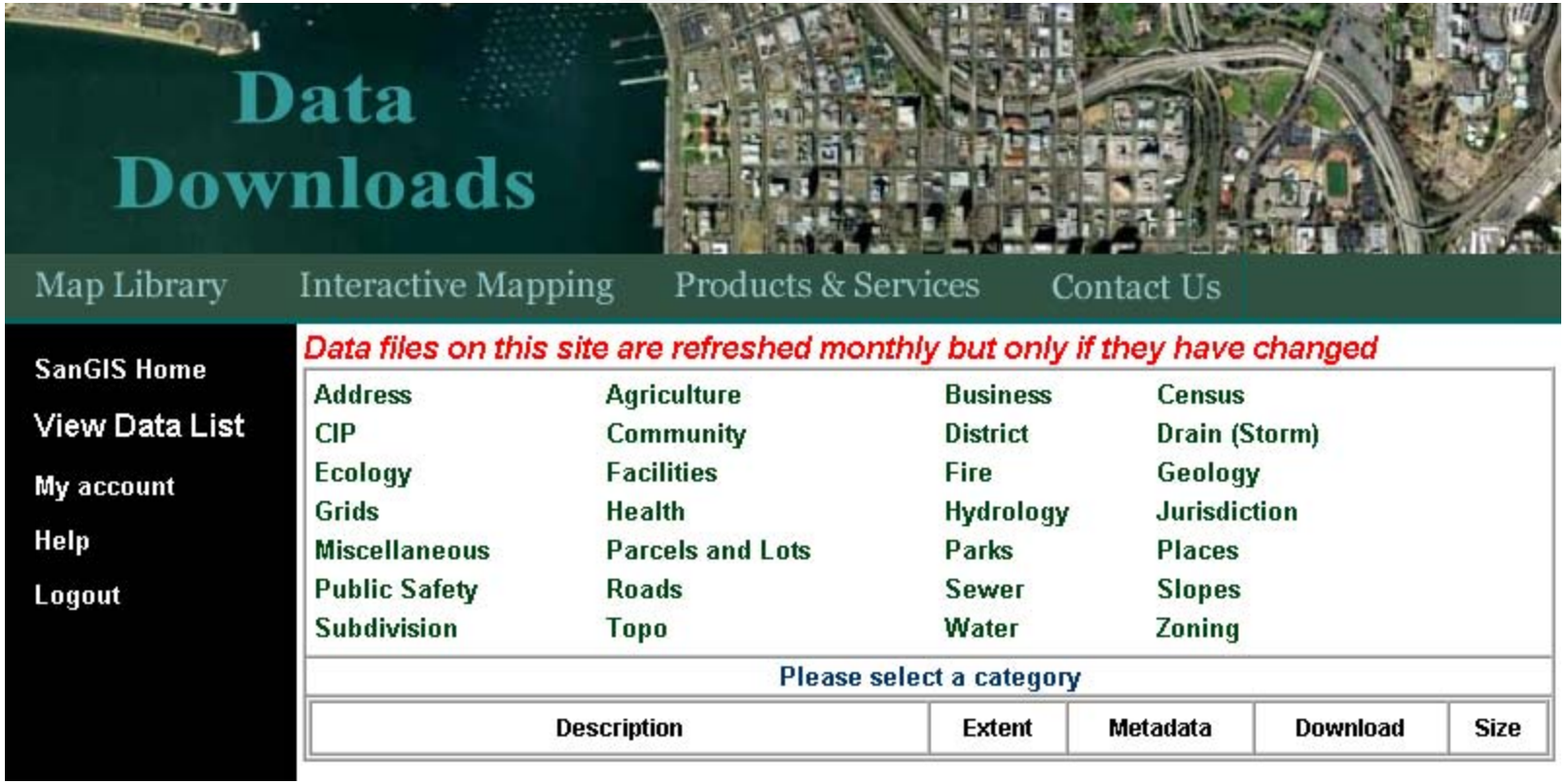

Fires - Year of Last Fire (1972-2006)
Year of Last Fire
1972-1979
1980-1989
1990-1999
2000-2006
Attributes of Fires - Year of Last Fire (1972-2006)
OBJECTID*
Number of Fires
Year of Last Fire
1 7 2006
2 10 2002
3 6 1991
4 3 1992
5 10 1995
6 13 2002
7 12 1994
8 8 2005
9 2 2004
10 17 2006
11 3 2005
Record: 21
Show: All Selected Records

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

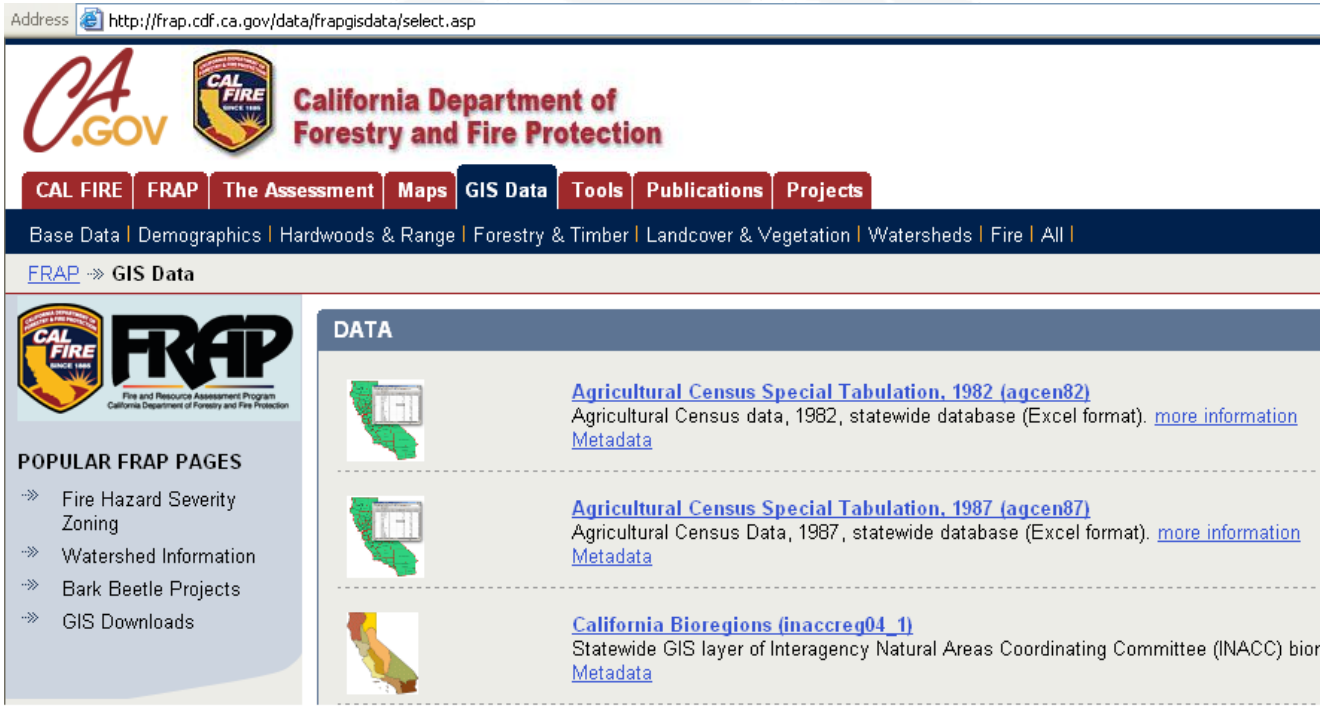
Data Sourcing

SanGIS: http://www.sangis.org



Data Sourcing

California Department of Foresty and Fire Protection: http://frap.cdf.ca.gov/data/



Data Compilation

Original attribute table

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

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, geoprocessing 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 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. Export data locally into shapefile format. Add the shapefile to ArcGIS project, and remove the SDE version of this data.
3. If there are any 'unburned inclusion', remove them from the dataset.
4. Delete all attribute fields except the 'date_event' field.
5. Run a definition query on the data to extract the year you are interested in (date_event >= 20010000 AND date_event <= 20011231).
6. Export data to create shapefile unique for that year. Add data to project.
7. On the newly created year shapefile, delete date_event field. Add field called Fxxxx (where xxxx is the year). The field type should be a short integer field. Calculate values for this 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 Fxxx = 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, meta_id, instln_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 (meta_id, instln_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)).

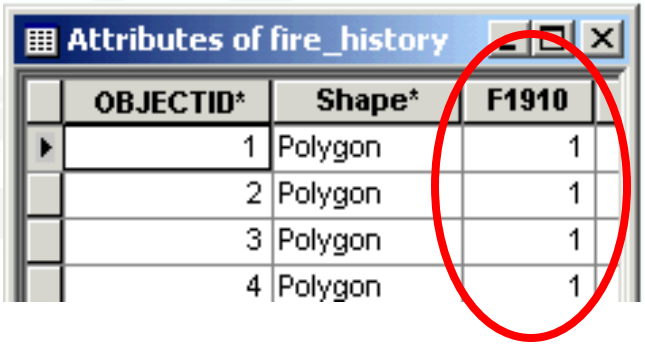
Data Compilation

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

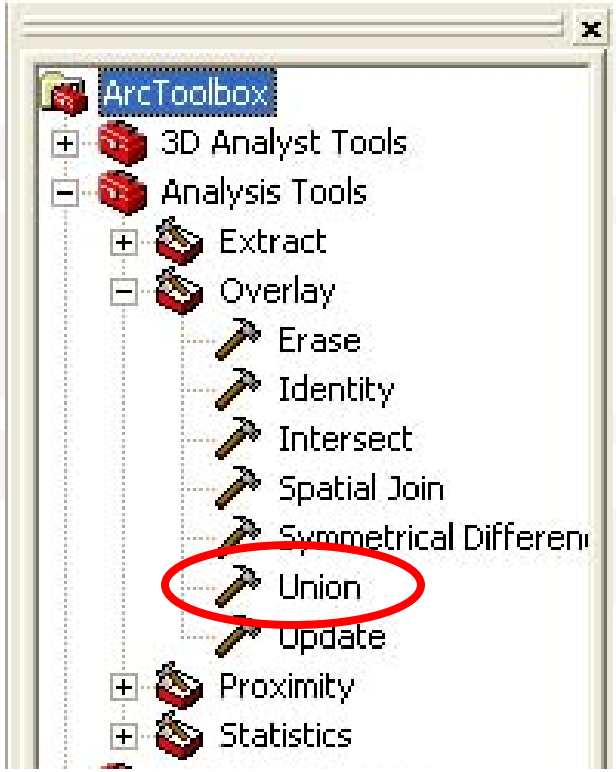


Data Compilation

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

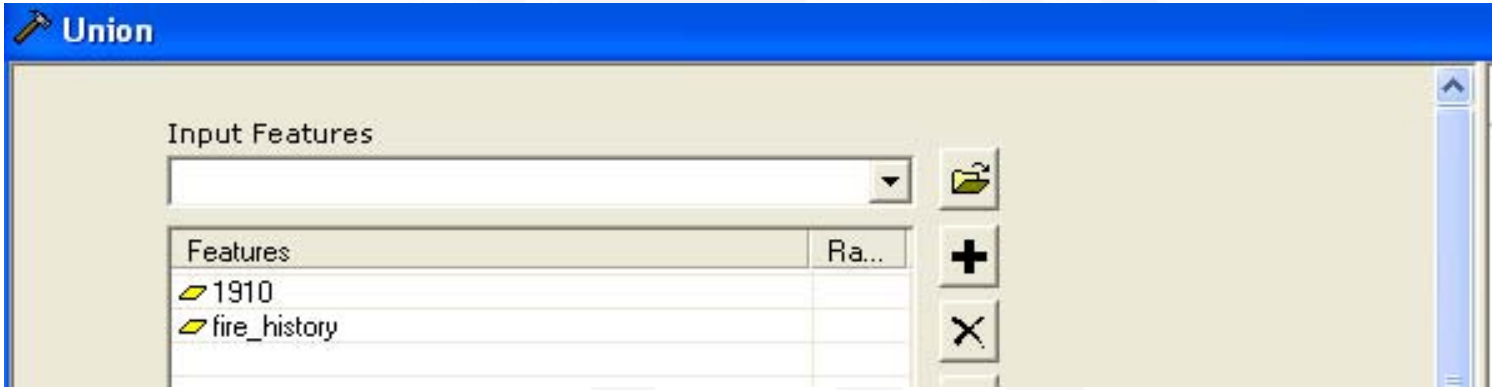
Data Compilation

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



Data Compilation

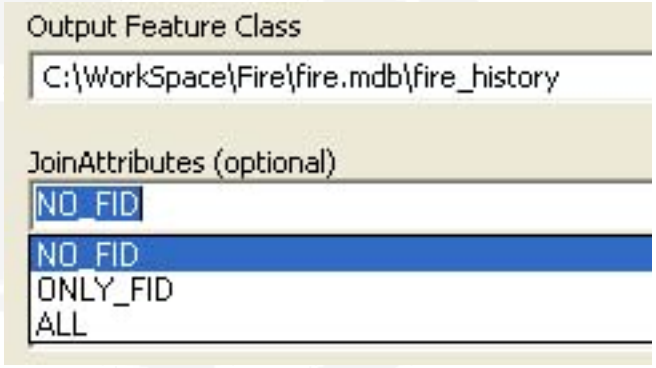
12. Input Features will be the individual year shapefile, followed by the fire_history shapefile. Perform this task separately for each year you are incorporating. Continue in chronological order, from oldest to most recent.



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.

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

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.

Attributes of fire_history

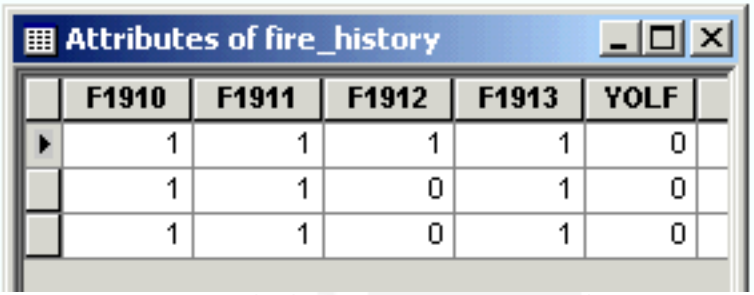
OBJECTID*	Shape*	FireCount	F1910	F1911	F1912	F1913
1	Polygon	1	1	0	0	0
2	Polygon	2	1	1	0	0
3	Polygon	1	1	0	0	0
4	Polygon	2	1	1	0	0
5	Polygon	2	1	0	1	0
6	Polygon	4	1	1	1	1
7	Polygon	2	1	1	0	0
8	Polygon	3	1	1	0	1
9	Polygon	3	1	1	0	1
10	Polygon	1	1	0	0	0
11	Polygon	1	1	0	0	0

Record: 1 Show: All Selected Records (0 out of 11 Selec

Data Compilation

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

F1913 = 1 and YOLF = 0



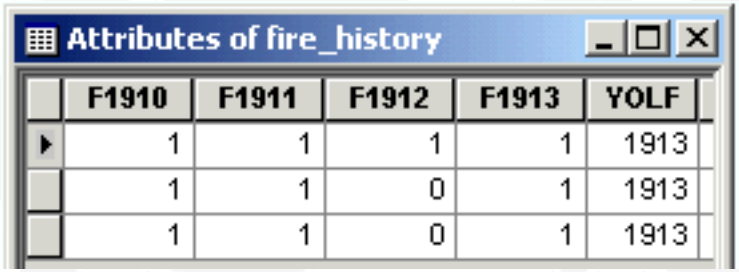
F1910	F1911	F1912	F1913	YOLF
1	1	1	1	0
1	1	0	1	0
1	1	0	1	0

Start in the most recent year.

Data Compilation

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

Calculate YOLF



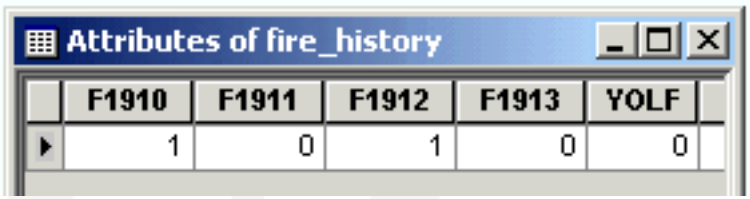
F1910	F1911	F1912	F1913	YOLF
1	1	1	1	1913
1	1	0	1	1913
1	1	0	1	1913

Calculate YOLF for that year.

Data Compilation

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

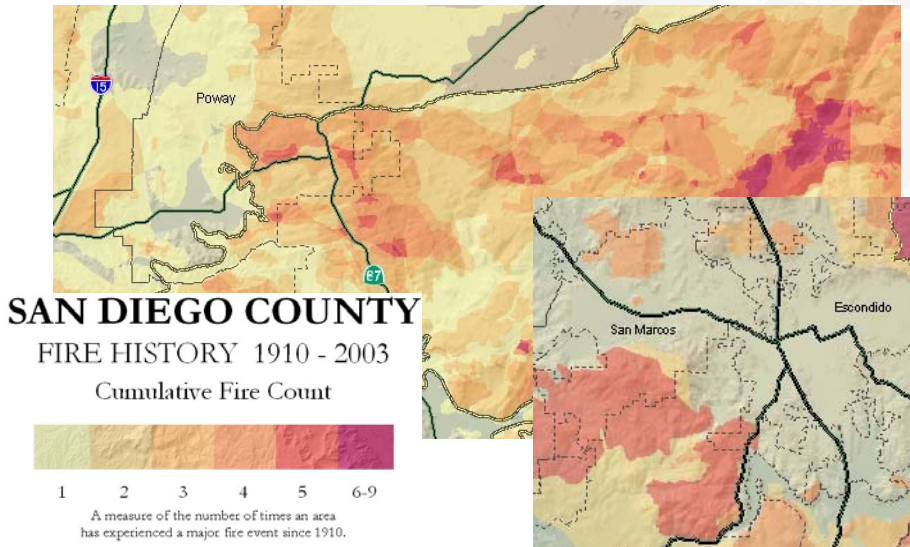
Next most recent year (1912)

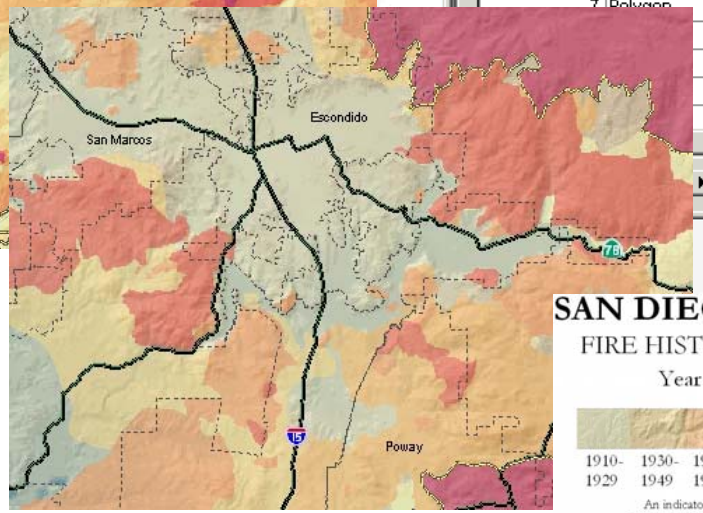


Continue through all years, working backwards.

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.





Attributes of fire_history

OBJECTID	Shape*	YOLF	FireCount	F1910	F1911	F1912	F1913
1	Polygon	1910	1	1	0	0	0
2	Polygon	1911	2	1	1	0	0
3	Polygon	1910	1	1	0	0	0
4	Polygon	1911	2	1	1	0	0
5	Polygon	1912	2	1	0	1	0
6	Polygon	1913	4	1	1	1	1
7	Polygon	1911	2	1	1	0	0
8	Polygon	1913	3	1	1	0	1
9	Polygon	1913	3	1	1	0	1
10	Polygon	1910	1	1	0	0	0
11	Polygon	1910	1	1	0	0	0

Show: All Selected Records (0 out of 11 Selected.)

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)

Attributes of fire_history

OBJECTID	Shape*	YOLF	FireCount	F1910	F1911	F1912	F1913
1	Polygon	1910	1	1	0	0	0
2	Polygon	1911	2	1	1	0	0
3	Polygon	1910	1	1	0	0	0
4	Polygon	1911	2	1	1	0	0
5	Polygon	1912	2	1	0	1	0
6	Polygon	1913	4	1	1	1	1
7	Polygon	1911	2	1	1	0	0
8	Polygon	1913	3	1	1	0	1
9	Polygon	1913	3	1	1	0	1
10	Polygon	1910	1	1	0	0	0
11	Polygon	1910	1	1	0	0	0

Record: 8 Show: All Selected Records (0 out of 11 Selected.)

Attributes of fire_history

OBJECTID	Shape*	YOLF	FireCount	F1910	F1911	F1912	F1913	F1914
1	Polygon	1914	2	1	0	0	0	1
2	Polygon	1911	2	1	1	0	0	0
3	Polygon	1910	1	1	0	0	0	0
4	Polygon	1911	2	1	1	0	0	0
5	Polygon	1912	2	1	0	1	0	0
6	Polygon	1913	4	1	1	1	1	0
7	Polygon	1914	3	1	1	0	0	1
8	Polygon	1913	3	1	1	0	1	0
9	Polygon	1913	3	1	1	0	1	0
10	Polygon	1914	2	1	0	0	0	1
11	Polygon	1910	1	1	0	0	0	0

Record: 9 Show: All Selected Records (0 out of 11 Selected.)

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

David Toney, GISP
GIS Manager
MCB Camp Pendleton
GEO*Fidelis* West
760.763.1891
david.toney@usmc.mil