

ARKANSAS' BEAR DATA: ONION PAPER TO DIGITAL

Author: Hanna L. Ford, Arkansas Game and Fish Commission

Abstract: The Arkansas Game and Fish Commission (AGFC) Bear Program is using GIS to visually represent relationships between nuisance black bear complaints and nuisance black bear captures in Arkansas. This paper discusses the path taken to develop databases to carry us from 'onion paper to digital,' the experience of managing data from the past, the difficulties unearthed while attempting to maintain uniformity and accuracy, and lastly utilizing GIS to provide a comprehensive visual representation of the data. The information derived from this data can ultimately be used to predict areas of high risk for nuisance black bear problems and hopefully assist us in reducing the amount of negative bear-human contacts in those areas. Future plans include creating a master database that would house all AGFC black bear related information, including nuisance, harvest and research information.

INTRODUCTION

The purpose of this paper is to describe the development of the supporting database behind the GIS and to emphasize the importance of good data. The development of the AGFC nuisance black bear GIS will be used as an example. All processes have been documented in order to assist in identifying particulars to be considered during similar database development. The potential uses of GIS are only moderately addressed; most emphasis is placed on the importance of data management.

BACKGROUND

Management of nuisance black bear problems is a statewide responsibility that requires the AGFC's statewide black bear coordinator prepare and distribute data collection forms, distribute immobilization equipment, train personnel in proper use of immobilization equipment and coordinate the activities of many people when nuisance bear problems arise. With all these responsibilities, and many more not mentioned, there are always pressing issues to be addressed, leaving data entry and data management as some of the lower priorities. In the past persons not educated in biology, wildlife management or GIS are generally relied upon for data entry. The value and importance of the data is not fully understood and consequently mistakes are made, errors go unreported and the integrity of the data suffers. Although this is a generalization, I believe it is a frequently encountered problem, not just for the statewide coordinators at AGFC, but also for any research biologist. Fortunately AGFC now has appropriate resources in the Wildlife Management Division to assist the statewide coordinators with data entry, data management and GIS. This enables all of the statewide biologists to direct some of the workload of data management to others, allowing them to focus attention on other responsibilities; they also have opportunity to utilize data to an extent not previously possible.

GIS NEEDS ASSESMENT

Developing a GIS and the supporting databases for the Nuisance Black Bear Program at the AGFC meant determining the specific GIS needs of the program, evaluating the existing data and prepare for new data. The main goal of this project was to develop a GIS to show distribution of nuisance black bear complaints in relation to the distribution of nuisance black bear captures, confirm identification of areas of the state that are prone to nuisance black bear problems, and show statewide and county level complaint vs. capture trends by year. This data combined with the expertise of the AGFC Regional Nuisance Black Bear Coordinators will hopefully assist in the reduction of negative human-bear contacts in Arkansas. Short-term data goals were to complete database renovations, data entry and GIS work for years 1993 through 2003 for both complaint and capture data. Long-term goals are to complete data entry for years previous to 1993, and continue developing a more customized GIS.

EVALUATION AND PROBLEM SOLVING

There are two main categories that divide the nuisance black bear data; complaint data and capture data. Complaint data consist of all reports of suspect nuisance bear problems reported to the AGFC. Capture data consist of any nuisance bear successfully captured by the AGFC.

Databases for both complaint and capture were pre-existing. The database for complaint data retained some of its original layout, however only approximately 25% of entered data was usable. The database for capture data was completely rebuilt, and none of the entered data was considered usable for the new database. No data for either complaint or capture was entered previous to 1990. Original data collection sheets for years 1983 through present were available to check existing data and provide an avenue to enter older data.

Nuisance Black Bear Complaint Database

The Nuisance Black Bear Complaint database currently houses all nuisance black bear complaints reported to the AGFC since 1993. Approximately 75% of the data was re-entered to ensure that accurate data was being used in the development of the GIS. The following table briefly outlines the fields used in the original nuisance black bear complaint database, explains the use of each field, problems with the existing format and what measures have been taken to correct those problems. Items in shaded boxes indicate they were dissolved and replaced with a more effective means of data management.

Name of Field	Field Description	Problems	Solutions
Date of Complaint	Date complaint was reported to AGFC.	Missing/ Incomplete Dates.	Research paper records.
Complainant's Name	Name of person/business reporting complaint.	Incomplete Names/ Misspelling.	Research paper records.
Address/County/RTS	Address of complainant, County in which the complaint is located, Range/Township/Section in which the complaint is located.	Incomplete Addresses/ Incomplete County/ RTS Not Entered.	Record usable Addresses/ Decipher County for all records/ Disregard RTS. Created separate fields.
Type of Problem	Description of Nuisance Bear Problem using one and two-letter codes.	One field housed many code entries.	Created Yes/No check box indicators for each type of possible problem.
Action Taken	Description of Action Taken to address Nuisance Bear Problem using one and two-letter codes.	One field housed many code entries.	Created Yes/No check box indicators for each type of possible action taken.
Result	Description of Result of the Nuisance Bear Complaint using one and two-letter codes.	One field housed many code entries.	Created Yes/No check box indicators for each type of possible result.
Time Spent	Time spent responding to complaint.	No unit for standard time entry.	Research paper records/ Define standard unit for time.
Miles Driven	Miles driven responding to complaint.	Missing/ Incomplete.	Research paper records.
Employee Name	Name of primary employee responding to complaint.	Inconsistent entries.	Correct misspellings/ Develop standard format for names.
WMD Region	Wildlife Management Division region in which the complaint takes place.	None.	Not Applicable.
Physiographic Region	Physiographic region of the state in which the complaint takes place.	None.	Not Applicable.

Summary of Changes to Nuisance Complaint Database

The field *Date of Complaint* is perhaps the most vital field. It provides the capability of looking at trends in nuisance black bear problems from year to year. The field *County* is a key field in producing this GIS; this is used to join the attribute table of the shapefile to the appropriate table in the Access database. Any record without a county was researched. If a county was not identified, the county was recorded as unknown. The fields *Type of Problem*, *Action Taken*, and *Result* used one and two letter codes to provide an explanation of the nuisance black bear complaint and outcome of the complaint. More than one code was usually needed to provide a response. The codes were entered into their respective text box fields in the Nuisance Black Bear Complaint database; unfortunately entries were not consistent. For example, in the text field for *Type of Problem* there were responses such as “C/H/F;” “C,H,F;” “CHF;” and occasionally the codes were disregarded and the responses were typed out like “Crops/House/Feed.”



Figure 1. Example of an entry into the field for type of problem.

The assistance of a code key would have communicated to the user the types of problems associated with the selected nuisance bear complaint. However, they fail to provide the capabilities of simple analysis such as percentage of complaints pertaining to “Fear.” All data for the fields *Type of Problem*, *Action Taken*, and *Result* were re-entered, using data from the original data complaint sheets, using Yes/No check box indicators for each possible response, providing new opportunities for analysis. Another problem encountered was the consistency of what the codes actually stood for. During the mid 1990’s the code “F,” which had previously meant *Fear*, was changed to *Feed*, *Fear* was combined with *House* using the code “H” and the code “A,” meaning *Animal Feed* was abolished. These changes needed to be recognized to ensure the data remained consistent and accurate. The field *Time Spent* was in need of a standard for entries, the first problem encountered was the type of field being used for data entry, a text field. Some entries included the units used to describe the number (i.e. 7 hours), creating an obstacle for providing totals for time spent per month. The field *Time Spent* was changed to a numeric field, all data for this field was re-entered using hours as a standard unit for measurement, records that did not specify hours, minutes or days were estimated. The field *Employee Name* contains names of employees with no standard. For example, entries were John Doe, J. Doe, Doe, etc... to standardize entries all names are entered as first initial, second initial and last name. This creates the potential for calculations such as quantities of nuisance black bear complaints responded to per individual employee.

Nuisance Black Bear Capture Database

The Nuisance Black Bear Capture database currently houses all nuisance black bear captures performed by the AGFC since 1993. The changes made to the nuisance black bear capture database were extensive, effecting almost every field and resulting in the creation of approximately 75 new fields. All fields in the original database were set as text fields. The use of a wrong field type resulted in the entry of text into what should have been numeric only fields. Other complications arose because the data contained in one field should have actually been split into several fields. Consequently, I chose to re-enter all of the data, rather than make hundreds of corrections. This gave me the opportunity to review each entry and ensure the correct data was being entered. It also allowed me to become more familiar with the data, providing valuable insight into the database needs. The following table briefly outlines the fields used in the original nuisance black bear capture database, explains the use of each field, problems with the existing format and explains the measures taken to correct those problems. Items in shaded boxes indicate they were dissolved and replaced with a more effective means of data management.

Name of Field	Field Description	Problems	Solutions
Employee Name	Name of primary employee responding to complaint.	Inconsistent entries.	Research paper records. Define a standard entry for names.
WMD Region	Wildlife Management Division region in which the complaint takes place.	None.	Not applicable.

Date of Capture	Date bear was captured by AGFC	Missing/ Incomplete dates.	Research paper records.
Complainant Name	Name of person/business reporting complaint.	Incomplete names/ Misspelling.	Research paper records.
Address	Address of person/business reporting complaint.	Incomplete addresses.	Research paper records.
City	City of person/business reporting complaint.	Incomplete cities/ Unknowns.	Research paper records and consult with regional offices.
County	County in which the complainant is located.	Incomplete counties/ Unknowns.	Research paper records and consult with regional offices.
Physiographic Region	Physiographic region in which the complainant is located.	Inconsistent entries.	Research paper records.
Phone Number	Phone number of person/business reporting complaint	Missing area codes.	Research paper records and reference city area code list.
Capture Location	Location bear was captured by the AGFC.	Contained all UTM information, names of places, etc...no standard for entry.	Created separate fields to contain data. Isolated location descriptions.
Type Drug	Type of drug used to anesthetize captured bear.	No standard for entering name of drug used.	Created a standard for type of drug used.
Amount Drug Used	Amount of drug used to anesthetize captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Bear Tattoo	Information on characters tattooed on captured bear.	Included all info (including color, location, etc). No standard.	Created separate fields to contain data. Created standards where applicable.
Bear Ear Tags	Information on ear tags attached to captured bear.	Included all info (including color, location, etc). No standard.	Created separate fields to contain data. Created standards where applicable.
Bear Radio Collar	Information on radio collar affixed to captured bear.	Included all info (type, frequency, delay, etc...). No standard.	Created separate fields to contain data. Created standards where applicable.
Color	The color of the captured bear.	None.	Not applicable.
Tooth Wear	General assessments of the tooth wear of captured bear.	Inconsistent entries.	Research paper records.
General Condition	A general assessment of the condition of the captured bear.	Inconsistent entries.	Research paper records.
Sex of Bear	The gender of the captured bear.	Missing data.	Research paper records.
Weight	The weight of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Total Length	The total length, nose to tail, of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Head Length	The length of the captured bears' head.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Head Width	The width of the captured bears' head.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Ear Length	The length of an ear of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to

			numeric field.
Neck Circumference	The circumference of the neck of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Chest Circumference	The circumference of the chest of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Height at Shoulder	The height at the shoulder of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Forearm Circumference	The circumference of a forearm of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Front Pad Length	The length of a front pad of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Front Pad Width	The width of a front pad of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Hind Pad Length	The length of a hind pad of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Hind Pad Width	The width of a hind pad of the captured bear.	Units of measurement included.	Eliminated inappropriate entries. Changed to numeric field.
Tooth Extracted	Remarks concerning the extraction of a premolar tooth of the captured bear.	None.	Not applicable.
Release Date	The date the captured bear was released.	Missing/ Incomplete dates.	Research paper records.
Release Location	The location the captured bear was released.	Contained all UTM information, names of places, etc...no standard for entry.	Created separate fields to contain data. Isolated location descriptions.

Summary of Changes to Nuisance Complaint Database

The field *Date of Capture* is, again, perhaps the most vital field, providing the capability to look at trends in nuisance black bear problems from year to year. As with the Nuisance Black Bear Complaint database problems arose with the type of field selected. Significant problems were unearthed as fields that should have been numeric only were evaluated, those fields include *Amount Drug Used*, *Weight*, *Total Length*, *Head Length*, *Head Width*, *Ear Length*, *Neck Circumference*, *Chest Circumference*, *Height at Shoulder*, *Forearm Circumference*, *Front Pad Length*, *Front Pad Width*, *Hind Pad Length*, and *Hind Pad Width*. All of these fields were originally created as text fields, consequently allowing the entry of text, specifically measurement units. The entry of text was not conducive for simple analysis of the data.



Figure 2. Examples of an entry into the fields for bear weight and bear ear length.

The initial plan was to isolate the numbers and delete any text that occurred in the fields, however, since the measurements were not taken in the same units many needed to be converted. *Amount Drug Used* and *Weight* were the only fields in which consistent units were used, cubic centimeters (cc) and pounds (lbs), respectively. The standard for all other measurements was centimeters (cm); so all data that was not recorded in centimeters was converted to centimeters. Eliminating the text characters and setting the above mentioned fields as numeric has now provided the opportunity for analysis such as average head width. The next challenge was to develop fields to contain location information. In the original database, one field was used to contain any remark pertaining to the location where the bear was captured and another field contained any remark pertaining to the release site of the captured bear.



Figure 3. Example of an entry into the field for location captured.

These all-encompassing fields housed UTM coordinates/UTM datum/UTM Zone; Latitude/Longitude; Range/Township/Section; and general remarks, such as “1 mile from Jones’ Cemetery.” These varied entries made mapping extremely difficult. Individual fields were created for UTM information and a separate set of fields for Township/Section/Range information. Latitude/Longitude was converted to UTM. Descriptions using landmarks were entered as comments in a separate field. The information for Township/Section/Range and any comments will be used in the future to assign UTM coordinates to these records. The remaining problem was tag/ID information. This includes all of the information for lip tattoos, ear tags and radio collars. The initial step was to establish a difference between existing and new tag/ID information. The secondary process was to further identify the different elements involved in each ID method. Lip tattoo information includes the characters (usually a combination of text and numbers) being tattooed, the color of the tattoo and the location of the tattoo. Ear tag information includes the characters (usually a combination of text and numbers) on the tag and the color of the tag for both ears. Radio collar information includes collar number; frequency; type (manufacturer); battery life; delay (new entries only); and ID number (new entries for GPS collars only). The end result was 26 new fields to replace 3 old fields. Separating all of the information as explained above provides capabilities such as, how many bears in a specific county have red ear tags. Some fields were entirely new to the capture database such as the vital signs (*Rectal Temperature*, *Respiration* and *Pulse*), bear cub information (number present), and *Fate*. *Fate* is a valuable tool, it allows for the viewer to instantly know if the bear has been harvested, dropped collar or perhaps is one of our research bears.

APPLICATION OF GIS

Development of the GIS and database renovations were simultaneous. A new project file was opened in ArcGIS 8.x. Two data frames were created; one for complaint data and one for capture data. The shapefile for Arkansas counties (Arccounties.shp) was added to each data frame. Make-Table Queries in Microsoft Access were used to create a separate table for each year of data and provide corresponding county totals for both capture and complaint data. These tables were joined, by the field *county name*, to the state shapefile (Arccounties.shp). The *symbolology* for the state shapefile (Arccounties.shp) was set to *Quantities-Graduated Colors*, the *Value* was set to the specific year of complaint or capture data that was to be illustrated, and the *normalization* was set to <NONE>. A standard green color ramp was used, the darker the green the greater the quantity of complaints. A standard layout was created containing the following items; a map for complaint data by county and Wildlife Management Division Region, a map for capture data by county and Wildlife Management Division Region, a line graph showing 10 year trend for complaints and a line graph showing 10 year trend for captures (line graphs were created in Microsoft Excel 2000). This layout was used for each year of data. Each final product was exported in portable document format (.pdf).

DISCUSSION

All of the above changes are examples of how the uniformity and accuracy maintained while entering data can affect the outcome of the capabilities of data manipulation and your GIS. Although these examples are specific to AGFC, the overall picture demonstrates the necessity of conformity when working with any type of data. As I have realized in working with this project, the GIS is not your only concern. The integrity of the data, knowledge of the ultimate uses of the data and even how the data was collected are essential to creating a successful GIS. For the AGFC Nuisance Black Bear data, the data was reviewed several times in search of errors or other problems thus improving the integrity. I participated in field activities where data was collected, read papers and ask many questions attempting to determine the ultimate uses of the data not just for the GIS, but also for any foreseeable need. This also afforded me a valuable understanding of how our data is collected and the many situations faced by our biologist while collecting data. As a result, to compliment the renovations to the nuisance black bear complaint and capture databases new data collection sheets have been designed to ensure the optimal use of data recorded and hopefully reduce the likelihood of error or misinterpretation.

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AUTHOR INFORMATION

Hanna Ford, Programs Support
Arkansas Game and Fish Commission
Wildlife Management Division
2 Natural Resources Drive
Little Rock, AR 72205
501-223-6366; E-mail hlford@agfc.state.ar.us