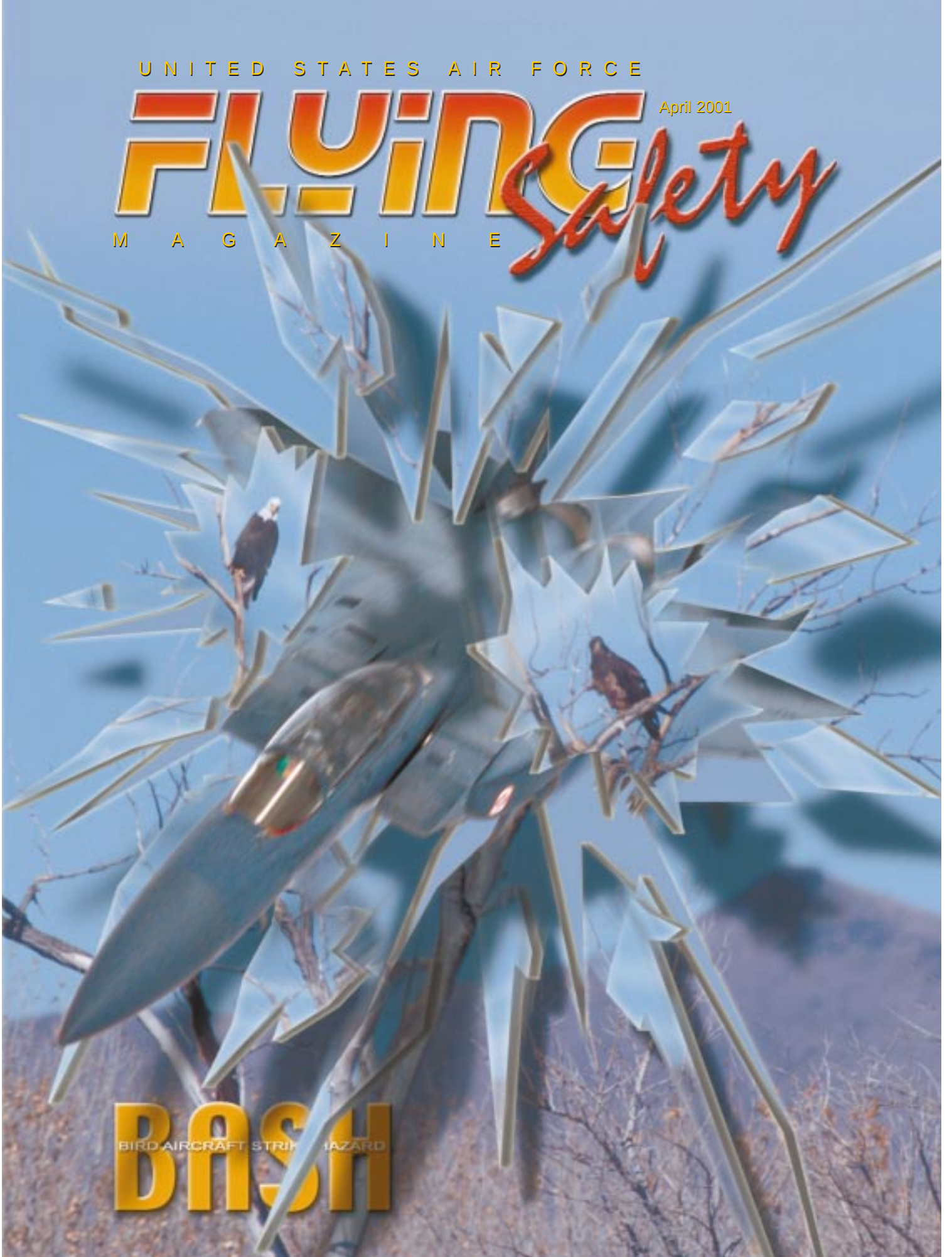
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BASH
BIRD AIRCRAFT STRIKE HAZARD

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FSM notams

WHEN CFIs FLY TOGETHER

Courtesy ASRS *Callback* #245, Nov 99
NASA's Aviation Safety Reporting System

This excellent report from a CFI involved in a loss-of-separation incident at an uncontrolled field describes some of the crew coordination issues at stake—and potential hazards—when two CFIs fly together.

This was a training flight where I, the pilot flying, was getting checked out in a new aircraft ...by another CFI. While I was doing the flying, the pilot not flying was handling all the electronics. We were both looking out for other traffic and making radio calls.

Unable to get a response from UNICOM we decided to land on Runway 22 ...On taxi back there was a fair amount of chatter on the UNICOM and the pilot not flying turned the volume down on the radio. We performed our before takeoff check and looked for traffic on final, base, and downwind for Runway 22. We did not turn the volume up on the radio (some takeoff check!) nor did we announce our departure.

While on the takeoff roll, the pilot not flying suddenly grabbed the controls, only to release them again allowing me to continue the takeoff, but pointed out [another aircraft] on short final for Runway 10! We were well past the intersection prior to his touchdown, but this was just a little too close.

There were a number of factors leading up to this incident. First and foremost, the concept of "See and Avoid" was not practiced. Unlike what I teach my students, we only checked the pattern we were using and did not accomplish a 360 to check the whole area ...Nor did we have the radio volume turned up. This was another factor. There is no excuse for not monitoring UNICOM or announcing our attentions.

Probably the most important factor, I feel, was the delineation of who actually was PIC and who was to do what. Though I was "sole manipulator of the controls," I assumed the role of student and expected/relied on the other CFI to assume all responsibility.

I feel that when two CFIs are flying together, the responsibilities HAVE to be spelled out so that there are no assumptions, second guessing, missed items/procedures and missed traffic.

It is truly scary when two CFIs fly together.

Photo courtesy of Author

What's BASH?

By tracking strikes and identifying the species struck, the BASH Team knows which species are causing the most damage.

MR. GENE LEBOEUF
HQ AFSC/SEFW

It takes personnel from many Air Force specialities to keep aircraft flying. Whether your career field falls within the flying, maintenance, engineering, airfield operations area or some other discipline, it's easy to become so focused on your own duties that you have little understanding of what your neighbor does. While this situation might not be uncommon, there are some things everybody should know. Take the Bird/Wildlife Aircraft Strike Hazards—BASH—Program, for instance.

BASH Program information is contained in Chapter 7 of AFI 91-202, *The US Air Force Mishap Prevention Program*. This guidance covers responsibilities for establishing and administering the BASH Program, all the way from headquarters level to base level. It covers lots of BASH Program details, from "Bird Watch Condition Codes" to airfield grass heights and lots more.

If one of your aircraft suffered a bird strike and you needed information on required actions, how would you begin?

One of your first actions should be to check for written guidance. It's available online at the Air Force Publications Web site at http://afpubs.hq.af.mil. From there, you can navigate to the necessary publications and forms and print out what you need.

If you're actually involved in a strike with a bird or other animal, AFI 91-204,

Safety Investigations and Reports, tells how to properly report the strike. Chapter 7 contains BASH reporting information and directs what needs to be reported for inclusion into the database here at the Air Force Safety Center. You'll also find an address to the Smithsonian Institute, where feather remains are sent for identification. It is crucial that all strikes are reported and that remains from all strikes are sent to the Smithsonian. Information gleaned from these strike reports provides a huge benefit to the flying community and is vital for keeping the BASH Team's Bird Avoidance Model (BAM) up-to-date. By tracking strikes and identifying the species struck, the BASH Team knows which species are causing the most damage, and where and when this damage is happening. Information like this is one reason the US Air Force has the only BAM of its kind in the world.

Now that you know where to find descriptive and directive BASH Program guidance, you can learn more about bird and other wildlife hazards to aircraft by taking a look at AFPAM 91-212, *Bird Aircraft Strike Hazard (BASH) Management Techniques*. It provides general information on BASH Program management basics, wildlife control methods around an airfield, a list of hazardous species, a self-inspection checklist, flight considerations, an authorized equipment list and a list of other government agencies that may provide assistance. It's a wealth of information that should be on hand in all flight safety offices.

As it takes more than one organization to keep an airfield operating, there's more than one source of information for BASH matters. Three other documents that mention BASH are AFI 13-213, *Airfield Management*, AFI 13-201, *Air Force Airspace Management*, and AFI 32-7064, *Integrated Natural Resources Management*. These instructions don't directly address BASH, but they do identify a number of areas of overlap between the disciplines.

Other sources, like online Web sites, have also become great sources of information. We here with the USAF BASH Team have an excellent Web page with a much wider range of information than that available through the AF Publications web site. Access it by going to: http://safety.kirtland.af.mil/AFSC/Bash/home.html. You'll find enough information to keep you busy for an entire day. It includes previous articles from *Flying Safety* magazine, MAJCOM safety magazines and excerpts from the AFIs listed above that deal with BASH. There are links to other organizations that deal with wildlife as well as *Prevention and Control of Wildlife Damage*, a US Department of Agriculture manual that provides information on all nuisance (or hazardous) species of wildlife.

If you happen to find yourself at a "joint use" location—an airfield where military and civilian operations are collocated—then you may want to log onto the FAA's "Airports Home Page" at www.faa.gov/arp/arphome.htm for their Advisory Circulars. The FAA has issued an Advisory Circular (AC), AC No: 150/5200-33, "Hazardous Wildlife Attractants on or Near Airports," dealing with wildlife hazards.

The most recent product from the BASH Team is another Web-based program, the Avian Hazard Advisory System (AHAS). It may be accessed at www.ahas.com. AHAS provides bird hazard information to pilots operating in the low-level environment. AHAS uses NEXRAD weather radar data and weather forecasts to post hourly updates on whereabouts of large flocks of birds moving along the eastern third of the United States. Plans are for the system to expand coverage to the central and western portions of the US as funding becomes available. The AHAS site also has a link to the BAM. This latest internet version of the BAM is a big improvement over what was posted on the Safety Center Web site in the past. BAM users can now access multiple data sets, along with the risk levels from birds, to gain a better understanding of bird hazards over their entire low-level route.

These sources of information aren't the only ones out there for BASH info, but they should provide answers to most of your questions. As always, if you can't find answers to your questions, you may get in touch with us via e-mail at: BASH@kafb.saia.af.mil. We here at the USAF BASH Team stand ready to assist you. Fly Safe!

The Avian Hazard Advisory System provides bird hazard information to pilots operating in the low-level environment.

Do You Have Questions About BAM and AHAS?

MAJ PETE WINDLER
HQ AFSC/SEFW

USAF Photo by TSgt Michael Featherston

AHAS is the latest bird hazard avoidance tool available for predicting bird risk during low-level and range flight operations.

One year ago, near-real-time bird risk advisories became a reality when the Air Force's Avian Hazard Advisory System (AHAS) began operations. AHAS is the latest bird hazard avoidance tool available for predicting bird risk during low-level and range flight operations. AHAS is operational and available (www.ahas.com) to access information on bird strike risk in the eastern third of the CONUS (west to 90W longitude). Data for the central third of the CONUS (west to 105W longitude) will be available in the spring of 2001 and full coverage of the CONUS is expected in 2002. The Web site provides simple-to-use pages to access bird strike risk for published instrument routes (IR) and visual routes (VR), ranges, military operating areas (MOA) and military airfields. Published slow routes (SR) will be available at the same time as the central region.

Now that we have both a Bird Avoidance Model (BAM) and AHAS, there is some confusion as to which one to use and what the differences are. I've tried to capture the most common concerns and questions about the BAM and AHAS which have been brought to our attention.

When using AHAS, I would like to access a graphic that depicts the routes. You can access the route displays through the bird avoidance model (BAM), which is available on the Web at the AHAS site (US BAM). You can look at any route (IR, VR, SR) or military airfield in the CONUS. Work is in progress to provide the graphic depictions through AHAS. The advantage of the tabular data is bandwidth, or speed of response. The tabular data can be retrieved as much as six or seven times faster than graphical information. This can be significant if bases experience slow Internet connections due to traffic loads.

AHAS's predictive value is based partly on hazard (bird strike) records for specific areas, but most areas have very sketchy records, thereby diminishing the strength of the predictions. AHAS is built on the BAM. We used the top 60 bird species in our bird strike database to build the model. We incorporated 30+ years of Breeding Bird Surveys, Christmas Bird Counts, and refuge bird counts. Hazard levels in the BAM are based on bird mass. Larger birds drive the hazard level higher. We have good information from the BBS, CBC and refuge data, but our data on how the birds get from summer to wintering areas is sketchy. That is where NEXRAD (next generation weather radar) comes in. We are archiving the radar data on bird migration. When we develop an algorithm to incorporate the data into the model, we will be able to fill in those areas where our data is currently lacking.

Bird strikes often occur during landing and takeoff, involving "local" birds. Aircrews should be aware that AHAS isn't designed to address localized bird problems. That is absolutely a true statement; AHAS won't address

local bird problems on your airfield. However, it will give you a heads-up when seasonal migration begins, which increases the bird hazards in your local flying area. Even if the birds don't stop at your base, they will be transiting your airspace, increasing your risk level, if only temporarily. An aircraft in the local traffic pattern could be 20 nautical miles from the base and 2000 to 3000 feet AGL. That aircraft is at greater risk from migrating birds than "local" birds. Night flying presents an even greater risk since most bird migration occurs at night. There is a note on the AHAS web page which reads, "Note that the bird strike risk indicated by AHAS is NOT the condition ON the airfield determined by airfield management, but the bird strike risk OFF the airfield within 5NM."

AHAS risk forecasts rely on weather predictions, which are very unreliable. This weakens the strength of the risk predictions in AHAS. The weakness of weather forecasts are fully understood and compensated for in AHAS. Consequently, more than 24 hours before flight time, when weather forecasts are most unreliable, AHAS reflects the historic information from the BAM. Less than 24 hours into the future, AHAS risk predictions are based on the BAM and National Weather Service (NWS) weather forecast data. These forecast models predict the bird risks expected and are updated every 12 hours. Risk prediction requests for the current hour generate a "near-real-time" risk prediction based on observations from the national NEXRAD radar network. AHAS processes the radar data hourly to detect bird activity in near-real time.

If a key weather variable for a particular low-level route or airspace is missing, the risk value shown by AHAS is the value depicted by the BAM. Taking a conservative approach to forecasting bird activity, as we have with AHAS, makes for a fairly robust system. Keep in mind, however, in the current configuration the accuracy of AHAS can never exceed the accuracy of the NWS weather forecast models. As computer-processing power increases and new automated weather sensors (wind and temperature profiler radars) become available, 24-hour bird activity forecasts will be very accurate, and modeling for 48 hours and beyond will approach current 24-hour prediction accuracy.

The emphasis of AHAS is almost strictly on large birds, but aircraft often hit flocks of small birds. Flocks of small birds should be considered more in the BAM and AHAS. We focused the BAM, and subsequently AHAS, on the top 60 bird species in our bird strike database, gathering information on these species from over 30 years of Breeding Bird Surveys, Christmas Bird Counts, and wildlife refuge bird counts. The risk values are based on the sum of the mean bird mass (in ounces) for all species present during a particular time period. The larger birds influence the risk layers since they do significant damage when struck. The small flocking birds are very much a part of the risk layers. Radar is being utilized more and more to map neo-tropical migrant stopover points along the coastal regions. Radar is also proving very useful in pinpointing large roosts of small birds such as Purple Martins and Swallows. As we gain more information on large concentrations of small flocking birds, we can update the risk layers in the BAM to reflect the hazards.

continued on next page

Aircrews should be aware that AHAS isn't designed to address localized bird problems.

Small birds flock at low altitude while foraging, as an anti-predator strategy, or while entering and leaving roosts. Robust control measures and habitat modifications can minimize airfield hazards associated with small flocking birds. Current radar technology is capable of tracking local bird activity and is especially useful during hours of darkness or inclement weather. Any base can obtain and use a mobile radar to track bird movements within their own airspace as a way of enhancing their BASH program.

AHAS discusses migratory routes of large bird species as though these routes are very precise, which they are not. There isn't enough information known about migratory routes for most birds. That's why data holes exist in our model. Our aim with AHAS is to describe 95 percent of the migratory track of birds 95 percent of the time. Migratory routes change over time as land uses along traditional corridors change. As radar and satellite tracking technology improve, we will be able to correctly map migratory routes and gain altitude data as well. The BAM and AHAS cannot account for local movements of flocks looking for new foraging and roosting areas as pressure increases at traditional locations. The BAM and AHAS are light years ahead of where we were five years ago. I anticipate we will make the same quantum leap in the next five to 10 years as we incorporate more accurate data into the risk layers of the BAM. We are working hard to capture the new technologies for improving AHAS.

As radar and satellite tracking technology improve, we will be able to correctly map migratory routes and gain altitude data as well.

Radars use filters to mask out ground clutter and weather and sometimes mask slow-moving airborne objects. Can the weather masking discussed on the AHAS web site mask out birds? The algorithms used to filter out the weather are very good and have been tested thoroughly. We are working with the Environmental Protection Agency (EPA), Audubon Society, Clemson University and US Geological Survey (USGS) to "ground truth" the radar returns. The WRS-88 (NEXRAD) radar and its follow-on generations are a vast improvement over some of the earlier radars. Even some of the airport surveillance radars are very good at detecting birds. There is no guarantee we aren't losing a few bird returns in the weather we filter out. However, from an aircrew standpoint, I'm less concerned with any birds within the weather return because I shouldn't be flying that close to the weather in the first place. AHAS is not suffering significantly from any potential loss of bird returns within the weather.

How do I know the risk assessments are accurate? Has a scientific peer review been done on the BAM or AHAS? Both the BAM and AHAS have received extensive peer review from MIT, Boston University, Cornell University, Lockheed Martin, Raytheon, the Federal Aviation Administration, the Dutch Air Force and the Israeli Air Force. The USAF's BAM and AHAS are the only bird hazard avoidance tools of their kind in the world, making comparisons difficult. After at least five years of operations, enough archived data will be available to compare BAM and AHAS predictions with actual bird activity and build a scientific peer review for publication. Neither the BAM nor AHAS are perfect; rather they are "works in progress," carefully scrutinized and reviewed by many different experts. Both are vast improvements over any previous avoidance tools available to Air Force personnel.

I'm not sure what the different risk values (low, moderate, severe) mean. There is no information given on the number of birds passing through a given portion of airspace (e.g., 1000 birds per square mile), nor any indication of the altitude of the birds. Is the term "moderate" defined the same way it is in a typical base BASH plan? The risk levels are basically the same between the BAM and AHAS. The risk levels describe three predicted risk classes—Low, Moderate and Severe—which are based upon the bird mass in ounces per kilometer squared. In other words, the risk levels represent the amount of birds (bird mass) in a kilometer squared spatial area.

"Moderate" indicates a risk ratio that is 57 to 708 times the risk of "Low," while "Severe" indicates a risk ratio that is 2,503 to 38,647 times the risk of "Low." Bird strike risk is the likelihood of a catastrophic event, a function of the mass of a bird. The larger the birds present, the higher the risk of a catastrophic

event. Up to this time there hasn't been any reliable altitude data on bird migration. Improvements in radars and satellite telemetry may provide accurate altitude data for future incorporation in the BAM and AHAS.

Risk levels in the BAM and AHAS should not be confused with airfield bird watch condition (BWC) codes. Continental-scale bird movements considered in the risk layers of the BAM and AHAS present different hazards than local bird activity reflected in BWC codes. BWC codes determination and associated operational decisions are based on number of birds, size, location, behavior and type of aircraft.

NEXRAD doesn't cover every square inch of the United States. Birds may move through gaps in radar coverage, decreasing the accuracy of bird strike risk assessments. There are known gaps in the NEXRAD coverage over the entire US, but it doesn't affect our bird strike risk assessments. The gaps are relatively small and we assume the migration will pass evenly across the gaps as we pick up the birds at each radar site. The foundation risk level is from the BAM, which is based on bird counts and not radar returns. One way of improving the radar "picture" used by AHAS is to bring FAA radars into the mix. AHAS was developed with a very careful understanding of radar horizon and point target suppression limitations. We are trying to gain access to additional radar systems, such as Level II NEXRAD (we are using level III now), terminal Doppler weather radar (TDWR), airport surveillance radar (ASR) and Air Route Surveillance Radar (ARSR) radar data.

There is another bird advisory system available on the Internet called BirdCast. Are BirdCast and AHAS the same? Can I refer to BirdCast for bird hazard advisories? The same contractor who developed AHAS, Geo Marine, Inc., conceived the BirdCast system. They are vastly different. The radar data currently used in BirdCast is nowhere near as robust as that used in AHAS. AHAS radar data is one kilometer resolution, whereas BirdCast uses a significantly lower resolution. AHAS has a specially-developed method to mosaic multiple radar sites so information from one radar image does not remove information from another site where the images overlap. BirdCast uses two data scales, making it hard to differentiate between intensities. AHAS uses a single data scale, the standard adopted by Lockheed Martin for all new NEXRAD radars. Radar data on BirdCast includes weather, chaff, smoke and airborne particles, creating images which can be easily misinterpreted. BirdCast focuses on small birds of interest to "backyard birders" and not on large birds, which cause more damage to aircraft and constitute the primary risk to aviation safety during low-level flight operations.

AHAS is designed specifically for aircrews. Aircrews don't have the time or expertise to look at raw NEXRAD radar images, as found in BirdCast, and try to discern what the bird risk is for their planned low-level route or special-use airspace. AHAS does that for them. AHAS relies on the historic bird risk layers in the BAM, whereas BirdCast has no such model. AHAS uses the same quantifiable data from NEXRAD that BirdCast uses, only AHAS updates the risk values from the BAM to a "near-real-time" risk value. Flying units should incorporate the BAM and AHAS into their scheduling and mission planning processes. The BAM is primarily a scheduling tool and AHAS allows flexibility in last minute scheduling adjustments based on updated bird activity predictions.

Hopefully I've answered your particular questions about the BAM and AHAS. Perhaps I've generated even more questions. For more information you can explore the AHAS (http://www.ahas.com), BAM (http://bam.geoinsight.com/Models/) or USAF BASH (http://safety.kirtland.af.mil/AFSC/Bash/home.html) Web sites. You can reach the USAF BASH team by e-mail at: bash@kafb.saia.af.mil. We'll do whatever we can to help.

The USAF's BAM and AHAS are the only bird hazard avoidance tools of their kind in the world.

What is the Risk of a Bird Strike at Your Airfield?

T. ADAM KELLY
BASH Project Manager,
Geo-Marine, Inc.

You have a BASH (Bird Aircraft Strike Hazard) plan that addresses airfield grass height and habitat management. You have obtained bird-scaring equipment and identified personnel to harass birds on or near the flightline. You feel you have a pretty good BASH program. But do you know the risk of a bird strike at your airfield?

For every bird strike on the BASH database we had eight near misses where a bird passed within a distance of one wingspan from the aircraft.

Assessing Risk at Your Airfield

Risk management and risk assessments are now fundamental steps in safety programs for both military and civilian aviation and non-flying programs. The first step in a risk assessment is to quantify the risk. Most bases are now doing an outstanding job of reporting all bird strikes to the USAF BASH Team, and the number of feathers provided to the Smithsonian Institution for identification each year is steadily growing. So why not base a risk assessment on your airfield's bird strike record? The BASH database is an important record of what we have hit in the past and provides a fairly accurate indicator of the scale of the BASH problem in terms of damage costs and species that frequently cause problems. This database was used extensively in the development of AHAS (Avian Hazard Advisory System) and the US BAM (Bird Avoidance Model).

The BASH database is limited in its ability to fully describe the risk of a bird strike at your airfield. Simple geometry says that for every bird strike on the BASH database we had eight near misses where a bird passed within a distance of one wingspan from the aircraft. The further out you go in distance from the aircraft, the number of birds that passed, but did not strike the aircraft, grows exponentially. This would appear to support the big sky theory that "we only get unlucky occasionally." We have a very good example of how flawed this theory is in the 1995 E-3B AWACS crash at Elmendorf AFB, Alaska. Canada Geese had been noted on or near the airfield for years, but they were not struck by aircraft so did not appear on the BASH database—until an aircraft was lost. So, just like the stock market, past performance can't guarantee future returns. The BASH database can't fully describe where the next airfield bird strike loss will occur.

Human Limitations, Technology Innovations

Some airfields do a good job of documenting all bird harassment runs on the airfield, recording time, location and species of bird found. Useful data are provided for improving the habitat management of the airfield by finding areas that birds consistently return to. But do these data provide an accurate description of risk? These observations are made with the human eye, an instrument which has problems seeing birds when they are more than 500 feet above the ground (40 percent of airfield bird strikes occur above this altitude). The eye also cannot detect flying birds at night. It may surprise you to know that 24 percent of all airfield bird strikes occur during the hours of darkness! When was the last time you harassed birds on your airfield at night? Do you know how many birds fly over your airfield at night? Birds may be more active at night than during the day, especially during the migration seasons. We know this from radar studies that indicate up to a 90 percent increase in birds flying at night than during the day. We would see a significant increase in the number of bird strikes reported if, when night flying, we flew all night rather than stopping before midnight.

Between 1995 and 1999 three studies of bird activity were conducted by the United States Air Force with small, powerful, high-resolution radars modified for bird detection. These studies were conducted at the Dare County Bombing Range, NC, Moody AFB / Grand Bay Weapons Range, GA and Offutt AFB, NE. Each of these studies found bird

activity that was previously unknown or of a magnitude not appreciated before the study was started. These specialized radars can precisely count birds, determine their altitude or ground track and be used to calculate the frequency and risk of a bird strike. It is for this reason that the Air Force Safety Center recently recommended use of mobile radars for airfields to conduct a baseline bird strike risk assessment.

The studies conducted in the late 1990s were not cheap. The technology available at the time meant that the data were recorded to videotape and then reviewed by an expert technician, who then logged bird targets in a computer database. Data from one six-hour recording session could take as long to review and record to the database as the session itself! If multiple radars were used to record both in the horizontal and vertical planes, then the post-processing time doubled.

The radar equipment itself has not become cheaper with time, but conducting radar-based risk assessments has. These are now about 30 percent less expensive, and are more accurate. Software has been developed that can find moving bird targets as effectively as the best expert technician. In the past, expert technicians would measure one parameter related to the size of the target. With current technology, software can make seven measurements on each target with much greater precision in a fraction of the time. The radar measurements can be made in real time so that the radar can be left running for extended periods without creating a huge backlog of data to process. The methods used to collect the data have also changed. A new scanning technique has been developed that takes a vertical slice through the atmosphere, counting birds as they pass overhead and recording their altitude and position.

What Questions Will a Radar Study Answer?

Once the radar data of bird activity has been collected, how can it be used? The first step of a risk assessment is to determine how many bird strikes are likely and how severe they are likely to be. These values can easily be calculated based upon the frontal area of the aircraft at the airfield and the number and size of birds recorded by the radar.

The data can also be applied in other ways to enhance your base BASH plan and Bird Hazard Management. Radar can be used to observe and quantify the level of bird activity over your airfield, and through your local traffic pattern, departure and arrival corridors. Are there local attractions to birds you had not previously noted? If you have a landfill in the area, you may be concerned with how many birds fly to and from that location through your airspace or how high they fly over the landfill. The radar data can also be used to determine if you are located on a major migration corridor, as well as how many birds are active around your airfield at night.

Even short-term radar studies conducted at key times of the year can collect data to shape management decisions and determine the appropriate responses. For example, the birds that have been causing nighttime strikes at your airfield may cross at altitudes below 500 feet. Under these circumstances, an alteration in flying schedules may be warranted. Equipping and manning your Bird Control Unit (BCU) for nighttime bird harassment operations would be justified, but harassment operations during darkness are difficult to execute properly. If, on the other hand, birds were only seen above 500 feet, actively harassing birds at night may have little or no effect. Reducing bird strikes at night under these circumstances will require operational changes based on the size, height and ground track of the birds. Such data can only be collected by radar! The data can be used to determine whether you will have more or fewer bird strikes if you change your traffic pattern altitude. Radar can be used to find optimum altitudes for your particular location and circumstances.

Use of radar when conducting a bird strike risk assessment at your airfield can aid in preventing future damaging bird strikes. Past experience has taught us that very few airfields fully understand the exposure they have to birds because they lack the information to conduct a full risk assessment. New technology may soon provide a more accurate way to quantify this risk.

Radar can be used to observe and quantify the level of bird activity over your airfield, and through your local traffic pattern, departure and arrival corridors.