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ENHANCEMENT OF THE FAA'S ON-LINE WILDLIFE AIRCRAFT STRIKE DATABASE WITH AN INTERACTIVE GRAPHICS CAPABILITY

Archie M. Dickey Embry-Riddle Aeronautical University, Prescott, AZ, dickeya@erau.edu

Allen R. Newman Embry-Riddle Aeronautical University, Prescott, AZ, newmana@erau.edu

Michel Hovan Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ, michel.hovan@faa.gov

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ENHANCEMENT OF THE FAA'S ON-LINE WILDLIFE AIRCRAFT STRIKE DATABASE WITH AN INTERACTIVE GRAPHICS CAPABILITY

Dr. Archie M. Dickey & Mr. Allen R. Newman Embry-Riddle Aeronautical University 3700 Willow Creek Road, Prescott, AZ 86301, USA Tel: (928) 777 – 3927, Fax: (928) 777 – 6945, Email: dickeya@erau.edu Tel: (928) 777 – 3947, Fax: (928) 777 – 6945, Email: newmana@erau.edu

Dr. Michel Hovan, Program Manager Federal Aviation Administration William J. Hughes Technical Center Atlantic City International Airport, NJ 08405, USA Tel: (609) 485 – 5552, Fax: (609)-485-4845, Email: michel.hovan@faa.gov

Abstract

Embry-Riddle Aeronautical University (Prescott, AZ, USA) was awarded a grant from the William J. Hughes FAA Technical Center in October 1999 to develop and maintain a web site dealing with a wide variety of airport safety wildlife concerns. Initially, the web site enabled users to access related topics such as wildlife management (at/near airports), bird identification information, FAA wildlife management guidelines, education, pictures, current news, upcoming meetings and training, available jobs and discussion/forum sections. In April 2001, the web site was augmented with an on-line wildlife strike report (FAA Form 5200-7). Upon submittal on-line, "quick look" email notifications are sent to concerned government personnel. The distribution of these emails varies as to whether there was damage, human injuries/fatalities, and whether feather remains were collected and will be sent to the Smithsonian Institution for identification. In July 2002, a real-time on-line query system was incorporated to allow federal and local government agencies, airport and operator personnel, and USDA and airport wildlife biologists to access this database (which as of June 2005 contains 68.288 researched strike reports added to at a rate of approximately 500 strike reports/month) to formulate strategies to reduce the hazards wildlife present to aviation. To date (June 2005), over 15,000 on-line real-time queries were processed. In June 2004, ERAU was authorized to develop a graphical interface to this on-line query system. Current capabilities include mapping strikes (by species) on the US map, each of the contiguous 48 state maps (with AK and HI being added), and airport diagrams of the major metropolitan airports as well as the next 46 airports with the most reported strikes The latter capability depicts strikes by runway in plan as well as in elevation view. Currently under development is the ability to view time-sequenced strikes on the US map. This extensive graphical interface will give analysts the ability to view strike patterns with a wide variety of variables including species, seasons, migration patterns, etc. on US and state maps and airport diagrams.

1. Introduction

The FAA's Airport Wildlife Hazard Mitigation Website¹ was established by Embry-Riddle Aeronautical University (ERAU, Prescott, AZ) in October 1999 under grant from the William J. Hughes FAA Technical Center in Atlantic City, NJ.[1] The objectives of the website are:

- To provide the aviation community with a large variety of sources of information concerning the risks that wildlife present to aviation safety and associated topics.
- To provide a user-friendly interface whereby airport, flight, operations, safety, and/or maintenance personnel may report wildlife strikes (in many airports a daily occurrence) on-line.
- To provide users an opportunity to register with the on-line community for electronic dissemination of items of interest, coming events and community news.
- To provide an on-line database of wildlife strike reports for dissemination of data to federal and local government agencies, airport managers, operator safety personnel, biologists, engine and airframe manufacturer personnel to analyze and develop strategies to reduce the risks wildlife present to aviation.

In May 2004, ERAU was authorized to further expand the on-line database query capability from a wide variety of discrete reports to include a graphics capability to allow analysts to view past strike patterns as an aid in predicting future strikes to reduce the risks wildlife present to aviation.²

2. Implementation

It was initially decided that graphing of wildlife strikes (hereafter referred to as "mapping of strikes" or briefly, "mapping") would be implemented on 3 levels: (1) on the US map, (2) on the 50 State maps, and (3) on Airport Diagrams for all airports with significant wildlife strike history. For the current implementation, significant wildlife strike history was defined as airports with 200 or more reported strikes since January 1, 1990. It is anticipated this list will be expanded to include those airports with 100 or more reported strikes.

2.1 US Mapping

US strike mapping is available in 2 levels, that available to the general public, and that available to specially authorized individuals designated by the FAA. Both levels show the location of strikes (or more accurately, the location of airports where the strikes occurred). Available to the general public are the total US counts (for the selected species) as well identification of the airports alone. Available to the FAA authorized personnel are also strike counts per identified airport. The general public entrance is shown in Figure 1. FAA Authorized Personnel entrance is shown in Figure 2.

¹ Airport Wildlife Hazard Mitigation Home Page is located at **http://wildlife-mitigation.tc.faa.gov**. A mirror (redundant) site is located at **http://wildlife.pr.erau.edu**.

² Although the primary risks are birds, mammals such as deer, fox, and coyotes also present a significant risk.



Figure 1 – General Public Entrance to Mapping of Strikes on US Map

 <u>Graphic Location of Strikes by Species on US Map</u> The user may select "To-From" dates and species of interest to show strikes (by airports) on a map of the US. From the US Map, any of the airports shown (or the entire US) may be selected for a more detailed analysis by species.

Figure 2 – FAA Authorized Personnel Entrance to Mapping of Strikes on US Map

Selection of either entrance takes the user to the Query Select Screen where dates of interest may be selected (the default is the time span of the entire database) and species of interest must be selected as shown in Figure 3.

FAA National Wildlife Strike Database US Mapping Select	
Latest Report: 03-31-2005 Earliest Report: 01-03-1990	
Reports in Database: 68,288 Species in Database: 651	
Change Date(s) (as desired) and Select Species of Interest:	~
Date(s) From: Beginning of Month JAN Vear 1990 JAN	
To: End of Month MAR 🗹 Year 2005 💽	
Species CANADA GOOSE	_
Submit Query Reset	

Figure 3 – Query Select Criteria for Mapping of Strikes on US Map

Typical results for the general public are shown in Figure 4. Note the airport identification (with a cursor mouseover) as well as the US Strikes Summary Data in the lower portion of the screen.





Typical results for FAA Authorized Personnel are shown in Figure 5 (following page). Particular attention is called to the following additional features:

- Individual airport strike counts are available with cursor mouseover.
- Airport summary results are available for any individual airport selected (Figure 6).
- High-density areas may be resolved by right clicking any airport in that cluster, for example, the cluster around the Minneapolis-St Paul (MN) area (Figure 7).
- US Summary Strike data are also available (not shown).

Each of the above screens is for some user selected time period. Of perhaps of equal importance is the ability to view strike build-ups over time in some sequential fashion. Currently under development is to select time sequenced US mapping. In this mode, the user would be able to view strike build-ups by time slices. The Query Selection Screen is shown in Figure 8. Current design concept is either user selection of monthly or yearly time sequential slices. For monthly time slices, the user would select a calendar year of interest (January – December) to be presented US mappings by monthly slice in a sequential pattern. For yearly time slices, the user would select a species of interest. The Query Selection Screen is shown in Figure 8.



Figure 5 – Typical Results of Mapping of Strikes on US Map for FAA Authorized Personnel

FAA National Wildlife Strike Database US Mapping by Species Summary Results						
	Selected Grouping by Species Criteria: Almost: DEM/ER ND AIRPORT Almost ID: KDEN					
	Species: CANAD/ From: JAN 1 1990	A GOOSE) To: MAR 31 2005				me
	Number of Repo	ets: 9				
	Click Incide	ent Date to View Individual S	Strike Report (Bolded D	ate Indicates Repo	rted Damage	e on Form 5200-7)
	Click Incide <u>Clic</u>	ent Date to View Individual S <u>k</u> For Info to Download Indiv	Strike Report (Bolded D idual Strike Reports int	ate Indicates Repo o EXCEL for a mo	rted Damage re detailed	e on Form 5200-7) Analysis.
<	Click Incide <u>Clic</u> Incident Date	ent Date to View Individual S & For Info to Download Indiv Airport	Strike Report (Bolded D idual Strike Reports int State/FAA Region	ate Indicates Repo o EXCEL for a mo Aircraft	rted Damage re detailed Damage Code*	on Form 5200-7) Analysis. Species**
<	Click Incide <u>Clici</u> Incident Date <u>10-18-1991</u>	ent Date to View Individual S § For Info to Download Indiv Airport DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int StaterFAA Region CO/ANM	ate Indicates Repo o EXCEL for a mo Aircraft ATR-42	rted Damage re detailed Damage Code* S	on Form 5200-7) Analysis. Species** CANADA GOOSE
<-	Click Incide Click Incident Date <u>10-18-1991</u> <u>10-13-1992</u>	ent Date to View Individual S For Info to Download Indiv Airport DENVER INTL AIRPORT DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int State/FAA Region CO/ANM CO/ANM	ete Indicates Repo e EXCEL for a mo Aircraft ATR-42 DHC7 DASH 7	rted Damage re detailed Damage Code* S M?	on Form 5200-7) Analysis. Species** CANADA GOOSE CANADA GOOSE
5	Click Incide Click Incident Date <u>10-18-1991</u> <u>10-13-1992</u> 01-21-1993	ent Date to View Individual 3 k For Info to Download Indiv Airport DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int State/FAA Region CO/ANM CO/ANM CO/ANM	e EXCEL for a mo Aircraft ATR-42 DHC7 DASH 7 DC-10	rted Damage Damage Code* S M? N	e on Form 5200-7) Analysis. Species** CANADA GOOSE CANADA GOOSE CANADA GOOSE
<	Click Incide Click Incident Date 10-18-1991 10-13-1992 01-21-1983 11-09-2000	Airport Airport DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int State/FAA Region CO/ANM CO/ANM CO/ANM	e EXCEL for a mo e EXCEL for a mo Alreraft ATR-42 DH07 DASH 7 DC-10 B-727	re detailed Damage Code* S M? N N M	e on Form 5200-7) Analysis. Species** CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE
s -	Click Incide Click Incident Date 10-18-1991 10-13-1992 01-21-1903 11-09-2000 02-27-2001	Airport Airport DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM	Alternational and anternational anternationa	rted Damage re-detailed Damage Code* S M2 N N M M2 M2	en Form 5200-7) Analysis. Species** CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE
<	Click Incide Click Incident Date 10-18-1991 10-13-1992 01-21-1993 11-09-2000 02-27-2001 09-04-2001	Airport Airport DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM	Alterative Report EXCEL for a more Alterative ATR-42 DHC7 DASH 7 DC-10 B-727 B-737-300 B-737-300	rted Damage re-detailed Damage Code* S M2 N M M M2 N	en Form 5200-7) Analysis. Species** CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE
~	Click Incide <u>Click</u> <u>Incident Date</u> <u>10-18-1991</u> <u>10-13-1992</u> <u>01-21-1993</u> <u>11-09-2000</u> <u>02-27-2001</u> <u>09-04-2001</u> <u>10-31-2002</u>	Airport For Info to Download Indiv Airport DENVER INTL AIRPORT	Strike Report (Bolded D idual Strike Reports int CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM CO/ANM	Alteraft ATR-42 DHC7 DASH 7 DC-10 B-727 B-737-300 B-737-300 BE-1900	rted Damage re detailed Damage Code* S M2 N M M2 N M2 N M2	en Form 5200-7) Analysis. CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE CANADA GOOSE

Figure 6 – Typical Selected Strike Summary Results US Mapping for FAA Authorized Personnel



Figure 7 – Resolving High Density Clusters - US Mapping for FAA Authorized Personnel

FAA National Wildlife Strike Database US Mapping Sequence Select
Latest Report: 03-31-2005 Earliest Report: 01-03-1990
Reports in Database: 68,288 Species in Database: 651
Instructions:
 If desired, change Mode of Display View (Animated or Static). Note Mode defaults to Static Display View. Click for <u>examples</u> of each.
 Select a "Sequencing Interval" of Monthly or Yearly. Monthly intervals are 1 calendar year from January through December. Yearly intervals are a maximum of 5 years from January of the "From" year through December of the "To" year. The Sequencing Intervals are valid for either the Animated or Static Display Views. Since the current year is incomplete, 2005 is not available for either Sequencing Interval.
Change the "From" Year as desired. The "To" may not be changed with the Monthly Sequencing Interval, but may be changed for the Yearly Sequencing Interval so long as the new "To" is not more than 5 years from the "From" year.
Change Mapping Mode (as desired)
Mode: Static (Multi Image) Display View Animated (Single Image) Display View
Sequencing Interval Select
Date(s) From: Beginning of Month JAN Vear 1990
To: End of Month DEC 🔽 Year Select 🔽
Species Select
Submit Query Reset

Figure 8 – Sequential Mapping Query Select - US Mapping for FAA Authorized Personnel

Examples of each of the display modes (Static Multi-Image) and Animated (Single Image) are shown in Figures 9 and 10 respectively.



Figure 9 – Sequential Mapping Results (Static Multi-Image Display Mode) - US Mapping for FAA Authorized Personnel



Figure 10 – Sequential Mapping Results (Animated Single Image Display Mode) - US Mapping for FAA Authorized Personnel

2.2 State Mapping

Location of strikes (actually the airports where the strikes occurred) are available for each of the 50 states as well as the Pacific Islands (PI), Puerto Rico (PR) and the Virgin Islands (VI). State views are also available to certain State Governmental Agencies (e.g., state Departments of Aviation and/or Aeronautics). A typical entrance to State Mapping would appear as shown in Figure 11.

FAA National Wildlife Strike Database Query Select (Authorized Wildlife Services Personnel)	
For Total Database: Earliest Report: 01-03-1990 Latest Report: 03-31-2005 Last Update: 05-11-2005 Database: Version 6.3 dated 5-13-05 Total Reports in Database: 68,288	
For Selected State: AZ Earliest Report: 01-25-1990 Latest Report: 03-27-2005 Reports in Database: 976 Airports in Database: 28 Species in Database: 152	12
NEW / Map es on State Map or NEW / Map Strikes on Airport Map	
Go to State Mapping Go to Airport Mapping	
Select Only Those Criteria of Interest:	
State AZ 💌	
Date(s) From: Month Select Dav Select Year Select	

Figure 11 – Entrance to State Mapping of Wildlife Strikes

Once selected, the user may select some specific date interval (note the dates of interest default to the entire range of dates in the database) and must select a species of interest as shown in Figure 12.

) ate(s)				
Fro	m: Beginning of Month	JAN 💌 Year 1990	-	
	To: End of Month	MAR 💌 Year 2005	-	
Species	AMERICAN KESTREL			

Figure 12 – Query Select for State Mapping of a Selected Species

Once submitted, the user is presented a screen as shown in Figure 13 showing airports where strikes occurred as well as the number of strikes for the selected species by mousing over the airport of interest.



Figure 13 – State Mapping of a Selected Species

If desired, the selected airport can be clicked and the user is presented with a screen of summary strike data as shown in Figure 14.

	FAA National Wildlife Strike Database US Mapping by Species Summary Results						
	Selected Group	oing by Species Criteria:					
	Airport: PHOEN Species: AMER From: JAN 1 199 Number of Rep Click Incid <u>Cli</u>	IX SKY HARBOR Airport I CAN KESTREL 10 To: MAR 31-2005 orts: 13 lent Date to View Individu ck For Info to Download In	ID: KPHX tal Strike Report (Bo tdividual Strike Rep	lded Date I orts into EX	ndicates Repo CEL for a mo	orted Dama; ore detaile	ge on Form 5200-7) d Analysis.
	Incident Date	Airport	State/FAA Region	Operator (Civ/Mil)	Aircraft	Damage Code⁼	Species**
ĺ	09-12-1999	PHOENIX SKY HARBOR	AZ/AWP	CIV	UNKNOWN		AMERICAN KESTREL
	07-26-2000	PHOENIX SKY HARBOR	AZ/AWP	CIV	UNKNOWN		AMERICAN KESTREL
	10-07-2000	PHOENIX SKY HARBOR	AZ/AWP	CIV	UNKNOWN		AMERICAN KESTREL
	04-16-2001	PHOENIX SKY HARBOR	AZ/AWP	CIV	UNKNOWN		AMERICAN KESTREL
	10-15-2001	PHOENIX SKY HARBOR	AZ/AWP	CIV	UNKNOWN		AMERICAN KESTREL

Figure 14 – Airport Strike Summary from State Mapping

The above State Mapping sequence represents mapping available to Wildlife Services personnel and state governmental agencies which are password-protected by state. Authorized FAA personnel may select any of the 50 states, PI, PR or the VI from a US Map by State as shown in Figure 15. Once the state is selected, the remaining screens are the same (user may changes included dates and select the species of interest).



Figure 15 – State Mapping Selection for FAA Authorized Personnel

2.3 Airport Mapping

Strike location mapping is also currently available for 85 US airports. Besides the 39 airports designated Major Metropolitan Airports by the FAA, the next 46 airports with the largest strike count were included. Additional airports are anticipated to be added in the coming months. A typical Airport Mapping Entrance is shown in Figure 16.

4	FAA National Wildlife Strike Database Query Select (Authorized Wildlife Services Personnel)
	For Total Database: Earliest Report: 01-03-1990 Latest Report: 03-31-2005 Last Up-date: 05-12-2005 Database: Version 6.3 dated 5-13-05 Total Reports in Database: 68,288
	For Selected State: MI Earliest Report: 03-03-1990 Reports in Database: 1,525 Airports in Database: 63 Species in Database: 122
	Go to State Mapping Go to Airport Mapping
	Select Only Those Criteria of Interest:

Figure 15 – Airport Mapping Selection

Once selected, the user may selects 1 of 2 Airport Mapping Modes available. The first (which is also the default selected mode) allows the user to view strike history by runway in the airport plan view. The user may also select a interval of interest and/or specific species of interest or use the default "All". The query select screen is shown in Figure 16.

Select Airport	Mapping Mode	
Mode: 🔍 Airp	ort Diagram View 🛛 🤇	Runway Elevation View
Select	and Runway, Chang	ge Date(s) (as desired) and and Select Species of Interest:
Airport	DETROIT METRO	or Airport Code Select 💌
Runway	All 💌	
In R	unway Elevation View	r mode, only runways with reported strikes are shown.
Date(s)		
From: Br	ginning of Month	MAR Y Year 1990 Y
	End of Month	MAR Vear 2005 V
Species 🦰	All	•
Viewing Option	ns for Tabular Data:	
Ordered By	Nr of Strikes 💌	
Ordering	Descending 💌	pre
		Submit Query Reset

Figure 16 – Airport Mapping Query Selection

In the Airport Diagram View, after submittal the user would be presented a screen as shown in Figure 17.

Selected Mapping From: MAR 1 1990 Airport: GERALD R Species: ALL Ordered By: STRIKI Click Stril	Criteria: To: MAR 31 2 FORD INTL (K(ES Ordering: kes to View St	005 GRR) DESCEND Immary St	ING trike Data
	Runway	Strikes**	
	17	<u>87</u>	
	26L	<u>75</u>	
	8R	<u>51</u>	
	UNK	<u>51</u>	
N	35	50	
13	8L	<u>15</u>	
	Off Airport*	<u>12</u>	
\sim	26R	9	
	17/35	4	
	8R/26L	<u>1</u>	
	8L/26R	1	
	"On Airport" Total Strikes	344 356	

Figure 17 – Airport Diagram View Tabular Results

Strikes, which occur at an altitude of greater than 1000 ft AGL, are grouped together as "Off Airport". The user may continue to view the strike counts superimposed on the Airport Diagram (still under development). A Developer's Concept image is shown in Figure 18.

The user is also presented the option to list the strikes by height for a selected runway. A typical selection and results screen are shown in Figures 19 and 20. Although when known, strike altitude is reported on the FAA Form 5200-7, there is no specific entry for distance from the airport or active runway. As a result, the distances to/from the active runway threshold are computed from the reported strike height. A 3-degree approach from the outer marker was assumed with a touchdown point 250 feet from the runway threshold as well as a 10-degree departure angle with rotation 4500 feet from runway threshold.

3.0 Conclusions

The On-Line availability of the FAA's National Wildlife Aircraft Wildlife Strike Database has been enthusiastically received by the aviation community concerned with minimizing the hazard presented by wildlife – mostly thought of as birds, but also including mammals should as deer. Since becoming available on the WWW in July 2002, there have been in excess of 15,000 online queries processed as of June 2005 accumulating at a rate of over 1,000 per month. It is expected when these new graphic capabilities become widely known, queries per month processed will further increase.

Figure 18 – Airport Diagram with Superimposed Strike Counts (Developer's Concept)

Select Airport	Mapping Mode
Mode: 🔍 Airpo	ort Diagram View
Select Airport	and Run , Change Date(s) (as desired) and and Select Species of Interest:
Airport	GERALD R FORD INTL V or Airport Code Select V
Runway 🚬	26L 💌
Date	unway Elevation ∀iew mode, only runways with reported strikes are shown.
From: Be	eginning of Month MAR 💌 Year 1990 💌
1	To: End of Month MAR 💌 Year 2005 💌
Species	All
Viewing Option	ns for Tabular Data:
Ordered By	Height
Ordering	Descending
	Submit Query Reset

Figure 19 – Airport Runway Elevation View Query Selection Screen

Figure 20 – Airport Runway Elevation View Query Results

References: [1] Collection And Dissemination Of Wildlife Strike Data At Airports For The US Federal Aviation Administration Via The World Wide Web, Dickey, Newman, and Hovan, I International Birdstrike Committee Conference, Athens, Hellas, May, 2005.