

AN ANNOTATED BIBLIOGRAPHY OF BIRD HAZARDS TO AIRCRAFT

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ABSTRACT

A centralized information bibliographic source is useful to bring together studies that can be reviewed and serve as a starting point for additional research. The working papers of the Bird Strike Committee Europe, along with articles published in scientific journals and proceedings from workshops sponsored by other state or international agencies, form the majority of what is known about bird hazards to aircraft and what can be done to reduce bird-aircraft interactions. A project to produce an annotated bibliography of bird hazard-related research is underway in cooperation with the U.S. Air Force Civil Engineering Agency's Technical Information Center. Compiling this information in an easily accessible document would assist bird hazard researchers worldwide. A magnetic format for the bibliography is planned that will facilitate keyword searches and will provide a comprehensive summary of research. The BSCE is solicited to provide input and expertise during the development of the bibliography.

Keywords: bibliography; bird hazards; annotated; database

**1.0 PURPOSE**

The purpose of this paper is to suggest a format and initial operational strategy for the preparation of an annotated bibliography for bird hazards to aircraft (termed here as ABBHA).

**2.0 INTRODUCTION**

At the 20th Congressus Internationalis Ornithologicus held in Christchurch, New Zealand (2-9 December, 1990), members of the Standing Committee on Applied Ornithology (SCAO) recognized the need to provide ornithological researchers access to existing literature on bird hazards to aircraft. Subsequent discussions with the SCAO chairman, Dr. Hans Blokpoel, affirmed that an annotated bibliography of birdstrike-related research would help lay the foundation for expanding the international research on this subject. An annotated bibliography would provide a readily available list of articles or books that deal with bird hazards to aircraft and an explanation of the information contained therein.

**2.1 Background**

It is often time-consuming and many times difficult to locate certain studies concerning bird hazards to aircraft. There are many excellent sources of information concerning bird hazards. Through its proceedings, working group reports and other documents, the Bird Strike Committee Europe perhaps is the premier international source of information on bird hazards to civil and military aircraft (See BSCE 19/WP3). Workshops conducted by the International Civil Aviation Organization as well as state-sponsored conferences have provided valuable information exchange for a wide range of bird hazard research topics. However, there remains a need for a central clearinghouse for bird hazard information that can be accessed by researchers worldwide.

**2.2 BASH Team Bibliographic Database**

The U.S. Air Force Bird-Aircraft Strike Hazard (BASH) Team maintains an extensive library on bird as well as other animal hazards to aircraft. The BASH Team uses the library resources of the USAF Civil Engineering Support Agency's Technical Information Center (HQ AFCESA/TIC) to locate documents to support their research and analysis activities. The AFCESA/TIC conducts bibliographic searches through a network of databases to provide their customers with the needed information. AFCESA/TIC is categorizing the BASH Team's reference documents and entering the information into a database easily accessible by other researchers. When complete, the AFCESA/TIC will maintain a large collection of BASH-related material for access by all researchers. Documents maintained at other information centers will not be copied and distributed by the AFCESA/TIC. The AFCESA/TIC can provide information on where specific documents or microfiche can be obtained. However, if difficulties are encountered in acquiring the full text from either the source or through your local corporate or university libraries, AFCESA/TIC will assist.

**3.0 BIBLIOGRAPHIC SOURCES**

The AFCESA/TIC searched several existing biological and engineering databases for documents relating to bird hazards to aircraft:

- (1) Defense
- (2) Zoologi
- (3) BIOSIS
- (4) Dissert
- (5) Nationa
- (6) Transpo
- (7) Aerospa
- (8) Enginee
- (9) NASA/RE
- (10) (US) Go

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**3.1 Bird Haz**  
Table 1 provides reference source obvious non-rele citations listed records.

Source

- DTIC
- ZoolRcd
- BIOSIS
- DissAbs
- NTIS
- TRIS
- Aerospace
- EI
- NASA/RECON
- GPO

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Eight bibliograp Appendix A. On could provide a some could provi for preparing bi information as a

Many do not have and also publish considered, the hazard research.

**4.0 ISSUES**

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- (1) Defense Technical Information Center (DTIC);
- (2) Zoological Record (ZoolRcd);
- (3) BIOSIS Previews (BIOSIS);
- (4) Dissertation Abstracts (DissAbs);
- (5) National Technical Information Service (NTIS);
- (6) Transportation Research Information Service (TRIS);
- (7) Aerospace Database (Aerospace);
- (8) Engineering Index (EI);
- (9) NASA/RECON; and,
- (10) (US) Government Printing Office (GPO) Reference File.

Selection of these reference sources was based on the relevancy to the subject of bird hazards rather than the authoritative nature of the references themselves. No attempt was made to judge the value of the material such as quality of reported research.

### 3.1 Bird Hazard Citations

Table 1 provides a breakdown of bird hazard citations for each reference source. The information was screened to eliminate obvious non-relevant material and duplications. Most of the citations listed were either titles only or short bibliographic records.

Source	Number of cites <sup>1</sup>	Bibliographic References
DTIC	273	2
ZoolRcd	120	None
BIOSIS	9	None
DissAbs	2	None
NTIS	234	1
TRIS	75	3
Aerospace	188	1
EI	67	None
NASA/RECON	53	1
GPO	2	None
Total	1023	8

<sup>1</sup>May include replications from other sources

Eight bibliographic citations were located; five are presented in Appendix A. On request, all bibliographic databases searched could provide a document containing the retrieved information; some could provide it in magnetic format. Several sources charge for preparing bibliographic searches while others provide the information as a subscription service.

Many do not have abstracts. Some studies presented at the BSCE and also published in other scientific journals. Of all considered, the DTIC provided the most complete search of bird hazard research.

### 4.0 ISSUES

Development of an annotated bibliography for bird hazards to aircraft (ABBHA) will require consolidation of a diverse assortment of literature from many worldwide sources. ABBHA must

be responsive to the wide assortment of research needs for bird management, bird avoidance and bird tolerance engineering. However, the ABBHA must be limited to those studies directly related to bird hazards to aircraft or it will lose its research relevance. The ABBHA can provide ornithologists and engineers, alike, a ready reference document to help locate studies and plan research.

#### 4.1 Availability

To comply with the purpose of the ABBHA, the database must be reasonably available to all researchers, worldwide. Though a hard-copy (paper) document is the usual method of distribution, a magnetic format would probably offer the user the most flexibility for searching the ABBHA. The magnetic format would also allow easy updates of the citations and would enhance distribution to a wide audience. Microfiche copies might be available for some articles.

#### 4.2 Accessibility

ABBHA hardware and software requirements must be affordable for the user as well as the host. Relatively modest computer hardware (usually IBM-PC/XT/AT or compatible) will run most bibliographic software. Many computer programs are available for development of the ABBHA but the costs must be kept as low as possible to allow access by researchers with limited computer resources. Some bibliographic search/retrieval software is available from the NTIS for a nominal fee while others are more expensive (see "REFEREE" information at Appendix B). The authors will review several different software packages to suggest alternatives to optimize use and reduce costs.

#### 4.3 Maintainability

The ABBHA database will be updated annually with new articles. The development and maintenance of the ABBHA promises to be an involved and possibly costly effort to access existing bibliographic information and to augment the ABBHA with missing literature, such as studies reported in the BSCE proceedings which are not currently in a database. Existing bibliographic sources will be used to locate copies of studies. Articles from the BSCE and other documents not available from bibliographic sources will be entered into the AFCESA/TIC database. (It would be helpful if the AFCESA/TIC could be provided copies of the early (BSCE 1-10) proceedings.) If appropriate, the information may be exported into a national database; e.g., DTIC. However, any material entered into a national database must comply with database rules and idiosyncrasies.

#### 4.4 Capability

The AFCESA/TIC will soon include an Environmental Quality Information Analysis Center (EQIAC). When the EQIAC is fully operational it will be able to provide a technical analysis of available information on bird hazards for USAF customers as well as many other environmental areas (see Appendix C). The EQIAC will have the capability to synthesize results of research and other information collected through its literature searches. (Please contact Mr. Poulis for additional information or questions on the EQIAC). Any documents included into a national database must comply with existing distribution regulations.

#### 5.0 RECOMMENDED

The BSCE could provide a "Working Group" to provide a "Reference Group" to provide a "Reference Group" associated with the community. This is a suggestion that the ABBHA is

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- (1) database
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### 5.0 RECOMMENDED BSCE ACTIONS

The BSCE could provide the oversight of the ABBHA development. It is suggested here that the BSCE establish a "Bibliography Working Group" to provide expert advice and to openly discuss issues associated with the transition of the ABBHA to the research community. This working group should review progress and ensure that the ABBHA is useful and meets the user requirements.

The BSCE could provide an excellent platform for the testing of the ABBHA, whatever final form it takes. In addition, a BSCE working group could help address the following issues during the development of ABBHA:

- (1) database fields;
- (2) standardized search descriptors (proposed in Appendix D);
- (3) format and software;
- (4) updates and other maintenance.

APPENDIX A

6:NTIS 64-92/9203B2  
(COPR. 1992 NTIS)

09131/5

9131 NTIS Accession Number: NTIS/PS-76/0538/9 ✓  
Bird Strikes and Aviation Safety (A Bibliography with Abstracts)  
(Rept. for 1964-Jun 76)  
Habercom, Jr, Guy E.  
National Technical Information Service, Springfield, Va.  
Corp. Source Codes: 391812

Jul 76 54p

Document Type: Bibliography  
Journal Announcement: GRAI7617  
NTIS Prices: PC N01/MF N01

Hazards to aircraft created by engine ingestion or airplane interception  
birds are investigated in these Government-sponsored research reports.  
rd damage assessment, structural strengthening, windshield design, and  
rd tracking and dispersal methods are studied. (Contains 49 abstracts)  
Descriptors: \*Bibliographies; \*Aviation safety; \*Ingestion(Engines);  
rcraft windows; Impact shock; Impact strength; Birds; Collision research;  
dar tracking; Migrations; Abstracts  
Identifiers: \*Bird strikes; NTISNTIS  
Section Headings: 1B (Aeronautics--Aeronautics); 85D\* (Transportation--Tr  
sportation Safety); 85A (Transportation--Air Transportation); 51B  
eronautics and Aerodynamics--Aeronautics)F

le 63:TRIS 70-91/NOV

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BIRD STRIKES AND AVIATION SAFETY. 1964-JUNE, 1980 (CITATIONS FROM THE  
IS DATA BASE)  
Habercom, GEJ  
National Technical Information Service, Springfield, VA.  
Jul 1980 117p  
SUBFILE: NTIS

AVAILABLE FROM: National Technical Information Service 5285 Port Royal  
ad Springfield Virginia 22161

Hazards to aircraft created by engine ingestion or airplane interception  
birds are investigated in these Government-sponsored research reports.  
rd damage assessment, structural strengthening, windshield design, and  
rd tracking and dispersal methods are studied. (This updated bibliography  
ntains 107 citations, 17 of which are new entries to the previous  
ition.)  
DESCRIPTORS: ABSTRACTS; AIRCRAFT WINDOWS; AVIATION SAFETY; BIBLIOGRAPHIES  
BIRD STRIKES; BIRDS; COLLISION RESEARCH; IMPACT SHOCK; IMPACT STRENGTH;  
GESTION ENGINES; MIGRATIONS; RADAR TRACKING

4571 DA

BIRD STRIKE HAZARDS: A BIBLIOGRAPHY, 1971 - 1976

Murthy, HSS

National Aeronautical Laboratory; Information Centre for Aeronautics;  
ngalore; India  
Jun 1977 22 pp

REPORT NO: NAL-BIBL-SER-77

SUBFILE: NTIS; ATRIS

AVAILABLE FROM: National Technical Information Service 5285 Port Royal  
ad Springfield Virginia 22161

A comprehensive collection of literature on aircraft bird strike hazards

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DESCRIPTORS: AIR  
RCRAFT COLLISION  
DAR; SAFETY; SAFI

5961 DA  
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Moorehead, AS; M  
Air Force Civil  
Jul 1976 Final R  
REPORT NO: AFCEC  
SUBFILE: NTIS; A  
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fort. (Author)  
DESCRIPTORS: AI  
RPORTS; AVIATION  
STS; DAMAGE ASSE

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Publication Date  
Report No.: TDCH  
Language: MULTII  
Country of Origin  
Document Type: R  
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Other Availabil  
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Source of Abstr  
Descriptors: \*A  
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TERATURE  
Subject Classif

presented. The entries are arranged into six groups: (1) literature survey; (2) bird ingestion; (3) environmental control; (4) laser techniques; (5) radar techniques; and (6) structural design. An author index is provided.

DESCRIPTORS: AIRCRAFT ACCIDENTS; AIRCRAFT SAFETY; BIBLIOGRAPHIES; BIRD COLLISIONS; BIRD STRIKES; ENVIRONMENTAL CONTROL; INDIA; LASERS; SAFETY; SAFETY MANAGEMENT; STRUCTURAL DESIGN

5961 DA

A REVIEW OF PUBLICATIONS ON THE BIRD/AIRCRAFT STRIKE HAZARD

Moorehead, AS; McCracken, PR

Air Force Civil Engineering Center; Tyndall AFB; Florida

Jul 1976 Final Rpt. 26 pp

REPORT NO: AFCEC-TR-76-21

SUBFILE: NTIS; ATRIS

AVAILABLE FROM: National Technical Information Service 5285 Port Royal Road Springfield Virginia 22161

The annual cost to the United States Air Force (USAF) to replace or repair aircraft damaged by bird/aircraft collisions has led to an intensive study of the problems associated with birds on airfields and in the enroute environment. Since 1969 an active program has been in effect, first at the Air Force Weapons Laboratory (AFWL) at Kirtland Air Force Base, New Mexico, and in 1975 at the Air Force Civil Engineering Center (AFCEC), Tyndall Air Force Base, Florida. This report reviews those Technical Notes (TNs) and Technical Reports (TRs) that have been published as a result of the program effort. (Author)

DESCRIPTORS: AIRCRAFT COLLISIONS; AIRCRAFT MAINTENANCE; AIRCRAFT SAFETY; AVIATION ACCIDENTS; AVIATION SAFETY; BIRD STRIKES; COST ANALYSIS; DAMAGE ASSESSMENT; ENROUTE; HAZARDS; REVIEWS; SAFETY

File 108:AEROSPACE 62-92/ISS04  
(COPR. AIAA 1992)

Set	Items	Description
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25105 N68-22034

Bird hazards to aircraft - A literature survey, January 1947 - September 1957 (Literature survey on bird hazards to aircraft and attempts to disperse birds from airfields)

FLIJNEN, J.

Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).

Publication Date: Oct. 1967 55P.

Report No.: TDCK-49208

Language: MULTIPLE; IN FRENCH, ENGLISH, GERMAN, AND DUTCH

Country of Origin: Netherlands Country of Publication: Netherlands

Document Type: REPORT

Documents available from AIAA Technical Library

Other Availability: NTIS

Journal Announcement: STAR6812

Source of Abstract/Subfile: NASA STIF

Descriptors: \*AIRCRAFT HAZARDS; \*BIBLIOGRAPHIES; \*BIRDS; \*FLIGHT HAZARDS  
ABSTRACTS; AIRCRAFT SAFETY; IMPACT DAMAGE; INGESTION (ENGINES); LITERATURE

Subject Classification: 6502 Aircraft (1965-74)

**Computer Product Information Sheet**

NTIS Federal Computer Products Center  
 UNITED STATES DEPARTMENT OF COMMERCE  
 National Technical Information Service  
 5285 Port Royal Road, Springfield, VA 22161

Model-Simulation

TO ORDER: Phone: (703) 487-4650 FAX: 703-321-8547 Telex: 64617  
 (Also available on a Rush basis for an added fee)

Title:

REFEREE: Bibliographic Database Manager Version 4.2 (for microcomputers)

Source: Environmental Protection Agency

NTIS Order Number: PB91-509794

Product Type: Software-Diskette

Date: 8/4/87

Price Code: D02 U.S., Canada, &amp; Mexico: \$80.00, all other addresses: \$160.00

*(Price includes documentation, add \$3 to each order for handling)*

## Summary:

REFEREE is a general-purpose bibliographic database management program for IBM-compatible microcomputers. The program is ideal for maintenance of large, master databases from which lists of citations on desired topics frequently must be drawn.

REFEREE databases exist as proprietary-format disk files. The program allows entry of information manually (from the keyboard) and automatically (bulk transfers from dBASE.DBF files). Each record in a REFEREE database contains 9 fields. Seven of the fields are variable-length free-text fields that have essentially no format requirements; each can extend to nearly 6000 characters when necessary (disk space is allocated on a field-by-field record-by-record basis). All fields can be renamed to suit the user's needs. Up to 1 million records theoretically can be stored in a single REFEREE database; the actual maximum number depends on the amount of disk space available. Stored records can be viewed, modified, searched, sorted, printed, moved between REFEREE databases, and exported to DBASE .DBF files. By default, records are displayed and printed in a format that includes the names and contents of all 9 fields; the user may define custom formats that involve a different selection or order of fields, different line spacing or indentation, or boilerplate text.

The software is on two 5 1/4 inch diskettes, 360K double density. File format: Clipper Microsoft C5.1 8086 as. The diskette(s) are in ASCII format. Documentation included; may be ordered separately as PB91-228791.

System: IBM-PC/XT/AT or compatible; MS-DOS 2.0 + operating system, 400K. Memory requirement - 490K RAM, 400K free disk space for software; data requires additional. Supersedes PB88-200779.

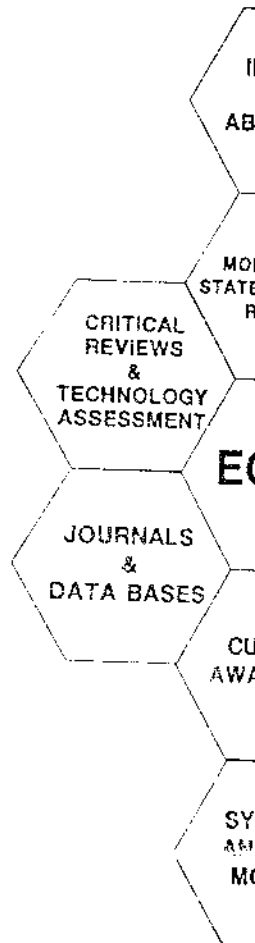
HQ AFCESA/TIC (FL7050)  
 Technical Information Center  
 Bldg 1120/Stop 21  
 Tyndall AFB FL 32403-6001

**Refund Policy:** NTIS does not permit return of items for credit or refund. A replacement will be provided if an error is made in filling your order, if the item was received in damaged condition, or if the item is defective.



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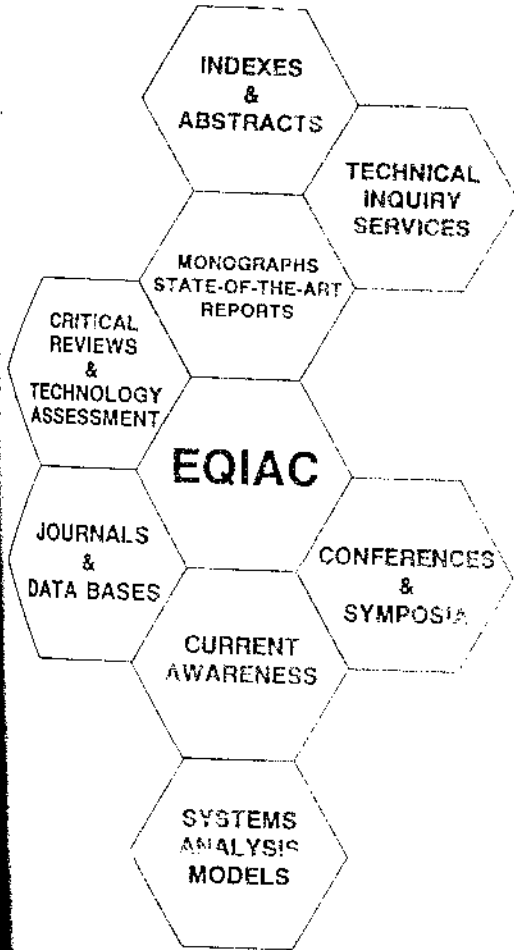
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## ENVIRONMENTAL QUALITY INFORMATION ANALYSIS CENTER (EQIAC)

RDX-91-1

July 1991



**SYNOPSIS:**

AFESC's Engineering and Services Laboratory has established the Environmental Quality Information Analysis Center (EQIAC) to gather, review, analyze and disseminate information in the areas of site restoration (SR), pollution prevention (PP), hazardous waste minimization (HWM), and environmental compliance (EC). This fulfills requirements for environmental data analysis and information transfer, two major categories of concern in the Environmental Quality Strategic Research and Development Program.

The most pressing problems confronting these involved in the research and application of new technologies in these critical areas have been the lack of an information focal point and the lack of a capability to obtain scientific/technical and cost-benefit analyses of (new) information in the SR, PP, HWM, and EC subareas. These analyses, as well as assessments of the state of the art and of current scientific developments and trends require capabilities not present in existing environmental information repositories; the combined skills of information specialists, researchers, field practitioners, and others in the federal, state, academic, and industrial community. Such services are essential to cost-effective and proactive environmental quality research, development and acquisition programs. The EQIAC was formed to meet these requirements in an economical, efficient, and unbiased manner.

The EQIAC provides technical,

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programmatic, and systems, and benefit analyses of the latest scientific developments in target EQ areas. It can respond to queries and referrals by accessing, reviewing and evaluating the literature, developing annotated bibliographies, and by enlisting the aid of a diversity of specialists to determine the focus of present and future activities and assess trends.

The EQIAC has ready access to thousands of commercial and government databases, as well as those of colleges and universities. Its own database resources include computerized bibliographic information on thousands of documents from DOD, other government agencies, industry and academic institutions. Hardcopy resources include books, technical reports, conference and symposium proceedings, standards and specifications, patents, and unpublished papers on environmental quality topics such as hazardous waste disposal and treatment technologies, site restoration, environmental pollution control, and environmental compliance.

**PRODUCTS AND SERVICES:**

EQIAC areas of emphasis are to: (1) review, analyze, and summarize data on EQ topics and issues; (2) provide programmatic decision tools to researchers and scientific managers; (3) identify and begin addressing voids in existing environmental information resources; and (4) disseminate information to users through periodic updates, bibliographies, state-of-the-art reviews, handbooks, and special reports. As an information focal

point, the EQIAC will provide referrals to those agencies best suited to meet the users' specific needs. This will further the full utilization of the expertise in place at other organizations.

The EQIAC will also assist its users with the management and planning of EQ conferences and seminars and can assist with the development of specialized handbooks and audiovisual aids. The results of conferences and seminars will be published and shared with the worldwide scientific and engineering community.

**BENEFIT:**

The EQIAC will facilitate more cost-effective site restoration pollution prevention, hazardous waste minimization, and environmental compliance efforts by providing EQ decision-makers, program managers, and researchers with timely access to the environmentally related research and technology information needed to accomplish their duties.

**AVAILABILITY:**

EQIAC's products and services are available to DOD environmental organizations, laboratories, managers and planners, DOE, EPA and other federal, state and local agencies, academia, and the private sector.

**USER CONTACT:**

Mr. Andrew Poulis  
 HA AFESC/TIC  
 Tyndall AFB FL 32403  
 DSN 523-6258  
 Comm (904)283-6258

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APPENDIX D

Proposed Search Descriptors for ABBHA

**Bird Attractants**

Food  
Vegetation  
Water  
Garbage  
Weather

**Bird Avoidance**

Airfield Environs  
Inflight Manuevering  
Preflight Planning  
Modelling Bird Risk

**Bird Control Measures-Airfield**

Bioacoustics  
Depredation  
    Falconry  
    Shooting  
    Chemical controls  
    Trapping  
    Predators  
Effigies  
Electronics  
Habitat  
Lights  
Mechanical  
Pyrotechnics  
Visual

**Bird Control Measures-Facilities**

Bioacoustics  
Building Design  
Depredation  
    Falconry  
    Shooting  
    Chemical controls  
    Trapping  
    Predators  
Effigies  
Electronics  
Lights  
Mechanical  
Visual

**Bird Populations**

Migratory  
Resident  
Behavior  
Marking  
Vectors of disease

**Bird Detection**

Radar  
Visual  
Sound  
Electronic

**Bird Physiology**

*Flight*

*Fright*

*Sensory*

*Auditory*

*Tactile*

*Visual*

**Bird Hazard Management**

*Plans*

*Reporting*

*Statistics*

**Legal Issues**

*Conservation*

*Protection*

*Refuges*

*Hunting*

*Siting-Airports*

*Siting-Attractants*

*Landfills (Rubbish Tips)*

*Offal Pits (Abattoirs)*

*Wastewater Treatment*

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