Bird/ wildlife Aircraft Strike Hazard (BASH) Assessments and Conceptual BASH Plans: USDA APHIS WS Technical Report in support of the Supplemental Environmental Impact Statement for a Proposed U.S. Navy Outlying Landing Field in North Carolina

Introduction

Various species of birds and mammals frequent airports because these areas often possess diverse natural and man-made habitats that provide food, water, shelter and open spaces (i.e., habitat). Many of the animals living on or around airports may never contribute to hazardous situations between aircraft and wildlife. However, some species of birds (e.g., blackbirds, gulls, raptors, waterfowl) and mammals (e.g., deer, canids and rodents) can exacerbate or directly pose significant threats to air traffic safety. The habitat conditions at an airport also can directly or indirectly contribute to hazardous situations for aircraft operations namely through the influence that habitat types exert on wildlife populations. Strikes between aircraft and animals cause considerable monetary damage to aircraft and in some cases total loss of aircraft and tragically, human life. Wildlife interactions with aircraft are an issue that all aviation facilities worldwide contend with on a variable basis. The safety hazards posed by wildlife at military airports are commonly referred to as BASH (Bird/ wildlife Aircraft Strike Hazard). No single aviation service attached to the Department of Defense (DoD) is immune to this situation. In fact, the major flying branches of the military all report that BASH incidents often result in the large loss of multiple resources including the tragic loss of human life.

This technical report serves as the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services Program (USDA WS) assessment and comments related to an effort by the United States Navy, Naval Facilities

Engineering Command Atlantic (NAVFAC Atlantic) to conduct a Supplemental Environmental Impact Statement (SEIS). The SEIS document constitutes additional information related to the Final Environmental Impact Statement (FEIS) for the Introduction of the F/A-18 E/F Super Hornet Aircraft to the East Coast of the United States. This work fulfills requests for cooperative services as described in two Military Interdepartmental Purchase Requests between NAVFAC Atlantic and USDA WS dated April 2004 and September 2005.

Background

The U.S. Department of The Navy (DoN) proposes to develop an Outlying Landing Field (OLF) for aircraft operations, primarily field carrier landing practice (FCLP) operations, in northeastern North Carolina. Five candidate sites for the proposed OLF are identified in the FEIS. An issue identified and explored in the original FEIS is that of BASH. A court case contending the findings of the FEIS found that the document was deficient; one area of deficiency found that the document did not adequately address BASH concerns. BASH concerns were divided into two main areas: 1) the FEIS failing to assess current BASH conditions and 2) failing to address the potential effects associated with the implementation of a BASH plan (i.e., an adaptive management plan designed to reduce BASH, either potential or realized) at each of the five proposed OLF sites. This work provides information for the planning processes of NAVFAC Atlantic and specifically addresses BASH conditions at each proposed OLF site and provides a conceptual BASH plan for each site.

Authority

The United States Department of Agriculture is authorized to protect American agriculture and other resources from damage associated with wildlife. The primary authority for Wildlife Services (WS) is the Animal Damage Control Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426c) as amended. WS activities are conducted in cooperation with other Federal, State and local agencies; private organizations and individuals.

The WS program uses an Integrated Wildlife Damage Management (IWDM) approach (sometimes referred to as IPM or "Integrated Pest Management") in which a series of methods may be used or recommended to reduce wildlife damage. IWDM is described in Chapter 1, 1-7 of the Animal Damage Control Program Final Environmental Impact Statement (USDA 1997; revised). These methods include the alteration of cultural practices as well as habitat and behavioral modification to prevent damage. However, controlling wildlife damage may require that the offending animal(s) are killed or that the populations of the offending species be reduced.

WS is recognized as the lead Federal entity for resolving conflicts with aviation and wildlife through the application of technical and operational assistance. The WS program is internally guided by Directive 2.305, Wildlife Hazards to Aviation whereby "WS will assist responsible Federal and State agencies…in reducing wildlife hazards to airports and airbases …". In this instance, the DoN specifically requested cooperative services resulting in this report.

Further program guidance is contained in two Memorandums of Understanding (MOU) (Cleary and Dolbeer 2005) and one multi-agency Memorandum of Agreement

(MOA). MOU (No. 12-34-71-0003-MOU) between the United States Department of Transportation, Federal Aviation Administration (FAA) and USDA/APHIS/WS defines the relationship whereby assistance is mainly rendered to civilian aviation entities. WS assistance designed to assist the DoD is guided by the MOU between the United States DoD and USDA/APHIS/WS titled Animal Damage Assessment and Control; the MOU recognizes that the DoD conducts animal damage control programs, as necessary, to prevent interference with mission objectives and the USDA/APHIS/WS has "particular expertise in the area of animal damage management".

A multi-agency MOA between the FAA, U.S. Air Force, U.S. Army, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and USDA to Address Aircraft-Wildlife Strikes recognizes that the signatory agencies are cognizant of the risks that aircraft-wildlife strikes pose to aviation safety. The expertise of each respective agency is recognized and procedures are established such that the signatory agencies can coordinate their respective missions when faced with aircraft-wildlife strike issues.

Methods and Purpose

WS conducts ecological surveys in order to identify wildlife populations, their associated habitats and wildlife attractants found within the property boundaries of airport facilities. The surveys also investigate the occurrence and relevance of wildlife populations, their associated habitats and wildlife attractants or other similar factors that occur proximate to the facility and sometimes within specific separation criteria as defined by the FAA. These separation criteria can range up to five miles from the core Aircraft Operating Area. Short-term surveys covering only one or a few visits to an

airport are referred to as initial consultations (i.e., site visits) whereas surveys conducted over an entire annual cycle are considered Wildlife Hazard Assessments. An internal agency manual provides a basic prescription for the conduct of consultations and assessments (USDA 2005). The methods employed are based on these basic prescriptions and represent a combination of qualitative and quantitative techniques commonly used by natural resource professionals to survey and inventory wildlife species and associated habitats.

In order to prepare this document, WS personnel conducted at least one visit to each proposed OLF site from late summer 2005 through early summer 2006 to view general habitat conditions in the area; studied aerial photography and Geographic Information Systems (GIS) data layers that delineated habitat types and met with State and Federal natural resources personnel familiar with the proposed locations. WS personnel conducted independent research of existing literature and news media coverage and consulted with wildlife management professionals that routinely deal with aircraft-wildlife situations.

This document specifically contains basic BASH assessments of the five proposed OLF sites located in northeastern North Carolina and conceptual BASH plans that describe the potential range of alternatives to mitigate BASH at each site. The contents of this document resemble more closely the letter report that WS issues to an airport following the conclusion of an initial consultation procedure. Parallels between a standard DoD BASH plan and a Wildlife Hazard Management Plan (WHMP; i.e., the civilian equivalent to a BASH plan) are evident in the section that describes ranges of BASH mitigation strategies. The BASH assessments and conceptual BASH plans

contained in the document are designed to inform the DoN about BASH conditions to be expected and how to best mitigate possible BASH scenarios. The decision on how to proceed with this information is solely the purview of the DoN.

This document is not a Wildlife Hazard Assessment (WHA) as normally described by WS internal training materials and FAA definitions as promulgated in 14CFR139.337 because WS surveys and procedures did not cover a complete annual cycle of observing wildlife populations at the sites and their interactions with various habitats and attractants. Considering that the intent of this evaluation was not to conduct a WHA, it was appropriate to perform a modified version of the initial consultation. Initial consultations generally focus on the immediate area at the airport and the nearby land that is in proximity to the air traffic pattern where aircraft altitudes are at or below 3000 feet altitude. In part, the reasoning behind this approach stems from bird strike data collected by the FAA and DoD documenting that the majority of bird strikes occur at altitudes of 3000 feet or lower (Cleary et al. 2005). It also is within this area that adaptive BASH management strategies can have their most positive effect (Wenning et al. 2004).

A complete (i.e., "non-conceptual") BASH plan is not attainable in the current situation. BASH plans and WHMP documents are predicated on the completion of a WHA. As mentioned previously a WHA of this magnitude would be conducted over at least one complete annual cycle. It also is important to note that typically a WHA considers the "complete" ecological interactions of wildlife populations and habitat at an airport. In this instance, no airfield structures (i.e., runway, other facilities; habitat) are present, which further underscores why a complete BASH plan cannot be prepared.

Information and interpretation of data from the U.S. Bird Avoidance Model (BAM) and the Avian Hazard Advisory System (AHAS) are not addressed in this report. These models are sometimes used in the DoD as decision-making tools in the flight planning context. The output of each model is based on the best available and current information and is not representative of local conditions (i.e., the immediate airspace above an airport) but rather on the potential conditions within 5 nautical miles of or further from the airport. The original FEIS contains an analysis of the BAM and updated information from the current BAM is addressed in the current SEIS. These descriptions adequately describe BAM information that can be applied in a regional context to the areas around the proposed OLF sites. There might be some efficacy to using the BAM as an environmental planning tool but this approach has not been evaluated and neither model has been subjected to scientific peer review by the wildlife management profession.

Study areas, general habitat conditions and associated wildlife

Five proposed locations for an OLF exist in northeastern North Carolina. These are the sites originally identified in the FEIS: Site A (Perquimans County), Site B (Bertie County), Site C (Washington County), Site D (Hyde County) and Site E (Craven County). The proposed sites are primarily combinations of forestland and agricultural lands all 30,000 acres is size. In some cases localized wetland areas make up a portion of the proposed location and water bodies are within close proximity. These main habitat types are the primary focus of this report as it relates to BASH. As part of the SEIS a

Conceptual Agriculture Management Plan was assembled (Navy 2006). The following percentages of habitat type are present at each site:

Percentages of current habitat types[1] at proposed OLF sites

Proposed OLF Site[2]	% Cropland	% Forestland	% Wetland
A-Perquimans County	70	23	14
B-Bertie County	40	50	< 1
C-Washington County	89	3	< 1
D-Hyde County	52	42	3
E-Craven County	10	89	< 1

[1] Identified habitat types (i.e., cropland, forestland) may contain localized wetland habitat.
[2] Proposed OLF sites refer to the 30,000 acre site as proposed by the DoN.

The DoN expects to develop approximately 2,000 acres in the core OLF area (i.e., 30,000 acre area). These 2,000 acres would contain a runway and taxiway system, service road system, control tower and other facility buildings. Sites A, C and D are composed mainly of croplands. The main crops grown in these areas are combinations of corn, wheat and soybeans with a wheat-soybean rotation being the most economical for farmers. Farmers have the ability to successively plant and harvest a corn-wheat soybean rotation in one annual cycle. Wheat is typically planted from September – October and harvested in April. Cotton production has increased in recent years and is expected to continue but this crop must be rotated after 4 years in accordance with good agricultural management practices. The majority of forested lands at all proposed OLF sites are managed pine plantations; Site C has little forested land of consequence to this work as the site is nearly all in agricultural production (Navy 2006).

The FEIS contains descriptions of some habitats that are in proximity to the sites while data collected during the SEIS procedure identifies habitat areas of interest (e.g., open water, waterfowl impoundments, wetlands, and roosting areas) in “regional”

proximity to the proposed 30,000 acres sites. These types of habitats and wildlife (i.e., mainly migratory waterfowl) observed in the areas are discussed. It is these factors that can have an immediate impact on BASH. Information was collected during various conversations with USFWS and North Carolina Wildlife Resources Personnel and through examination of various technical reports detailing habitat and wildlife observations made during 2005 through 2006 prepared by Ecology and Environment, Inc (E & E, Inc.).

Site A

The Perquimans River flows in a southeast direction away from the proposed OLF area emptying into the Albemarle Sound. The river serves as a wildlife corridor into the area for various species of birds that may raise BASH potential. Available habitats that could attract resident and seasonally occurring migratory birds are nearby national wildlife refuge (NWR) land (i.e., Great Dismal Swamp NWR) and lands maintained by the NCWRC (i.e., Chowan Swamp Game Land). The immediate refuge boundary is approximately 9 – 10 miles to the north and the NCWRC land is just to the west of the proposed OLF area. Historically, these areas support relatively low concentrations of waterfowl. Summation of NCWRC data and personal observations from NWR staff recorded by E & E, Inc. revealed that approximate counts of tundra swans did not exceed 3,500. Direct field observations by E&E, Inc. personnel reported an average of 400 tundra swans mainly in the agricultural fields in the proposed site. The large water areas to the southeast (Albemarle Sound) and to the east (Currituck Sound) do support various species of wintering ducks and snow geese. Flocks of resident and migratory Canada

geese and various gull species are likely to be encountered in the area. An initial consultation of U.S. Coast Guard Air Station Elizabeth City documented ring-billed gulls, Canada geese and European starlings as BASH concerns and a BASH incident involving a strike between a Canada goose and a C-130 aircraft was recorded (author observation; USDA WS data 2002). Additionally, snow geese are observed during the waterfowl surveys at Great Dismal Swamp NWR, but such observations are infrequent. A snow goose is reported in the FAA National Wildlife Strike Database as being struck by a civilian aircraft in 2001, at night with damage to the aircraft wing. This is the only record of this type in the database for Elizabeth City.

Site B

The proposed site for the OLF lies to the southwest of Edenton and south-southwest of the Chowan River. Extensive riverine and wetland habitats are south of the proposed location. These areas are attractive to many species of migratory birds and waterfowl (i.e., Roanoke River NWR; NCWRC lands: Bertie County Game Land, Roanoke River Wetlands Game Land and Batchelor Bay Game Land). The areas are characterized mainly as bottomland hardwoods; species that are mainly located in this area include but are not limited to mallards and wood ducks (pers. comm. NCWRC personnel). Seasonally, various species of gulls and blackbirds use the area (i.e., winter months). The comments in the preceding section concerning USCG Air Station Elizabeth City are relevant to this location as well (i.e., gull use of the river corridor, species present, etc.). Anecdotal information exchanged between USDA WS personnel and air crew personnel from Marine Corps Air Station (MCAS) Cherry Point and

Seymour Johnson Air Force Base (SJAFB) report that vultures are perceived as being a potential BASH hazard in the general region of the sites extending west-northwest to general vicinity of Roanoke Rapids. Approximately, three years ago an EA-3B Prowler aircraft from MCAS Cherry Point encountered a vulture during low level training near Roanoke Rapids. The vulture penetrated the canopy windscreen and injured one air crew.

Site C

Pocosin Lakes NWR lies to the east of the proposed OLF site approximately 5 miles away from the core area of the site. Similar to proposed OLF site B, Batchelor Bay Game Land is situated nearby, in this instance to the north. To the south-southwest lies Van Swamp Game Land. Further to the east is New Lake which comprises a portion of the NWR. The NWR area is an important over wintering area for migratory waterfowl, especially snow geese and tundra swans. The complex of open water provided by Pungo, Phelps and New Lakes provide high quality roosting and loafing habitat for waterfowl; additionally, the NWR also has five seasonal waterfowl impoundments. Some lands are managed for agriculture designed to leave un-harvested grain crops for waterfowl. E & E, Inc. conducted several studies in support of the SEIS procedure. A foraging habitat study examined agricultural practices within approximately a 20 mile radius of the proposed OLF site C. Approximately, 300,000 acres of agricultural crops are planted comprised mainly of corn, soybeans and winter wheat. In the autumn of 2005, approximately, 118,000 acres were planted in winter wheat. The open water habitat, on-site NWR management and regional agricultural practices are some of the reasons that up

to and sometimes greater than 75% of the tundra swans in the Atlantic Flyway (i.e., 60,000-80,000 birds) winter in the region versus prior wintering in the Chesapeake Bay region since the 1980s.

Snow geese populations generally winter on the NWR lands but do forage on adjacent lands outside of the NWR. Tundra swan use of the area found as determined by E&E, Inc. personnel found that corn and wheat fields at the south end of the proposed site were heavily used for foraging and loafing. Based on direct observation, winter wheat fields were predominantly used more corn or soybean fields.

Flocks of gulls (i.e., mixed flocks, mainly ring-billed gulls) and mixed flocks of blackbirds were observed by USDA WS personnel on trips to the site. During participation in an F-18D over-flight test a bald eagle was observed at the proposed site. Additionally, soaring raptors (i.e., some hawks and turkey vultures were observed) and low flying Harrier hawks were often seen foraging in agricultural fields.

Geo-Marine, Inc. Avian RADAR study at Site C

During the wintering season of 2003 – 2004, Geo-Marine, Inc. (GMI) operated a Mobile Avian Radar System (MARS) at the proposed site C location. A draft final report (Geo-Marine, Inc. 2005a) detailed observations of birds that were designated as the number of targets per square kilometer of RADAR area covered per hour. Additionally, GMI personnel conducted incidental visual observations at and near the radar site generally during the first three hours after sunrise and last two hours preceding sunset. The majority of birds visually observed were various species of waterfowl, predominantly tundra swans, blackbirds, grackles and ring-billed gulls.

In order to distinguish between different types of RADAR detected targets, RADAR ornithologists have created and continue to refine proprietary algorithms that can be used in processing procedures to categorize observations. At best these algorithms can be used to classify individual targets as small, medium, large and flocks. However, scientific peer review of the validity of these types of procedures and findings is lacking. Personal communication with known experts in the field of radar ornithology indicates that trained RADAR observers with working knowledge of ornithology and the equipment can produce highly educated observations concerning target size and possibly species identification. However, given that there is a well known base of ornithological knowledge of what bird species utilize the region in which proposed Site C is located and the fact that visual observations were collected, it is reasonable to draw general conclusions from the radar data collected.

The majority of radar observations recorded occurred during the daytime versus night and below 600 feet altitude. It was noted that fewer movements were recorded during the early to mid-afternoon hours with a peak occurring just prior to sunset. These observations are consistent with historic and current (i.e., E&E, Inc. over-wintering observations) bird observations. It is suspected that RADAR observed bird activity documents visual observations of birds leaving roosting areas to foraging areas. Seasonally, there was less night-time activity during November through the end of January. From February through the beginning of March this trend was more variable most likely owing to the onset of spring migration. During the RADAR study it was observed that the majority of wintering tundra swans left the area by mid-March.

Site D

The proposed site for the OLF lies to the northeast of several USFWS refuge lands and NCWRC lands that are located in a region recognized as important wintering areas for various species of migratory waterfowl. These areas include Mattamuskeet NWR, Alligator River NWR, Gull Rock Game Land, and Dare Game Land. The NCWRC lands that comprise Dare Game Land are close to the Dare County Bombing Range Complex and are a mixture of wetlands and semi-forested pocosin habitats. USDA WS personnel attached to SJAFB record BASH risks mainly posed by raptors (hawks and vulture species) during annual visits to the site. Historically, these areas are not a primary attractant to wintering populations of waterfowl; however, risks from waterfowl more likely occur from birds that are transiting the area. The Gull Rock Game Land does contain shoreline on the Pamlico Sound that can provide habitat for waterfowl species.

The predominant feature of Mattamuskeet NWR is Lake Mattamuskeet which is a large fresh water system approximately 50,000 acres in size. Approximately, 10,000 acres is a mixture of marsh and forested marsh/ wetland. A small component less than 500 acres is managed for agriculture. The NWR is recognized as one of the most important refuge systems in the Atlantic Flyway. During the winter months, large amounts of wintering waterfowl utilize the area (e.g., nearly half of the Atlantic Flyway pintail duck population). The Alligator River NWR lands in proximity to the proposed site are south of the Dare County Game Land and border the Pamlico Sound. The NWR is comprised of forested wetlands, pocosin, freshwater and saltwater marsh lands.

Privately owned waterfowl impoundments exist in and near the proposed core area mainly to the east and west. Some of these areas are permanent impoundments. During field visits large numbers of various duck species were observed transiting the core area headed to roost (up to 1,000 birds). E &E, Inc. recorded observations of tundra swans from January through March 2006 which peaked in January with approximately 4,200 observations and recorded average duck observations of 300 individuals.

Site E

The proposed site for the OLF lies to the north of New Bern and northeast of Kinston in an area referred to as the Big Pocosin close to Vanceboro. The site is primarily forested and managed for forest production with some scattered agricultural uses such as pasture/ hay fields and row crop cultivation. The Neuse River Game Lands (NCRWC) is to the south straddling the Neuse River northwest of New Bern. The Neuse River is narrow in this area and could be categorized as forested wetlands and does not provide large open water areas that are often used by snow geese and tundra swans. However, this area is a favorite for local waterfowl hunters during the hunting season for wood ducks and other species. Resident flocks of Canada geese are present in the general area of New Bern (internal information USDA WS) and bald eagles maintain nesting locations just north of the Vanceboro area (NCWRC personnel, pers. comm.). Small groups (less than 100) of tundra swans utilize agricultural areas to the east of the proposed area in Pamlico County, near Grantsboro (author observation, USDA WS).

Historical Bird Strike Data

Various species of waterfowl are involved in many of the recorded BASH incidents involving DoD aviation assets in northeastern North Carolina (author observation based on USDA WS work in North Carolina). Previous sections of this report and the USN FEIS and draft sections/ technical reports for the SEIS present current and historical data concerning waterfowl populations that are present near the proposed OLF sites. It is established that waterfowl can pose hazards to aviation safety. It is reasonable to assume that these populations will contribute to BASH at each proposed location to some degree.

However, in an effort to quantify the potential BASH risk posed by other species of wildlife to aviation at the proposed OLF sites USDA WS analyzed strike data from the FAA National Wildlife Strike Database (1990 – March 2006) and examined strike data collected by USDA WS personnel that occurred to USAF aircraft operating from Seymour Johnson Air Force Base (SJAFB) from October 1999 – current time. The data from these sites were chosen as representative data related to military and civilian aircraft operating in the airspace of North Carolina.

Since 1990 there have been 1,229 strikes between wildlife and aircraft in North Carolina. This data is mainly reported from civilian aircraft operators, airports and in some cases civilian and military joint use facilities. Approximately 98% of these events involve bird species, the overwhelming majority being species that are protected through federal statute. Nationally, the majority of bird strikes are not identified to a common bird group or species; this was reflected in the North Carolina data with approximately 63% of bird strikes recorded as unknown species.

Pertinent to this work is an incident involving a snow goose and a civilian aircraft near Elizabeth City during August 2001 mentioned in a previous section. No incidents between aircraft and tundra swans are definitively recorded in the FAA National Wildlife Strike Database. However, a bird strike that occurred en-route in October 2004 involved a Cessna 172 and what might have been a tundra swan. Although this strike possibly involved a tundra swan, it was reported in the database as a "duck or goose", exact species unknown.

The remaining data was comprised of 44 different bird groups and/ or individual species. The top ten bird groups and/ or species struck and identified during this time period involved gulls, blackbirds, sparrows, hawks, waterfowl and exotic bird species (e.g., European starlings and feral pigeons). All of the species listed occur locally in the eastern portion of the state. The majority of all of the recorded strikes occurred between the months of July and November (64%) with the most occurring between August and October (46%). Regardless of the location of the proposed OLF in North Carolina these groups and/ or species will represent a potential BASH issue at all times of the year. BASH issues will be subject to seasonal influences similar to other areas, nationwide.

Ten most common bird groups and species involved in aircraft/ wildlife strikes in North Carolina, March 1990 – March 2006.

Bird group or species struck	# of times recorded
Gulls	78
Blackbirds	50
Mourning dove	44
Sparrows	40
European starling	38
Rock pigeon	27
Canada goose	26
Hawks (mixed species)	24
Crows	10
Red-tailed hawk	9

FAA National Wildlife Aircraft Strike Database maintained by USDA APHIS Wildlife Services.

Starting in 1999 through 2005, USDA WS has conducted a six Wildlife Hazard Assessments throughout the state (four in the eastern part of the state) and to varying degrees each bird group/ species reflected in the aforementioned FAA data was identified during the WHA procedure as a BASH concern at each airport. The negative BASH potential of species identified in North Carolina also is reflected in Dolbeer et al. (2000). The work by Dolbeer (2000) categorized species hazardous to aviation through an examination of the entire FAA National Wildlife Strike.

USAF bird strike data collected from SJAFB displays similar trends to the FAA bird strike data for North Carolina. From October 1999 through March 2006 a total of 436 wildlife strikes were recorded. Sixty-nine percent of the wildlife strikes to SJAFB based aircraft occurred between May and October. The months with the greatest number of strikes were October, May and August. The majority of birds struck were various songbirds or other small perching birds. However, one difference between the databases was that vultures (turkey and black vultures) were struck more often by SJAFB-based aircraft. The last significant loss of a SJAFB aircraft occurred in 2004 on a low level training route near the Virginia border when an F-15 Eagle fighter jet was lost following a black vulture strike.

Although the preceding presentation of data mainly pertains to migratory bird species some mammal species may be associated with potential BASH issues at each of the proposed OLF sites. These species are recognized as contributing to BASH in North Carolina: white-tailed deer, coyote, various species of small mammals and beaver. White-tailed deer and coyote have been recorded as being involved in civilian BASH incidents in North Carolina 22 and 3 times, respectively. In terms of scope this statistic is

similarly reported across the nation. Military airfields in the state report routine problems with white-tailed deer and aviation safety (USDA 2002, 2003). The FAA, DoD and USDA WS maintain a zero-tolerance stance regarding white-tailed deer on airports given the high proportion of damage or flight alteration (approximately 90%) that occurs during events involving deer nationwide (Cleary et al. 2005). Coyote are becoming a nuisance at airports throughout North Carolina, as evidenced by an increase in coyote observations and coyote related issues at military and civilian airports.

The FAA data indicates one record of a small mammal (i.e., rabbit) and one of an unknown fox species being struck by aircraft. The presence of small and medium sized mammals at airports can often become a BASH issue through the food resource that these animals provide to coyote/ fox and raptors (i.e., alive or as carrion) or through the creation of habitat (i.e., beaver ponds) that can support other birds potentially hazardous to aviation.

Discussion

BASH is a realized concern for civilian and military aviation in North Carolina. The wildlife strikes that occur in North Carolina are part of a worldwide problem that has resulted in the loss of 165 aircraft during the last 18 years (Richardson and West 2000; Thorpe 2003, 2005; pers. comm. unpublished data Dolbeer 2006). Similar findings document that although rare, bird strikes also result in human fatalities both civilian and military. The most recent fatal bird strikes in the U.S. occurred in 2003, when a general aviation aircraft struck a turkey vulture in Texas and crashed and in 1999 when a USAF F-16 pilot was lost in Florida after a bird strike and subsequent crash. The problem costs

the civil aviation industry around $500 million per year and current statistics report that DoD losses are about $80 million per year.

Approximately 74% of all bird strikes occur during low-altitude flight (i.e., less than 500 feet altitude) with about 60% of the total occurring in the immediate airfield environment (i.e., 100 feet altitude or less) (Cleary et al. 2005). It is recognized that low altitude operations and take off and landing procedures are times when aircraft are most vulnerable to wildlife strikes. This trend is apparent when examining USN and USAF Safety Center records for aircraft training at low altitudes as evidenced by the loss of a 4th Fighter Wing F-15E on a military training route in 2004 and due to the loss of a Marine Corps EA-6B Prowler during FCLP training exercises in eastern North Carolina following engine ingestion of Canada geese in 1996 (USDA 2002; Good 2005).

The management of potential and realized wildlife issues at airports in North Carolina requires an on-going (often daily), adaptive and site specific program. The potential for BASH at any given airfield is mainly based on local conditions related to the proximity of the area to natural and other habitats, weather conditions, the type and number of resident and migratory bird species that use these habitats, and the daily and seasonal movement patterns of these bird species as they relate to local aircraft movements. These local conditions are considered when developing BASH management procedures to reduce strike hazards. Given that a large majority of BASH incidents occur at low altitudes and in the airport environment suggests that a proactive BASH management program may lessen the potential risk of bird strikes. Several military and civilian airfields across the United States and in North Carolina (i.e., SJAFB and Marine Corps Air Station Cherry Point) maintain programs to mitigate wildlife–aircraft

interactions and have successfully lowered either BASH incidents or other factors related to BASH (e.g., Wenning et al. 2004).

Mitigating BASH at a proposed OLF location - There are several techniques and tools available to assist in reducing the likelihood of a BASH incident. All entities that deal with BASH agree that there is no one "silver bullet" with which to address the issue; but maintain that a multi-faceted approach will yield the highest rate of success. An adaptive management approach to implementation is recommended. The strategies used to manage BASH issues can be broadly categorized into the following areas: aircraft flight modification, habitat modification and exclusion, repellent and harassment techniques and wildlife removal (Cleary and Dolbeer 2005). These strategies can be categorized as a variety of active and passive controls that make use of basic natural resources management theory and applied science. Increasingly, new technology and approaches are being employed and in some instances proving efficacious in the management of BASH (e.g., avian RADAR).

In general military airfields are more flexible in terms of airspace management and flight scheduling than large civilian facilities when using flight modification procedures. Approaches and tools exist that can aid in managing BASH in this context. Aircrews can use the BAM and AHAS models, previously mentioned, during flight planning especially when scheduling training time on military training routes. In essence, aviators use this information as a data point to assess this particular safety concern during flight planning.

Because these models are not specifically designed to reflect conditions at the airfield level, air traffic control and/ or air operations personnel use "bird watch conditions" to denote the level of wildlife activity that is realized in the airport environment. Generally, there are three levels corresponding to the amount of wildlife observed (i.e., low, medium and high). The draft DoN OPNAVINSTR (Office of the Chief of Naval Operations Instruction) concerning the BASH Prevention Manual discusses in Chapter 6, the role of Air Traffic Control Tower personnel to communicate the current airfield BASH condition (i.e., bird watch condition) via the ATIS (Automatic Terminal Information System) per Federal Aviation Administration Order 7110.65. The instruction notes that "wildlife hazards, like any other safety hazards, must be assessed with respect to operational requirements. During contingency operations or advanced stages of readiness, wildlife hazards may have minimal safety priority. During training to maintain operational readiness; however, certain changes can be made to improve safety, reduce costly repairs, and protect aircrews." When an elevated bird watch condition is set steps are taken, when possible, to reduce the condition as soon as possible. In some cases the only mitigation for wildlife hazards to aviation is communicating the situation to potentially affected parties because other techniques will not immediately decrease the BASH potential.

An area of interest that can provide more information on local bird movements at all proposed OLF sites is the use of RADAR. However, a RADAR unit may not be necessary at all locations. RADAR can offer a BASH program more information, in different biological scales, at different times of day. For example, RADAR could be efficacious during night hours; it is known that approximately 25 percent of strikes occur

to civil aircraft (Cleary et al. 2005). The analysis of data from the avian RADAR unit used by Geo-Marine, Inc. indicated that birds wintering near the OLF Site C traveled in the local environment in a predictable manner. Generally, periods of low bird activity could be used for aircraft training (i.e., afternoons and night). This activity appeared to be subjected to biological influences (e.g., more activity in early winter and just prior to spring migration). The use of RADAR should be investigated for real time warning capabilities at all sites, but mainly at OLF Sites C and D. This type of use is new and is technologically progressing. Currently, the USAF is employing mobile RADAR (Merlin unit, DeTect, Inc.,) at the Dare Bombing Range to give real time information to aircrews using the training facility. Currently, Geo-Marine, Inc. also operates a mobile RADAR unit at a United Kingdom airbase (i.e., Kinloss RAF) to collect bird movement information and provide real-time warnings of bird activity related to aircraft operations (pers. comm. GMI personnel 2005). This was in part related to a catastrophic event in 1980 involving a multiple engine ingestion of a flock of comprised of two species of gulls (Richardson 1996). The incident resulted in the loss of a British Aerospace Nimrod MR.1 with two personnel. The use of RADAR at an OLF site will provide basic data on bird movements that can be tested in an ecological framework to determine the efficacy of habitat management decisions. Although RADAR can provide this capability, collected information will need to be assessed by a properly trained team of individuals that deal with BASH. At all times other BASH mitigation tools will still need to be employed to mitigate situations as they arise by trained individuals.

Wildlife populations interact with the natural environment in three key areas: water resources, food resources and cover resources. Habitat management on and near

airfields is the foundation of a successful BASH management program. Through careful study of how wildlife populations interact with the environment an adaptive program can be initiated to mitigate BASH conditions starting with habitat modification. The species identified as BASH concerns at each proposed OLF site are using the available habitat for some or possibly a variety of reasons. In most instances, agricultural production was identified as a key attractant for wildlife (e.g., Site C) and in some cases natural areas (e.g., open water features) are attractive to wildlife (e.g., Sites A, B, C and D). It will not be possible to alter the form or function of large open water areas such as lakes and rivers. The DoN, however will possess considerable latitude to make management decisions regarding natural resources within the 30,000 acre footprint of a proposed OLF site. In terms of BASH management this is an advantageous scenario as it allows for flexibility and adaptive management over time.

Habitat modification will be required at all sites to some degree. Within the core area of the proposed OLF locations it is recommended that non-pavement areas be converted to grasslands; preferably a mono-culture. Recent work by the USDA WS National Wildlife Research Center demonstrates that certain types of fescue grass are not palatable to migratory waterfowl, in particular Canada geese. A grass release program whereby a specific grass species is established should be implemented. Grass species such as a fescue variety could be investigated for this practice.

Various types of wetlands are attractive to wildlife especially waterfowl, water birds and aquatic mammals. These areas also can hold migratory birds of various types at all times of year but especially during autumn and spring migration. Some of the wildlife encountered in wetland areas might contribute to BASH. Wetland areas within the core

area should be removed and in accordance with current FAA guidance not mitigated on the proposed site, when possible (FAA AC 150/5200-33a, 2004). An exception to wetland removal may exist at proposed OLF Site C where ditches currently exist for the management of water resources. If desired these ditches could be bridged or have culverts installed. BASH issues that might arise from wildlife use of the ditched water could be mitigated using other techniques (e.g., exclusion by fencing, grid wiring).

Agricultural operations at some point during the establishment, growth and harvest cycle generally provide some type of attractant to wildlife. Agricultural production within departure/ approach corridors should not be allowed or if allowed, highly monitored for bird activity. In all cases where agriculture production is allowed efforts should be made to continually harass and/ or repel wildlife from them using some type of active technique (e.g., pyrotechnics, etc.). It would be unwise to allow wildlife to habituate by having access to these areas thereby increasing BASH potential.

Agricultural production outside of the core area will have to be carefully evaluated. It is recommended that following a WHA the information regarding wildlife use of current agricultural lands be assessed and decisions made regarding taking lands out of production. Current work by E&E, Inc. (i.e., over-wintering waterfowl study) points toward the need for immediate conversion of some agricultural lands at the proposed OLF sites once a site is selected (e.g., conversion to non-agricultural lands at proposed sites A, B, C). This is due to the highly attractive nature of these crops as food resources for waterfowl populations. In a scenario where all efforts are focused on BASH, a phased approach of land conversion is recommended versus entire land conversion away from agriculture from the outset in order to monitor the changes and

responses from wildlife. Crop selections and rotations may need to be changed to reduce the amount of winter wheat planted at sites where it currently is grown. During the roundtable discussion on agricultural practices the technique of allowing fields to become fallow for a period of time was discouraged by agricultural experts (Geo-Marine, Inc. 2005b). This was based on the potential for the establishment of disease and insect populations that may impact future crops. However, it is recommended that this topic be explored further and used as a possible management technique in a seasonal context (i.e., no planting in winter) or possibly on an annual cycle. In either scenario a cover crop providing less attraction to wildlife could be established versus a grain crop. Another technique of interest that was discussed at the aforementioned meeting was harvesting corn fields such that the stalks were allowed to remain through the winter. There is anecdotal evidence that tundra swans may forgo loafing and resting in fields where cornstalks preclude free movement.

In the transition zone(s) between core areas and the remainder of the proposed OLF sites, habitat edge effect should be managed. For example, areas between grasslands and forested areas or agricultural areas should be maintained to preclude weedy and shrub vegetation. These overgrown areas become attractive to wildlife and may serve as travel corridors, provide food or cover for various species of wildlife (e.g., small mammals) (Barras et al. 2000). Raptors will often attempt to forage in these types of areas. During trips to the proposed OLF Site C location USDA WS personnel observed Harrier hawks foraging along field drainage ditches and red-tailed hawks perched in tree lines between agriculture fields. The reduction of vegetation in these areas will assist in lowering the abundance of wildlife that might contribute to BASH

(Washburn and Seamans, 2004). Clear zone management also is related to this topic area. Clear zone management is a topic addressed by airports whereby clear areas and safety overrun zones at the end of paved surfaces are maintained in accordance with FAA specifications. It would be advisable at sites that have a forest or sub-forest/ shrub component to remove this forested area that might lie with in this area. It would be preferable from a BASH perspective to have an established mono-culture grass area versus an area that is allowed remain in mixed woods or shrubs.

When the use of habitat modification and management fails to dissuade wildlife use of an area, harassment and removal of wildlife from the area is necessary. These techniques might include the use of chemicals that alter the taste of food resources, cause irritation to wildlife; audio devices that might harass or cause distress; and visual devices that might mimic predators or otherwise harass wildlife. Harassment with pyrotechnics that cause loud noise and visual effects can be effective. Other harassment techniques can include the use of other wildlife such as a falconry program or the use of dogs to chase and ultimately move wildlife from an area. Finally, the removal of nests, other structures providing cover and lethal removal of wildlife through the application of toxicants, shooting or trapping might be needed. Employing a combination of these techniques is widely regarded as a necessary part of an effective BASH program and is accepted by the FAA, DoD and USDA WS. Research demonstrates that these efforts are efficacious and may not have long-term effects on local or regional populations when employed in a prudent, science-based manner over time (Dolbeer et al. 2003; Blackwell et al. 2004; Dolbeer pers. comm. 2006). It is important to note that wildlife can become accustomed to the repeated use of some harassment devices so the use of multiple

techniques in an adaptive manner is recommended. When lethal removal is deemed necessary efforts to target only the species of interest are important and in this instance, two main permits should be maintained for use at the proposed OLF site, 1) a USFWS Migratory Bird Depredation Permit and 2) a NCWRC Special Airport Depredation permit. Any other types of permits and/ or regulations should be investigated and retained if necessary.

Managing wildlife hazards at airports is a complex, public-sensitive, endeavor involving many species of wildlife governed by the Migratory Bird Treaty Act and various federal, state and local regulations. Because of the complexity and sensitivity involved in managing wildlife hazards, civilian airports are required to utilize professional biologists trained in wildlife hazard management at airports (14 CFR Part 139.337) to assess hazards and to assist in the development, implementation, and evaluation of wildlife hazard management plans (i.e., the BASH plan). A professionally developed and implemented BASH management plan will minimize the likelihood of catastrophic or major-damage wildlife strikes at the OLF site. The installation BASH plan will be the instrument used by personnel on a daily basis to guide BASH mitigation procedures.

Conceptual BASH Plans

Daily operations and the decision making process are best guided by a management plan to mitigate for BASH (e.g., the "BASH Plan or Order" at DoD airports; "WHMP" at civilian airports). Naval aviation installations are required to develop BASH plans as referenced in Naval Instructions (i.e., OPNAVINST 5090.1B, CH-2,

Environmental and Natural Resources Program Manual) as part of the Integrated Natural Resources Management Planning (INRMP) process. General guidance for the development of such plans is referenced in the NAVFAC P-73, (i.e. NAVFAC Natural Resources Management Procedural Manual, P-73, Volume II).

The basic components of a BASH plan mentioned in the guidance package describe various topic areas that should be addressed. The components of the BASH reduction plan should be promulgated at the installation level such that three main tenets are adhered to: 1) new personnel are informed of local hazards; 2) local conditions contributing to BASH are identified as well as the mitigation strategies in place to address them; and 3) that the assistance of the Aviation Safety Officer and the local Bird Hazard Working Group (BHWG) is sought.

If the USN successfully sites an OLF facility in North Carolina, a BASH plan will be drafted and its procedures implemented. This BASH plan should be predicated on a complete WHA that will comprehensively investigate and interpret the local conditions contributing to BASH as previously mentioned. Recommendations contained in the WHA will form the basis for the plan. This final plan will likely resemble BASH plans already in place at various DoN aviation facilities. Components will broadly revolve around the following descriptive areas:

1) **the purpose**, identification of high hazard situations, aircraft operating procedures, habitat management guidelines and management of bird hazards;

2) **the local area**, the geographic location and local/ regional conditions (i.e., natural and man-made) contributing to BASH will be identified and how BASH is handled will be discussed;

3) **the training areas and low-level routes**, that is the local and special airspace will be identified;

4) **the responsibilities**, tasking of appropriate personnel or departments, (i.e., generally who is responsible for a particular issue related to impact BASH (e.g., ground maintenance, natural resources, air operations, bird dispersal personnel, etc.))

5) **the collection and identification of bird remains**, bird strike remains will be collected and information concerning the damage incurred should be determined and disseminated following species identification;

6) **the BASH condition codes**, basic codes of bird/ wildlife activity around the runway should be used in order to manage or mitigate the local situation;

7) **the aircraft operation procedures**, as mission conditions permit alterations to flight operations may be considered;

8) **the habitat management guidelines**, how the airfield and surrounding areas may be managed to decrease BASH;

9) **the BASH management of wildlife**, how wildlife issues are to initially be addressed following their identification as contributing to a BASH;

10) **the basic guidelines for dispersing wildlife from the airfield**, techniques and tools applicable for dispersing and when necessary removing wildlife from the airfield;

11) **the information for dispersing specific species** should be discussed

Management Components for Site Specific Conceptual BASH Plans

Components	Site A	Site B	Site C	Site D	Site E
Airfield design	Y	Y	Y	Y	Y
Conduct WHA	Y	Y	Y	Y	Y
INRMP considerations	Y and E	Y	Y and E	Y and E	Y
BASH plan	Y	Y	Y	Y	Y
Habitat management	Y	Y	Y	Y	Y
Standard techniques	Y	Y	Y	Y	Y
Other techniques	E	E	Y	E	E
RADAR	E	E	Y	Y	E
Continued risk monitoring and evaluation	Y	Y	Y	Y	Y

Y (Implement BASH management technique) **E** (Evaluate the BASH management technique prior to possible implementation) **Y and E** (Completely evaluate the potential effects of a hunting program as part of INRMP prior to possible implementation)

Airfield design

Airport design should include the comments of a qualified wildlife damage management biologist knowledgeable about wildlife hazards to aviation. Design criteria regarding waste and storm water management, fencing criteria, habitat type selection and road access issues can be addressed to facilitate an overall reduction in BASH potential.

In this instance airfield design refers to the design of the core 2,000 acres around the primary runway and facilities.

Conduct a Wildlife Hazard Assessment

Following the selection of a proposed OLF site a Wildlife Hazard Assessment (WHA) conducted by a qualified wildlife damage management biologist knowledgeable about wildlife hazards to aviation should be conducted. This assessment should be conducted over at least one annual cycle to gather information concerning the ecological interactions between the wildlife populations and habitat present at the site. Generally, these assessments are conducted at established airport locations. The USN is advised to conduct a long-term assessment that is initiated pre, during and post construction at the proposed OLF site following final site selection. This is especially true that upon completion of facilities new habitat will have been introduced into the environment and wildlife populations will possibly interact with the environment differently.

Integrated Natural Resources Management Plan considerations

The DoN in accordance with the Sikes Act will be required to complete an Integrated Natural Resources Management Plan. Agricultural out leasing and the creation of hunting programs as part of natural resources management should be carefully evaluated so these activities will not contribute to potential BASH issues. In some cases, the overall effort of a hunting program can contribute to a reduction in species hazardous to aviation (e.g., the hunting of white-tailed deer). The initial review process and the subsequent review process of INRMP documents will provide an opportunity to examine the efficacy and appropriateness of management actions. Collaboration with state and

federal agencies should beneficial in the decision making process when making decisions related to the BASH issue.

BASH plan

A successful BASH plan is predicated on a complete WHA of the aviation facility site. However, during the conduct of the WHA, information and recommendations can be used to start the formulation of a site specific BASH plan. Currently, DoN natural resources guidance instructs facilities to assess and mitigate BASH as part of the INRMP process. The BASH plan will contain specific details regarding how BASH issues will be handled by field personnel, how bird watch conditions will be set, collection of bird strike remains and other BASH related guidance as per USN instructions.

Habitat management

It is probable that the habitat on the immediate proposed OLF site and on areas surrounding the proposed OLF site will require alteration designed to reduce the potential attractiveness to wildlife (i.e., core area grass management, potential use of native vegetation versus exotic species, forest management, reduction of habitat edge effect, conversion of agricultural lands and reduction of wetland areas).

Standard techniques

Standard techniques refer to the use of hazing and harassment tools and when necessary the use of depredation permits to remove wildlife from an airport site. Various types of hazing/ harassment tools are available for personnel to use in an effort to dissuade wildlife from the airport environment and lands around the airport. The techniques include such items as pyrotechnics, propane cannons, bio-acoustics, radio-controlled devices (i.e., model aircraft) and the use of chemical repellents (i.e., methyl

anthranilate, anthraquinone, polybutenes). In some cases, the use of effigies and laser devices may be useful for visually deterring vultures and gull species. The use of controlled toxicants should be investigated and employed on an as needed basis (i.e., Avitrol and DRC-1339).

Other techniques

One technique that may be useful in the current situation is the use of trained dogs for the dispersal of flocking birds. Border collies have shown to be efficacious in several instances. This technique exposes the target species to a natural predator which seems to reinforce the harassment technique. On an as needed basis the use of trap and relocation techniques should be considered especially for raptor species (e.g., red-tailed hawks). Proper permits from federal and state entities will be necessary.

RADAR

The use of small mobile radars to detect birds and to gather long-term information on bird species is a technology that continues to advance. The technique has demonstrated efficacy in delineating where and how wildlife populations interact with the environment in a spatial and temporal context. Some airfields are employing the use of RADAR to assist in real-time detection and warnings that can be utilized by aircrew in an operational risk management context.

Continued monitoring and evaluation

Natural resources management programs should continue to collect and analyze data concerning wildlife populations. Long-term monitoring data can be analyzed and evaluated to determine the efficacy of management decisions. When appropriate, new

recommendations can be made and implemented at the site in an adaptive management context and their effects studied over time.

Summary

Wildlife hazards to aviation are part of the larger safety picture at airfields. All BASH situations vary in complexity between airports; however, a reasoned and diligent application of wildlife damage management techniques based in the science of natural resources management can be successful in managing BASH (Wenning et al. 2004). The USN has decided to potentially locate an OLF on the Atlantic seaboard specifically in eastern North Carolina. Some of the proposed locations are in close proximity to major migratory bird wintering areas that might present unique BASH challenges. These challenges can be addressed by implementing an adaptive management program that includes: managing airfield operations as needed, habitat management/ manipulation, repelling and harassing wildlife and when necessary removing wildlife. The use of traditional BASH management tools might be enhanced and the efficacy of management decisions examined over time through the use of new technologies. Following the selection of a site; the USN should conduct a WHA to more fully understand BASH issues over an annual cycle at the location. The findings can be utilized to form a BASH plan that can be effectively used to guide the management of wildlife hazards to aviation at the proposed OLF location.

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