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ANNOTATED BIBLIOGRAPHY OF BIRD HAZARDS TO AIRCRAFT: BIRD STRIKE COMMITTEE CITATIONS 1967-1997

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AIR FORCE RESEARCH LABORATORY
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13. ABSTRACT *(Maximum 200 words)*

Over the past 30 years, much progress has been made to address the hazards proposed by birds to aircraft by the military, the aerospace industry, and international working groups. In an effort to "jump start" those researchers with bird hazard problems, the U.S. Air Force Research Laboratory has consolidated into a single document a significant portion of the literature on bird-aircraft interactions. This annotated bibliography of bird hazards to aircraft, termed ABBHA, is a compilation of citations with abstracts on a wide range of related topics such as bird strike tolerance engineering, bird hazard management and control, bird strike avoidance, and bird remains identification. ABBHA is available electronically and can be used with various word processing or bibliography management software. Computerization of the ABBHA reduces distribution costs, allows for frequent updates, and helps users to locate similar references on topics of interest through keyword "searches."

The ABBHA citations included in this report include working papers published in the proceedings of the Bird Strike Committees of Europe, Canada, and the United States.

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FOREWORD

The development of the Annotated Bibliography of Bird Hazards to Aircraft (ABBHA) began in April 1991 as a result of discussions in December 1990 with members from the Standing Committee on Applied Ornithology, a working group of the International Ornithological Congress.

The ABBHA includes references maintained by the Defense Technical Information Center, the National Technical Information Service, and the National Air and Space Administration. The citations in this report were compiled from ABBHA citations from meetings of the Bird Strike Committee Europe (now renamed the International Bird Strike Committee) and the Bird Strike Committee USA. This report covers 30 years of bird strike committee presentations.

The ABBHA was compiled as a part of an ongoing Air Force program to reduce losses from birdstrikes by applying state-of-the-art technologies to improve aircraft survivability to bird hazards and overall reduced cost-of-ownership. This technical report is the result of an Air Force Reserve project to transfer the results of birdstrike research and the "lessons learned" from operational experience to benefit organizations affected by bird hazards.

ACKNOWLEDGMENTS

The project supervision and administrative direction was provided through the Air Force Research Laboratory (AFRL/VAVE), and its predecessor organization, Wright Laboratory (WL/FIVE/FIVR). The active support and technical direction of Messrs. Ralph Speelman, Malcolm Kelley, Robert McCarty, and Albert Basso are gratefully acknowledged.

The initial and continuing technical support of the Air Force Research Laboratory-Tyndall Site, Technical Information Center at Tyndall AFB, Florida, especially Mr. Andrew Poulis, Ms.Virginia Davis, and Mr. Fred Nagle, has enabled the ABBHA to reach its full potential.

Review comments and suggestions on the ABBHA project were obtained from many reviewers, including the USAF Bird Aircraft Strike Hazard Team, the U.S. Department of Agriculture, Denver Wildlife Research Center, and members of the various Bird Strike Committees.

1 INTRODUCTION

1.1 Background on the Birdstrike Problem to Aviation

Birdstrikes are a costly, worldwide problem for private, commercial and military aircraft operations. In a typical year (1985-1996), Air Force aircraft are involved in over 2,500 birdstrikes at a cost of nearly $38 million (see http://www-afsc.saia.af.mil/AFSC/Bash/test2.htm). Worldwide losses for the aviation industry from birds are estimated to exceed $1 billion annually. Recent birdstrikes involving significant loss-of-life and costly damage reinforce the need for an enhanced capability to obtain information, review what has been done to reduce the hazards presented by birds and, perhaps, develop new approaches to solve the problem.

The Vehicle Subsystems Division of the Air Force Research Laboratory conducts engineering research on the birdstrike problem. A review of the literature generated over the past 40 years shows a wide range of references on the problem and a diversity of approaches to reduce birdstrikes. Depending on the particular situation, a combination of three different approaches are generally used to reduce birdstrike damage: (1) avoid the birds by planning, scheduling, or maneuvering, or, make it easier for the birds to avoid the aircraft; (2) remove the birds through scaring, depredation, or by changing the habitat; or, (3) build aircraft that can tolerate birdstrikes.

1.2 Purpose of the Bibliography

The Annotated Bibliography on Bird Hazards to Aircraft (ABBHA) can help in the decision on which approach is appropriate to reduce the danger caused by birds. The ABBHA provides a centralized listing of references concerning bird-aircraft interactions. The bibliography includes abstracts obtained from the National Technical Information Service, the Defense Technical Information Center, and other national repositories. However, the ABBHA also references results of research presented at national bird-aircraft hazard meetings (e.g., the Bird Strike Committees of Europe, Canada, and the United States), workshops sponsored by the International Civil Aviation Organization, and other symposia. Other, related topics are included in ABBHA such as pest bird management techniques, the legal aspects of bird hazards, bird remains identification, and aerodrome facility design and landscaping considerations.

1.3 Audience and scope

Implementation of birdstrike prevention activities can be facilitated by systematically identifying key documents on the birdstrike issue. The ABBHA was compiled to assemble into one document, those important references concerning birdstrike hazard reduction. This bibliography can make important studies on bird hazards quickly available to aircrew members, airport operators, wildlife managers, and aerospace engineers.

The ABBHA is designed for researchers as well as those involved in the application of bird hazard reduction measures. Researchers in lesser-developed nations particularly have difficulty in acquiring information on past research that can assist in solving their bird hazard problem. The ABBHA will assist these researchers in identifying current techniques--and even locate expert assistance--to reduce aviation losses caused by birds.

2 CONTRIBUTING ORGANIZATIONS

2.1 Bird Strike Committee Europe

The Bird Strike Committee Europe (BSCE) was formed in 1967 to address the growing flight safety hazards created by birds. The BSCE consisted of civil and military participants from Europe with a common interest in the bird strike problem. Participants include airport personnel, biologists, engineers, meteorologists, ornithologists, pilots, and air traffic control safety staff.

BSCE meetings convened biennially, with English as the working language, and the venue rotating between active member states. The proceedings of the BSCE meetings, including the working papers presented, are published and available to attendees. Attendance is open to interested participants from all parts of the world.

2.2 International Bird Strike Committee

In 1996, the BSCE changed its name to the International Bird Strike Committee to reflect the organization's growing membership outside the European subcontinent. The IBSC is informal, has no regulatory powers, no budget, and no secretariat.

The IBSC has several standing working groups to address the bird hazard problem. The terms of reference for the various groups follow:

- Aerodrome Working Group - Exchange of information on methods used and results obtained from the work being done on aerodromes to minimize the bird problem at and around airports.
- Military Low-flying Bird Strike Working Group - Exchange of actual data concerning medium and high intensity of bird migration as well as bird strike warnings in a standardized format (BIRDTAM) via the civil and military air traffic control or weather network, and implementation of bird hazard maps for the national civil and military aeronautical information publications.
- Remote Sensing of Birds Working Group - Exchange of information on the use of radar and other sensors in the surveillance, identification and the risk assessment of bird presence and movements.
- Testing of Airframes and Engines Working Group - Exchange of information on the prediction, test methods and test results from: (a) bird impact research and development, design and testing of materials, structural specimens, windscreen, engines, etc. and, (b) tests to show compliance with airworthiness requirements.
- Bird Remains Identification Working Group - Exchange of information on the methods used and results obtained on identification of bird remains.
- Statistics Working Group - Collection, analysis, and circulation of data and information relating to birdstrikes.
- Public Relations Working Group - Improve awareness of bird hazards throughout the aviation community, including airport management and staff, air traffic controllers, local authorities and landowners, maintenance staff, pilots, and the waste disposal industry.

The IBSC has adopted the following tasks from the BSCE:

- Collect, analyze and circulate to all concerned, data and information related to the bird strike problem;
- Establish liaison on further research to avoid duplication;
- Study and develop methods to control the presence of birds on and near aerodromes;
- Investigate electromagnetic wave sensing methods for observing bird movements;
- Develop procedures for the timely warning to pilots concerned where the existence of a bird hazard has been positively established;
- Develop procedures enabling a quick and reliable exchange of messages regarding bird hazard warnings;
- Develop materials regarding bird hazards for inclusion in aeronautical information publications;
- Aim at a uniform application of the methods and procedures and the use of materials developed to deal effectively with bird hazards.

2.2 Bird Strike Committee USA

The Bird Strike Committee USA (BSCUSA) was formed in 1991 to:

- Facilitate the exchange of information, promote the collection and analysis of accurate wildlife strike data;
- Promote the development of new technologies for reducing wildlife hazards;
- Promote professionalism in wildlife management programs on airports through training and advocacy of high standards of conduct for airport biologists and bird patrol personnel; and,
- Be a liaison to similar organizations in other countries.

The BSCUSA is directed by an eight person steering committee consisting of two members each from the Federal Aviation Administration, U.S. Department of Agriculture, Department of Defense, and the aviation industry Wildlife Hazards Working Group. Attendees of the meetings receive abstracts of the technical papers presented and a list of all attendees and addresses. Copies of the papers presented may be obtained from authors who choose to provide them. BSCUSA meetings are held at major airports in the United States.

2.3 Bird Strike Committee Canada

The purpose of the Bird Strike Committee Canada (BSCC) is to provide a structure for effective and informed dialogue on matters related to bird hazard and wildlife control at Canadian airports. The Committee operates as a forum for the dissemination and exchange of information on bird hazard and wildlife control. The BSCC serves an advisory role to the Departments regarding wildlife hazard control programs, technical and operational evaluations or other activities.

The BSCC has permanent membership from the major federal Departments of the Government of Canada (Canadian Wildlife Service, Agriculture Canada, National Museum, Transport Canada and National Defense) whose involvement with bird control would be of benefit to the Committee. The chairmanship of the Committee rotates every two years between Transport Canada and the Department of National Defense. Associate members include affiliated non-government representatives, such as the national and regional airlines, wildlife control consultants, pilots associations, engine manufacturers and other members of the aviation industry.

2.4 International Civil Aviation Organization

The International Civil Aviation Organization (ICAO) closely monitors the hazards that birds create to aviation. In 1969, the ICAO added a requirement to decrease the number of birds at aerodromes. Since then, the ICAO has developed the Airport Services Manual, Part 3 -- Bird Control and Reduction. The ICAO introduced the Bird Strike Information System (IBIS) to compile useful data on birdstikes. The data are used to develop bird hazard control and reduction measures and to ascertain airworthiness criteria related to bird strike damage.

3 HOW TO USE THE BIBLIOGRAPHY

3.1 To Research a Specific Subject

To speed the distribution and facilitate periodic updates, the ABBHA is designed as an electronic document that can be utilized with a wide array of computer hardware and software. The electronic format allows the organization of the citations in various ways, enabling the user to print only those citations of interest. The electronic format also allows wide dissemination of the ABBHA.

The bibliography provides several relevant pieces of information about each citation. In addition to the reference's title, author, and date of publication, a brief abstract (when available) describes the nature and content of the reference. The abstracts were either obtained through various computerized data bases, found within the information materials, or developed by the Air Force for the bibliography. The bibliography also provides information on how to obtain the full reference.

3.2. Using Keywords

The ABBHA citations are assigned keywords which are used to locate references with a similar theme. Many citations relate to several keyword categories. The ABBHA keyword list is provided at Appendix I.

Determine which keyword(s) best describe the subject of interest by referring to the list of keywords in the subject index. Second- and third-tier keywords are available to further “narrow down” the search. Though not listed, additional keywords are provided for some bird

groups (e.g., geese; gulls), for specific aircraft (e.g., F-4; B-747), and for certain aerodromes (e.g., Orly; JFK International Airport).

The ABBHA can be electronically "downloaded" in a variety of word processing and bibliographic management software formats. If using an electronic version of ABBHA, use the keywords to highlight those references of interest. For example, if the user would like to locate those references on using birds of prey to control birds, they would perform the search first for "Control Methods" to reduce the number of citations and then search secondarily, for "Falconry" to highlight specific citations.

Appendix II provides the ABBHA reference numbers for the first "tier" (boldface) of subject areas. Some ABBHA citations pertain to more than one keyword category. In this technical report, the citations from the Bird Strike Committee meetings are arranged by ABBHA reference number. This will allow the user to easily locate those references with similar subject matter.

3.3. Availability of Full Citations

The keyword entry "AT TECHLIB" denotes a reference accession available from the U.S. Air Force Research Laboratory-Tyndall Site, Technical Information Center (TIC) at Tyndall AFB, Florida. Most of the papers presented at Bird Strike Committee Europe meetings can be obtained by contacting the TIC at (850) 283-6285 or by email: andrew.Poulis@ccmail.aleq.tyndall.af.mil.

4 COMPILATION OF CITATIONS AND ABSTRACTS (1967-1997)

ABBHA Ref. #: 127
Citation: ANONYMOUS. 14 th Meeting of the Bird Strike Committee Europe. Bird Strike Committee Europe 14; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: Proceedings of meeting.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 130
Citation: ANONYMOUS. Measures available to the airport management for the reduction of the bird strike risk. Bird Strike Committee Europe 13, WP 27; Bern, Switzerland; 29 May-2 June, 1978: 301-304.
Abstract: There is sufficient statistical evidence that bird strikes impose significant repair cost upon airlines and that bird strikes may cause severe damage even to large transport aircrafts. The intention of this document is to collect and publish information about methods available for the reduction of bird strike risks on and around airports. To what extent a specific measure will prove successful at a given airport depends on the local conditions and this paper does

consequently not recommend specific measures, but concentrates on giving information about the different measures.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; CONTROL METHODS; HABITAT MODIFICATION; UNITED STATES

ABBHA Ref. #: 131
Citation: ANONYMOUS. 13th meeting of Bird Strike Committee Europe. Bird Strike Committee Europe 13; Bern, Switzerland; 29 May-2 June, 1978.
Abstract: Proceedings of meeting
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA; UNITED STATES

ABBHA Ref. #: 132
Citation: ANONYMOUS. Information paper no. 1. Bird Strike Committee Europe 13, WP 27; Bern, Switzerland; 29 May-2 June, 1978: pp. 310-318.
Abstract: The members are informed that International Civil Aviation Organization is holding, in Montreal, the 88th session of the air Navigation Commissions from May 4, 1978 to June 30, 1978. (In French)
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ICAO; ORGANIZATION

ABBHA Ref. #: 133
Citation: THORPE, J. Bird strikes during 1976 to European registered civil aircraft (aircraft over 5700 kg maximum weight). Bird Strike Committee Europe 13, WP 15; Bern, Switzerland; 29 May-2 June, 1978: pp. 84-125.
Abstract: The strikes reported throughout the world in 1976 by operators from ten European countries have been analyzed. The analysis includes rates for countries' aircraft movements. It also covers bird species part of aircraft struck, effect of strike, cost, and airlines affected. the strike rate in 1976 was significantly greater than in previous years. Gulls were involved in nearly half the incidents. The major effect was the crash of an executive jet aircraft, and damage to 57 engines. During the year bird strikes were estimated to have cost European airlines at least $US 3.7 million in engineering repairs.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 134
Citation: DAHL, H. Garbage dumps in the vicinity of airports. Bird Strike Committee Europe 13, WP 10a; Paris, France; 20-28 October, 1977: pp. 156-161.
Abstract: In accordance with a recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome Working Group Meeting from 18 countries to give information about the subject.

Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; LANDFILLS; LEGAL ISSUES

ABBHA Ref. #: 135
Citation: DAHL, H. Homing pigeons in the vicinity of airports. Bird Strike Committee Europe 13, WP 27; Bern, Switzerland; 29 May-2 June, 1978: pp. 162-165.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the vice chairman asked by letter of January 3, 1978, participants to the Aerodrome Working Group Meeting from 18 countries to give information about the subject.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; PIGEONS; RESIDENT

ABBHA Ref. #: 136
Citation: DAHL, H. Use of land in the vicinity of airports. Bird Strike Committee Europe 13, WP 10c; Bern, Switzerland; 29 May-2 June, 1978: pp. 166-176.
Abstract: Results from survey on land use restrictions from 18 countries
Keywords: AT TECH LIB; BSCE; LAND USE; LEGAL ISSUES

ABBHA Ref. #: 137
Citation: DAHL, H. Sanctuaries in the vicinity of airports. Bird Strike Committee Europe 13, WP 11a; Bern, Switzerland; 29 May-2 June, 1978: pp. 177-180.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome Working group Meeting from 18 countries to give information on the subject.
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; LAND USE; LEGAL ISSUES; SAFE AREAS

ABBHA Ref. #: 138
Citation: DAHL, H. Length of grass along the runways. Bird Strike Committee Europe 13, WP 11a; Bern, Switzerland; 29 May-2 June, 1978: pp. 177-180.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome Working Group the following subject: What is your position regarding the question of length of the grass along the runways, and indicate especially if you allow the grass to grow long right up to the runway?
Keywords: AT TECH LIB; BSCE; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 139
Citation: BESSE, J. Exploitation des tirs d'oiseaux a grande vitesse sur structure d'avions

mettaliques. Bird Strike Committee Europe 13; Bern, Switzerland; 29 May-2 June, 1978: pp. 356-395. (In French.)
Abstract: Extensive discussion of transparency tolerance issues
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; ENGINEERING; MATHEMATICAL MODELS; TRANSPARENCIES

ABBHA Ref. #: 140
Citation: DAHL, H. Trees and bushes in the vicinity of airports. Bird Strike Committee Europe 13, WP 11c; Bern, Switzerland; 29 May-2 June, 1978: pp.185-189.
Abstract: In accordance with a recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome Working Group Meeting from 18 countries to give the following information on the following subjects: Are there in your country regulations regarding the existence of trees and bushes in the vicinity of airports?
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; HABITAT MODIFICATION; TREES/SHRUBS

ABBHA Ref. #: 141
Citation: ANONYMOUS. 12th Meeting of the Bird Strike Committee Europe. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977.
Abstract: Proceedings of meeting.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 142
Citation: DAHL, H. Use of chemicals to make the soil of airport surroundings unattractive. Bird Strike Committee Europe 13, WP 12a; Bern, Switzerland; 29 May-2 June, 1978: pp.189-192.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome Working Group Meeting from 18 countries to give information on the following subject: Do you use any chemical to make the soil of the airport surroundings unattractive to birds?
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; HABITAT MODIFICATION

ABBHA Ref. #: 143
Citation: DAHL, H. Bird dispersal devices. Bird Strike Committee Europe 13, WP 12b; Bern, Switzerland; 29 May-2 June, 1978: pp.193-205.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the Vice Chairman asked by letter of January 3, 1978, participants to the Aerodrome

Working Group Meeting from 18 countries to give information on the following subject: If you use or have used bird dispersal devices, it being visual scaring, bird corpses, bird models, acoustical scaring, it being ultrasounds, non-natural sounds, natural sounds, or combined visual and acoustical scaring; it being pyrotechnics, birds of prey, remote-controlled model aircraft, you are requested to provide details both on devices being successful and devices to be unsuccessful.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; PYROTECHNICS; SOUND

ABBHA Ref. #: 144
Citation: DAHL, H. Organization of the scaring away of the birds. Use of fixed installation or mobile units. Bird Strike Committee Europe 13, WP 12c; Bern, Switzerland; 29 May-2 June, 1978: pp.206-209.
Abstract: In accordance with the recommendation of the 12th BSCE Meeting in Paris in October 1977 the vice Chairman asked by letter of January 3, 1978, participants about the following subjects: How is the scaring away of birds organized? Do you use fixed or mobile units, and do you scare both before take-off and landing?
Keywords: AT TECH LIB; BIRD CONTROL TEAM; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 145
Citation: ANONYMOUS. First experiences with gull models at Zurich Airport. Bird Strike Committee Europe 13, WP 13; Bern, Switzerland; 29 May-2 June, 1978: pp. 210-211.
Abstract: The airport of Zurich is situated in a plain between Kloten, Rumlang, and Bulach. To the south, in a distance of about 11 km, there is the lower part of the lake of Zurich. To the northwest, in a distance of about 7 km, there is the real of Neerach. These two areas offer ideal living conditions for different kind of birds are about 16 km apart- the direct route between the two sites touches the airport area. A variety of control measures have been applied with effigies being the most successful.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; EFFIGIES; GULLS; SWITZERLAND

ABBHA Ref. #: 146
Citation: ANONYMOUS. Bird Strike Committee Europe : 18th Meeting. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986.
Abstract: Proceedings of meeting
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 147
Citation: ANONYMOUS. Strategies for the identification of bird remains from birdstrikes. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 113-

122.
Abstract: In 1985 the Belgian Air Force recorded 100 birdstrikes (BS), among these 44 with damage. Actions to avoid or diminish birdstrikes are not only based on aerodrome measures and birdtam information but also on information about the bird species involved, their behavior and their way of living. This kind of information may be useful, e.g. to render airfields and their surroundings less attractive to some bird species. Different bird species may respond in a different way to the same dispersal methods. It is therefore important to be able to identify them up to the species level in order to take the exact preventative measures. Since several years, a group of biologists attached to the Meteorological Wing of the Belgian Air Force and a research laboratory at the University of LEUVEN collaborate at the same question within the frame of B.S.C.B. This collaboration is of interest for both parties since a lot of scientific information concerning the flying habits of birds can be obtained from these birdstrikes. This paper deals with some recent developments in the identification of bird species by means of biochemical techniques.
Keywords: AT TECH LIB; BIOCHEMICAL; BSCE; IDENTIFICATION

ABBHA Ref. #: 148
Citation: ANONYMOUS. Bird Strike Committee Europe 19th meeting. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988.
Abstract: Proceedings of meeting
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 149
Citation: DAR, M.G.; SU-ARETZ, M.S. Treatment for repelling birds at Ben Gurion (LOD) international airport, Israel. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 161-164.
Abstract: The series of anti-bird treatment by Reta Bird Repellent during 1976-77, was based on results of two previous winter trial campaigns carried out at Ben Gurion Airport in 1975-76.
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; ISRAEL

ABBHA Ref. #: 150
Citation: ANONYMOUS. Terms of reference of the steering committee of BSCE. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: 155.
Abstract: The present composition and membership of the BSCE is presented.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 151
Citation: ANONYMOUS. Bird Strike Committee Europe 20th meeting. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990.

Abstract: Proceedings of meeting
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 154
Citation: ANONYMOUS. Contact persons regarding bird strike work. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 47.
Abstract: At the end of the BSCE 19 meeting in Madrid 1988, the Plenary decided that there exists a need for a revised list of persons to be contacted in connection with bird strike work in each country.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; NOTIFICATION

ABBHA Ref. #: 155
Citation: ANONYMOUS. 11th Meeting of the Bird Strike Committee Europe. Bird Strike Committee Europe 11, London, U.K.; 24-28 May, 1976: 304 pp.
Abstract: Proceedings of meeting
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 156
Citation: ANONYMOUS. EEC regulations regarding reforesting of former farm lands. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: p. 103.
Abstract: (not available)
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; VEGETATIVE

ABBHA Ref. #: 157
Citation: ANONYMOUS. Finnish Air Force bird strike summary: 1981-1989. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 235-242.
Abstract: The Finnish Air Force recorded 199 bird strikes during 1981 - 1989. These strike caused neither aircraft losses nor injuries, but 30 strikes resulted in damage of various degrees to aircraft. During the period covered by this summary, the annual number of bird strikes varied between 10 and 32, the figure approaching 30 around the mid-decade. The number of strikes increased markedly due to a significant increase in high speed, low-level training flights after the introduction into service of the Hawk trainer aircraft.
Keywords: AT TECH LIB; BSCE; FINLAND; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 159
Citation: ALERSTAM, T. Spring migration of cranes over southern Scandinavia. Bird Strike Committee Europe 10, WP 27; Stockholm, Sweden 9-13 June, 1975: 222-227.

Abstract: In Sweden, a joint project to study bird migration was started in 1971. An effort has been made to map different main types of bird migration. The information gathered will provide answers to some of the questions raised by air traffic authorities and that it will contribute to the development of efficient bird warning systems.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; CRANES; MIGRATION; WARNING SYSTEMS

ABBHA Ref. #: 160
Citation: ALFIYA, H. Nocturnal migration of birds over Israel - changes in direction and rate of migration according to the time of night. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 83-92.
Abstract: About 280 species migrate over Israel, mainly at night. Diurnal migration of soaring birds over Israel --raptors, storks, and pelicans-- has been thoroughly studied with radar, ground observers and motorized glider (Leshem, 1988, 1984). Most of the damage done to Israel Air Force aircraft is attributed to these birds. this is due mainly to their large size and their flight altitude, which may reach 5000 feet above sea level.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR; VISUAL

ABBHA Ref. #: 161
Citation: ALLAN, J.R.; WATSON, L.A. The impact of a lumbricide treatment on the fauna of airfield grassland. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 531-542.
Abstract: This paper presents data from trials of a lumbricide (worm-killing) chemical to reduce bird numbers on an airfield by reducing the available food supply. Numbers of feeding birds, worms and other invertebrates were monitored in adjacent 1 hectare treated and untreated plots from 1 November 1989 - 2 April 1990.
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; FOOD

ABBHA Ref. #: 163
Citation: ARIZZI, R.J. Development and certification of a rugged engine relative to foreign object ingestion. Bird Strike Committee Europe 14, WP 22; The Hague, Netherlands; 22-26 October, 1979.
Abstract: The design of the CFM56 engine optimizes the birdstrike tolerance and operating factors. The engine underwent development and certification tests with birdstrikes in mind.
Keywords: AT TECH LIB; BIRD IMPACT; BSCE; ENGINEERING; ENGINES; TESTING

ABBHA Ref. #: 164
Citation: AUSTIN, T.S. Military aircraft birdstrike analysis 1974. Bird Strike Committee Europe 11, WP 28; London, U.K.; 24-28 May, 1976: pp. 273-291.
Abstract: This data supported what is now known to be the normal pattern of birdstrike in that 80% of birdstrikes occurred below 1,000 feet, 48% occurred above 250 knots. 51% of recorded strikes occurred during the low level, en route an attack phase of flight, whilst 41% occurred in the vicinity of the airfield either during take off or landing.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 165
Citation: AUSTIN, T.S. Bird control units in the RAF. Bird Strike Committee Europe 11, WP 29; London, U.K.; 24-28 May, 1976: pp. 292-295.
Abstract: Discusses bird control units and their organization in the British Royal Air Force.
Keywords: AT TECH LIB; BIRD CONTROL TEAM; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; ORGANIZATION

ABBHA Ref. #: 166
Citation: AUSTIN, T.S. Birdstrike - the airport manager's brief. Bird Strike Committee Europe 11, WP 24; London, U.K.; 24-28 May, 1976: pp. 243-245.
Abstract: Birds represent a hazard to aircraft in the air. An aircraft striking a bird may suffer damage to the structure of its windscreen. The severity of the damage will depend on the weight of the bird, the speed of the aircraft and the strength of the part struck. At best, a birdstrike will result in a delay or a diversion and a maintenance test, at worst it could result in a catastrophic accident. In Europe, civil aircraft strike a bird about once in every 1500 flights and once in every 2000 take-offs and landings. Military aircraft suffer a rather lower take-off and landing rate but have more en-route strikes because they carry out more flights at low-level. Several military and civil aircraft are lost each year due to birdstrikes and the cost is considerable.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; GUIDANCE; HAZARD MANAGEMENT; MILITARY AVIATION; ORGANIZATION; STATISTICS

ABBHA Ref. #: 167
Citation: BAKKER, C. Birdstrikes during 1985. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 382-387.
Abstract: (not available)
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 168
Citation: BAKKER, C. Information to pilots about the danger of birdstrikes. Bird Strike

Committee Europe 14, WP 27; The Hague, Netherlands; 22-26 October, 1979.
Abstract: (not available)
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; NOTIFICATION

ABBHA Ref. #: 169
Citation: BAKKER, C. Birdstrikes during 1987. Bird Strike Committee Europe 19, WP 36; Madrid, Spain, 23-26 May, 1988: pp. 573-588.
Abstract: Tables annotating civil aviation (KLM) statistics from 1982-87.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 170
Citation: BARRA, B. Air traffic control radar data analysis and bird movements detection. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 239-254.
Abstract: This paper discusses the problem of the analysis of the ATC radar echoes and the possibility of detecting bird's movements, by implementing an appropriate logical function. The approach looks promising and some additional advantages may be expected in terms of system performances. Moreover, it is suggested that this problem should be duly considered in the specification of the ATC radar meteo channel.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR

ABBHA Ref. #: 171
Citation: BECKER J. Bird migration a flight safety risk. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 563.
Abstract: The video tape starts with the history of aviation, and describes the flight safety hazards to modern aviation caused by migrating birds. The video shows the procedures of the Federal Armed Forces with the intention of reducing the birdstrike hazard, especially the existing observation-, reporting-, warning-, and forecast system of the German Military Geophysical Service with respect to large scale bird migration.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; FILM/VIDEO; HAZARD MANAGEMENT; TRAINING

ABBHA Ref. #: 172
Citation: BECKER J. Mapping the birdstrike risk. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.179-182.
Abstract: The Bird Movement and Low-Level Working Group shall initiate map concerning permanent or temporary bird concentration areas for the information of pilots with the purpose of bird hazard prevention and bird protection. The paper gives a survey of existing bird hazard maps and discusses the limits of mapping the birdstrike risk.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; MAPS

ABBHA Ref. #: 173
Citation: BECKER J. Bird Observation by the skyguard search- and tracking radar. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 221.
Abstract: The SKYGUARD search- and tracking X-Band radar of the manufacturer Contraves is normally used by the German Air Force for the surveillance or low flying aircraft. In fall 1989 the system was tested for its suitability for recording the flight paths of birds in an area north of Munich. Gulls, lapwings, ducks, and crows could be tracked up to a distance of 9 km. The altitudes of the birds varied between 30m and 600m, but mostly between 100m and 300m. During daylight the bird species could be identified by a TV-camera with a focal length of 1000 to 4200 mm.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR; VISUAL

ABBHA Ref. #: 174
Citation: BECKER, J. New procedures for evaluation of radar information. Bird Strike Committee Europe 14, WP 13; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: This paper discusses the improvement of the bird warning system using an electronic counting system that is validated with photographic counts.
Keywords: AT TECH LIB; BSCE; DETECTION; FORECASTING; RADAR

ABBHA Ref. #: 175
Citation: BECKER, J. The use of radar data for bird strike prevention in Germany. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 82-92.
Abstract: In the Federal Republic of Germany military and civil radar stations perform observations of bird movements by Polaroid pictures or movie pictures of the radar scope. The Polaroid pictures give information of actual migratory movements of birds, and are used for bird strike warnings (birdtam). The observations by movie film are used for the investigation of seasonal and spatial variations of bird movements as well as for the correlation between weather and bird migration. The knowledge of factors influencing the timing and amount of bird migration is fundamental to the bird strike risk forecast issued by the German Military Geophysical Office.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR; VISUAL

ABBHA Ref. #: 176
Citation: BECKER, J. Military Aircraft Bird strike analysis - 1985-1986. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 83-91.
Abstract: Provides detailed information on bird strike incidents on military aircraft operating in Europe.
Keywords: AT TECH LIB; BSCE; EUROPE; HAZARD MANAGEMENT; MILITARY

AVIATION; STATISTICS

ABBHA Ref. #: 177
Citation: BECKER, J. Measures to minimize bird hazard at low level. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 95-104.
Abstract: The Bird Movement Working Group (BMWG) shall develop preventive measures to minimize the bird hazard to low flying aircraft. A survey of the existing procedures for military low level flights was given during two meetings "Bird Hazard at Low Level." The participants emphasized the necessity of regular radar observations, standardized birdstrike warnings (BIRDTAM) as well as standing procedures for the flying units. They recommended the improvement and standardization of the existing procedures, and the distribution of all information concerning large-scale bird movements of medium and high intensities beyond national borders.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; MILITARY AVIATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 178
Citation: BENTZ, P.; BROM, T.G. The Convair accident in the Skagerak 1989 - A presentation of the identification work on feather remains found in the wreckage. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 363-371.
Abstract: A Norwegian registered Convair crashed into the sea north of Denmark in 1989. Fifty-five people were killed. this paper describes the results of the chemical tests and the identification work which were carried out on the feather remains found in the wreckage. The findings do not support the theory that a bird strike caused the accident.
Keywords: AT TECH LIB; BIOCHEMICAL; BSCE; IDENTIFICATION

ABBHA Ref. #: 179
Citation: ANONYMOUS. Proceedings of 17th meeting Bird Strike Committee Europe. Bird Strike Committee Europe 17; Rome, Italy, 15-19 Oct 1984.
Abstract: Proceedings of Bird Strike Committee Europe 17
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 180
Citation: ANONYMOUS. Bird strike committee Europe to all pilots-watch out for birds!! Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 182
Citation: BIRYUKOV, Y.; NECHVAL, A. Homogeneity testing problems in bird strike data

processing when sample sizes are small. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp 157-167.
Abstract: This paper deals with testing the homogeneity of bird strike data when sample sizes are small. The traditional statistical approaches developed for large sample data processing will usually not be applicable in the above case . Using a method of conditioning on a sufficient statistic of the likelihood function of bird strike data, we develop some new homogeneity tests. The present paper undertakes a statistical analysis with respect to homogeneity testing problems in the Poisson and two-parameter exponential distributions. Tests are recommended on the basis of certain optimal power properties. The illustrative examples are given.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 183
Citation: BIVINGS, B.; MEDVE, K.A. The U.S. Navy's bird aircraft strike hazard (BASH) problem 1985-1989. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.499-509.
Abstract: Each year the Navy suffers significant aircraft damage due to collisions with birds (bird strikes). The Navy Safety Center has recorded 6,365 strikes (an average of 707 annually) since 1981 when the Department of Defense standardized accident reports in military. Even though the number of reported strikes is high, the actual number may be far higher. A 1989 study of the BASH problem at Naval Air Station Point Mugu, California showed that only 33% of bird strikes are reported. Therefore, Naval aircraft have probably taken close to 20,000 strikes (2,000 annually) since 1981. A bird strike itself is not the problem though. Loss of aircraft, money, and time is the problem. since the inception of the BASH program, two aircraft have been lost to birds: an A-4 crashed north of Mayport, Florida in 1984 and an AV-8 crashed near Yuma, Arizona in 1986.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 184
Citation: BIVINGS, A.E. Advantages and limitations of Radio-Controlled aircraft in bird dispersal. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 481-487.
Abstract: Radio-controlled aircraft were utilized to attempt to scare birds out of agricultural crops, staging or loafing areas, transit lanes, and roosts. Positive results were obtained for most birds tested in crops, staging and loafing areas, and transit lanes. Poor results were obtained at roosting areas. Dense escape cover at roost sites was thought to be the major reason roost scaring was ineffective. Simulation of a noisy aerial predator, lack of habitation, increased area covered, and better control if displaced birds were the major advantages of this technique. Difficulty in flying, limited endurance, high maintenance and acquisition costs, and limited ability to operate in adverse weather were the major limitations. The conclusion was that radio-controlled aircraft offer a good tool under a wide variety of circumstances, but should not be expected to be the

only tool used to resolve all possible problems.
Keywords: AIRCRAFT; AT TECH LIB; BSCE; CONTROL METHODS; REMOTE CONTROLLED

ABBHA Ref. #: 185
Citation: BLOKPOEL, H. Bird hazards to aircraft. Bird Strike Committee Europe 10, Stockholm, Sweden 9-13 June, 1975: pp. 263-266.
Abstract: Detailed review of the international problem caused by birds to safe aircraft operations. Chapters on birds and bird strike statistics; methods for reducing the hazard; bird-proofing aircraft; on-board devices to clear birds from an aircraft's flight path; reducing bird numbers at airfields; warning techniques during high-risk bird migration season; and, organizing birdstrike reduction programs.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BOOKS/MANUALS; BSCE; CONTROL METHODS; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 186
Citation: BLOKPOEL, H. Prediction of the spring migration of snow geese across the terminal control area of Winnipeg International Airport. Bird Strike Committee Europe 10; Stockholm, Sweden 9-13 June, 1975: 192-195.
Abstract: The chronology of spring migration of Lesser Snow and Blue Geese in the vicinity of Winnipeg was determined, the influence of the weather was examined and the results were used to develop a method for predicting major flights (waves of migration).
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; CANADA; DETECTION; GEESE; MIGRATION; NORTH AMERICA; WARNING SYSTEMS

ABBHA Ref. #: 187
Citation: BOOMANS, J.F. Synopsis of the organization and activity of the BSCE Belgium in 1974-75. Bird Strike Committee Europe 10, WP 9; Stockholm, Sweden 9-13 June, 1975: p. 171.
Abstract: A Belgian Bird Strike Committee was installed in 1975. Representatives of the Belgian Air Staff, the Tactical Headquarters, the Training Group, the Meteorological Wing, the Radar Stations and civil ornithologists are members of this committee.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 188
Citation: BREMOND, A. Helicopter bird strike resistance. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 127.
Abstract: The hazard created by bird encounters for helicopter occupants does not account for a large percentage of serious accidents. For example, no fatal accident due to a bird strike has been recorded, to date, on the Aerospatiale fleet. However, some cases of cockpit penetration and of

engine ingestion have indeed occurred. Furthermore the rotors, the sensitive and vital part of the helicopter, must be proofed against bird strike effects.
Keywords: AT TECH LIB; BSCE; ENGINEERING; HELICOPTER; TRANSPARENCIES

ABBHA Ref. #: 189
Citation: BRIOT, J.L. Solution propre a la France: sensibilisation des personnels. Bird Strike Committee Europe 14, WP 23; The Hague, Netherlands; 22 -26 October, 1979. (In French.)
Abstract: Airfield bird control can be improved with proper training.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; TRAINING

ABBHA Ref. #: 190
Citation: BRIOT, J.L. The use of synthetic noise generators at French airports. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 505-532.
Abstract: This paper summarizes seven years of research in France with different noise generators. The latest type of equipment manufactured in France is described. Visual observations and birdstrikes are analyzed, the results discussed and the future considered.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; NOISE

ABBHA Ref. #: 191
Citation: BRIOT, J.L. The attempt to get rid of the Wood-pigeons (Columba palumbus) from Orly Airport. Bird Strike Committee Europe 11, WP 22; London, U.K.; 24-28 May, 1976: pp. 223-230.
Abstract: Since it is quite difficult to affect the distribution of clover, we preferred to affect its abundance (CBDW) by spreading a hormone which essentially kills the Dicotyledons. This was the U46 KV liquid, containing 350 grammes/litre of 2.4 DP, 150 g/1 of Mecoprop and 100 g/l of 2.4 MCPA. This herbicide was spread in April 1976 over two sections of land next to the Orly Paved area, four litres per hectare and 800 litres per hectare of water. It seems that the method is effective since no pigeon has been seen on the treated sections.
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; FRANCE; HABITAT MODIFICATION; ORLY IAP; PIGEONS

ABBHA Ref. #: 194
Citation: BRIOT, J.L. Last French experiments concerning bird-strike hazards reduction (1981-1986). Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 202-208.
Abstract: This paper briefly gives the results obtained in four different experiments carried out in France since 1981 in civil aviation: falconry, radio controlled model aircraft, noisy synthetic sounds along the runways, on-board flashing lights.

Keywords: AIRCRAFT APPEARANCE; AT TECH LIB; BSCE; CONTROL METHODS; ENGINEERING; FALCONRY; LIGHTS; REMOTE CONTROLLED; ULTRASONICS

ABBHA Ref. #: 195
Citation: BROM, T.G.; WATTEL, J. Proposal for the establishment of a European centre for the identification of bird remains. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 223-234.
Abstract: Proper identification of bird remains is essential and fundamental to bird strike statistics. During the last meeting of BSCE a growing interest in the methods of identification was noticeable, resulting in the establishment of the Working Group "Bird Remains Identification". The next step forward and one of the major goals of the newly formed Working Group should be the standardization of identification methods employed in different countries. One of the possible ways is to concentrate existing expertise and subsequently made it available to all organizations that have problems. In this paper it is therefore suggested to establish a European Centre for the Identification of Bird Remains.
Keywords: AT TECH LIB; BSCE; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 196
Citation: BROM, T.G. The analysis of feather remains: evaluations and perspectives. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 343-356.
Abstract: Different methods of feather identification are discussed and evaluated, such as macroscopical comparison with bird skins, light-microscopy (LM), and scanning electron microscopy (SEM). Several new techniques are discussed which might be applied in the future, such as sectioning of feather parts, biochemical analysis of keratins, and analysis of chemical elements in feathers. The results obtained in bird strike analysis in the Netherlands with LM investigation of feathers and feather fragments in combination with comparisons with bird skins are evaluated. 96% of all examined feather remains (n=1659) could be assigned to order, 71% to family, 64% to genus, and 58% to species. The Swift accounts for 24% of all identifications at species level. At family level, the Apodidae score highest with 19%, followed by gulls and terns (Laridae & Sternidae) with 18%. At order level, the Passeriformes score highest with 40%, followed by the Charadriiformes with 26%.
Keywords: AT TECH LIB; BSCE; FEATHERS; IDENTIFICATION; MACROSCOPIC; MICROSCOPIC; SCANNING ELECTRON

ABBHA Ref. #: 197
Citation: BROUGH, T. An overview of aerodrome bird control and related activities in the UK. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 373-384.
Abstract: This paper briefly describes the methods used to control birds on aerodromes in the UK. Military and civil practices are compared and developments in procedures are related.

Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 198
Citation: BROUGH, T. Addendum to aerodrome measures book: Some measures used in different countries for reduction of bird strike risk around the airport. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 583-588.
Abstract: Provides revisions to BSCE Aerodrome Measures Book on garbage dumps, pigeons, land use, vegetation, sanctuaries, grass length, chemical repellents, distress calls, effigies, organization, etc.
Keywords: AERODROME DESIGN; AT TECH LIB; BSCE; CONTROL METHODS; UNITED KINGDOM

ABBHA Ref. #: 200
Citation: BRUDERER, B. Some proposals for evaluations of bird strike data. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 591-594.
Abstract: The paper emphasizes the importance of careful evaluation and interpretation of statistical data. With respect to recent comparisons of the strike rates at different airports it is proposed, that if airports are to be compared, the data should be based on the strike rates of individual operators. Conclusions should only be drawn if the results of different operators show a similar pattern.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; SCANNING ELECTRON; STATISTICS

ABBHA Ref. #: 201
Citation: BRUDERER, B. Electronic recording of bird tracks and bird numbers by tracking radar. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 603-606.
Abstract: The tracking radar "Superfledermaus" can be used in a tracking as well as in a surveillance mode. The flight paths of automatically tracked birds are digitized and recorded at intervals of one second by a personal computer. The same computer also stores a reduced and digitized picture of the PPI, while the pencil-beam of the radar rotates around a vertical axis at selected elevation angles.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR
ABBHA Ref. #: 202
Citation: BRUDERER, B. Weather-dependence of height, density and direction of migration in Switzerland. Bird Strike Committee Europe 12, Working Paper 25; Paris, France; 20-28 October, 1977: pp. 182-187.
Abstract: Since bird hazards to aircraft have become a real problem for flight safety, the interest of aviation people in the old field of bird migration research has increased rapidly, and the

interest of biologists in radar observations has opened a wide field of cooperation. This paper summarizes the present knowledge on vertical and horizontal distribution of migration above Switzerland, to show the problems of forecasting day-to-day variation in migratory activity in an Alpine environment and to indicate the gaps in our knowledge.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR; SWITZERLAND

ABBHA Ref. #: 203
Citation: BRUDERER, B. Collisions of aircrafts with birds of prey in the Alps. Bird Strike Committee Europe 13, WP 3; Bern, Switzerland; 29 May-2 June, 1978: pp. 72-76.
Abstract: Some recent reports suggest that besides the incidental collisions, large birds of prey may, under certain circumstances, actively attack an aircraft. By comparison of the known cases, we will discuss circumstances leading to attacks and examine how such attacks might be avoided. Attacks of eagles seem to occur when an aircraft approaches a sexually displaying pair, especially when the aircraft is at the same or slightly lower altitude.
Keywords: AT TECH LIB; BEHAVIOR; BIRD POPULATIONS; BSCE; EAGLES

ABBHA Ref. #: 204
Citation: BRUDERER, B. Bird observations at Zurich Airport. Bird Strike Committee Europe 13, WP 13; Bern, Switzerland; 29 May-2 June, 1978: pp. 248-287.
Abstract: During the years 1971-1973 amateur ornithologists among the airport personnel have collected data on the distribution of the most hazardous bird species within the confines of Zurich Airport. The data by these non-specialists, in a fairly unsystematic way, have furnished a heterogeneous sample. It is the aim of the present paper to show possibilities of evaluation, presentation and use of such data.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; ORGANIZATION; STATISTICS; SWITZERLAND; ZURICH IAP

ABBHA Ref. #: 205
Citation: BUURMA, L.S.; BRUDERER, B. The application of radar for bird strike prevention. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 373-445.
Abstract: The following pages of the "radar booklet"(from a total of 75 pages, 37 figures and photos, one color map) may serve as an introduction for those readers who were not present in Helsinki (BSCE 20) or did not receive a copy.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR

ABBHA Ref. #: 206
Citation: BUURMA, L.S. Patterns of bird migration over the Netherlands: a classification illustrated with radar film. Bird Strike Committee Europe 14, WP 21; The Hague, Netherlands;

22 -26 October, 1979.
Abstract: A selection of film fragments will be presented in order to illustrate the complicated patterns of bird migration as we do observe them at the radar screen. Situated in the southern part of the North Sea basin, our airspace is a crossing area of N-S and E-W bird movements. It is not the aim of this contribution to present a full summary of all types of migratory activity occurring in The Netherlands: primarily because we do not yet fully understand all observed patterns; secondly, because we start to realize that the birds in the North Sea region behave rather flexibly with respect to altitude and choice of direction.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; EUROPE; MIGRATION; RADAR

ABBHA Ref. #: 207
Citation: BUURMA, L.S. The practical use of bird migration warnings. Bird Strike Committee Europe 13, WP 34; Bern, Switzerland; 29 May-2 June, 1978: pp. 342-345.
Abstract: Next autumn the RNLAF will start experiments with an electronic counting system on a full operational radar station in the north of the Netherlands. This means a big step forward after more than two years, of improvisational detection of bird migration with the help of Polaroid photos taken from the screen of a small airport radar with several technical failures. Parallel to the introduction of this new system, called KIEVIT, we think the time is right to discuss again the practical use of the measurements, the way of dissemination of messages, and especially, how to cooperate with other countries in the future.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 208
Citation: BUURMA, L.S. Thermal imaging, a new remote sensing technique for nocturnal wildlife studies. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 621-628.
Abstract: It is one of the aims of the radar working group to discuss all possible means for remotely sensing bird movements. Besides radar some other techniques have been tested for the observation of nocturnal migration and were reported here. Portable infrared goggles combined with IR illumination have already reached the third generation and are frequently applied in biology. Light amplification is the other candidate that attracted attention during the last two decades. Especially the approach of Gauthreaux (1979) who later combined small radar and light amplification within a spotlight beam, appeared to be successful. Here, I report on some preliminary observations with a new challenging technique: thermal imaging.
Keywords: AT TECH LIB; BSCE; DETECTION; INFRARED

ABBHA Ref. #: 209

Citation: BUURMA, L.S. Establishment of bird control units at six Dutch air bases. Bird Strike Committee Europe 12, WP 27; Paris, France; 20-28 October, 1977: pp. 112-115.
Abstract: Birdstrike prevention activities in the RNLAF, but probably also elsewhere in aviation, seem to be a cyclic phenomenon. Two years ago I showed you some figures and expressed some thoughts about success and malaise as regards fighting the bird problem in Holland. This paper gives a short description of the establishment of Bird Control Units: groups of personnel and equipment responsible for birdstrike prevention at air bases.
Keywords: AT TECH LIB; BIRD CONTROL TEAM; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 210
Citation: BUURMA, L.S. Bird strike presentation success and malaise in the RNLAF. Bird Strike Committee Europe 10, WP 22; Stockholm, Sweden 9-13 June, 1975: pp. 214-215.
Abstract: The Netherlands, because of its geographical location, is very rich in birdlife. The birdstrike ratio is therefore very high which resulted in the exponential increase in damage to ever faster flying aircraft. After a number of productive years, the interest in birdstrikes has waned due, in part, to the widespread disbelief in preventative measures, particularly in bird migration warnings. Several recommendations are made to renew the effectiveness of the birdstrike program.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 211
Citation: BUURMA, L.S. Autumn radar study of the coastal migration in Western Holland. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp.188-189.
Abstract: Prevention of birdstrikes "en route" is only possible by avoiding those parts of the airspace in which the density of birds exceeds a certain level.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; NETHERLANDS; RADAR

ABBHA Ref. #: 212
Citation: CAITHNESS, T.A. A granulated insecticide to control invertebrates on airfields. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 262-267.
Abstract: The broad spectrum insecticide "Thiodan" has been formulated into a high density, slow release, clay-based granule for the control of invertebrates, earthworms in particular, on airfields. Using the South Island pied oystercatcher, "Haematopus ostralegus finschi" as the indicator species, the "Thiodan" granule was applied to the 90 hectares of grassed areas at Nelson Airfield in three separate applications: 1983, 1984 and 1985. A marked reduction in feeding attempts and use of the airfield by oystercatchers has resulted, brought about by a huge reduction in earthworms.
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; CONTROL

METHODS; FOOD; INVERTEBRATES; SHOREBIRDS

ABBHA Ref. #: 214
Citation: CESBRON, H. How should funds be allocated to strengthen the structure? Bird Strike Committee Europe 11, WP19; London, U.K.; 24-28 May, 1976: pp. 210-219.
Abstract: The use of a method of optimization will help to find how to spend a given amount of money in research and industrial actions on structure for higher security concerning bird hazards.
Keywords: AT TECH LIB; BSCE; ENGINEERING; MATHEMATICAL MODELS

ABBHA Ref. #: 215
Citation: CESBRON, H. Global statistical approach to the bird strike. Bird Strike Committee Europe 11, WP 18; London, U.K.; 24-28 May, 1976: pp. 191-209.
Abstract: The military analysis gives more information from the data collected on the reporting form. Several couples of variables are explored. The main factors leading to a birdstrike are the number of hours of flight and the mean speed of the aircraft.
Keywords: AT TECH LIB; BSCE; MILITARY AVIATION; REPORTING; STATISTICS

ABBHA Ref. #: 220
Citation: DAHL, H. Revised index for BSCE working papers issued during the period 1966-1990. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 565-612.
Abstract: Includes papers presented at the 1977 World Conference in Paris which was organized partly by the BSCE. This index provides an easy reference to locate papers presented at the Bird Strike Committee Europe meetings.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; LITERATURE SURVEY

ABBHA Ref. #: 221
Citation: DALLO, E. The Bird Strike Committee Europe and the international organization. Bird Strike Committee Europe 13, WP 30; Bern, Switzerland; 29 May-2 June, 1978: pp. 312-319. (In French.)
Abstract: Discusses the establishment and workings of the BSCE.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ICAO; ORGANIZATION

ABBHA Ref. #: 222
Citation: DAR, D. Summary of tests carried out at the International Ben Gurion Airport (LOD) with "Bird repellent RETA". Bird Strike Committee Europe 11, WP26; London, U.K.; 24-28 May, 1976: 247-267.
Abstract: As a result of observation carried out from September 1974 at the Ben Gurion

International Airport at LOD we were able to note that out of all the species of birds in the area surrounding the runway, partridges and seagulls, and to a lesser extent Lapwings, could be the greatest danger to collide with aircraft landing or taking-off.
Keywords: AT TECH LIB; BEN GURION IAP; BIRD POPULATIONS; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; GUSTATORY; ISRAEL

ABBHA Ref. #: 223
Citation: DE FUSCO, R.P. United States Air Force bird strike summary (1986-1987). Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 387-397.
Abstract: The United States Air Force recorded 5,324 bird strikes during 1986 and 1987. These strikes resulted in the loss of four aircraft, six lives, and over $260,000,000 in damages. Strike records are summarized by aircraft involved in incidents, impact location, birds involved in strikes, phases of flight, times of day and year when strikes occurred, and altitudes where strikes were reported. These data are used to focus bird strike reduction efforts by the US Air Force.
Keywords: AT TECH LIB; BSCE; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 226
Citation: DEFUSCO, R.P. Frightening devices in airfield bird control. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 93.
Abstract: The United States Air Force Bird-Aircraft Strike Hazard (BASH) Team has developed a slide-tape presentation demonstrating safe and proper use of airfield bird frightening devices. While written guidance exists on use of these devices, personnel frequently use incorrect frightening techniques. This demonstration will be distributed Air Force-wide for the purpose of standardization and training in proper airfield bird control. The presentation will be available to other agencies through DAVA, Norton AFB, CA 92409. Slide-tape presentation approximately 25 minutes. NO ATTACHED PAPER
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; SLIDE-TAPE; TRAINING; UNITED STATES

ABBHA Ref. #: 227
Citation: DEVAUX J. Propeller foreign objects damages testing. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 463-473.
Abstract: CEPr has proceeded in 1987 and 1988 at new TRANSALL composite propeller foreign object damage (FOD) qualification in its HO test rig. Those were performed under the JAR-E and Far 33 regulations spirit: therefore new testing techniques were developed by CEPr to achieve test objectives. All the tests being done have given a lot of information on the difficulties FOD testing teams might encounter during a propfan or propeller qualification. Test campaign conclusions indicate clearly that some arrangements must be introduced in the qualification process of such engines in order to find a compromise between test cost and engine reliability.

Keywords: AT TECH LIB; BSCE; ENGINEERING; ENGINES

ABBHA Ref. #: 228
Citation: DEVAUX J. Static blades under load foreign object damages testing program. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 455-462.
Abstract: To analyze the gun and projectiles main influence on Foreign Object Damage tests done on High ByPass Ratio engines, French Certification Authorities have asked CEPr to find a test mounting able to support the study. CEPr has chosen to simulate the projectile impact on a static blade placed in similar mechanical conditions as those encountered on engines. As the main study has been delayed due to surprising first results, other studies were proposed and performed with this special mounting : in particular CEPr was interested in using it for propeller composite blade development. The mounting has helped CEPr to prepare TRANSALL FOD qualification tests. Today, the initial study work is still on work, but research is mainly aimed to the definition of a realistic false bird.
Keywords: AT TECH LIB; BIRD IMPACT; BSCE; ENGINEERING; ENGINES; TESTING

ABBHA Ref. #: 229
Citation: DEVAUX, J. Propfan bird ingestion testing. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 475-484.
Abstract: To face the UDF GE 36 qualification and to understand the results obtained during the TRANSALL composite propeller blade Foreign Object Damages qualification, CEPr has developed a simple modelization of bird impact on turbo engines blades, which take the tests installation parameters uncertainty in account. Preliminary tests in comparison with our experimental results obtained both on High ByPass Ratio engines and propeller, the model is a good description on what can happen and what is the probability of it to happen. Some results obtained in propeller or propfan modules are surprising and have direct consequences on the FOD qualification methods or processes to be used for engines certification.
Keywords: AT TECH LIB; BSCE; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 230
Citation: DEVAUX, J.P. Engine bird strike tests at CEPr SACLAY test methods improvements. Bird Strike Committee Europe 19, WP 32; Madrid, Spain, 23-26 May, 1988: pp. 535-556.
Abstract: The CEPr SACLAY has developed for almost twenty years a full FOD test capacity, in order to offer at the French engine manufacturers a very high level FOD engine test rig, both for development and certification purposes. Throughout those years, a large number of development tests was performed at CEPr SACLAY TX test rig in order to improve the French regulations and to decrease the costs of full size test on a real engine by testing components under different conditions. Studies on the test methods have been achieved to avoid certification authorities as non-representative of a real bird strike: those

new technologies were applied to the HBPR engine CFM56-5 program. As the engine and material technology is improving quite rapidly CEPr SACLAY has to adapt his knowledge to the new engine concepts born a few years ago: in particular, CEPr SACLAY is developing new FOD test technology to face the challenge of firing nine to ten birds into an UHBPR engine, as required for certification. Two FOD campaigns were achieved on composite propellers: the results are very encouraging and CEPr SACLAY will be prepared to test the GE 36UDF on bird strike hazards. A video is presented to illustrate typical tests achieved on various kinds of engines.
Keywords: AT TECH LIB; BSCE; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 231
Citation: DYCK, J. The ways in which feather colours are produced and their potential for identification of feather remains. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 543-548.
Abstract: Feather colours can be produced in principally two way: 1) the deposition of pigment (dyestuffs) in the feathers; 2) the formation of light-reflecting structures in the feathers. Pigment colours are the most frequent, giving rise to black, brown, grey, yellow and red colours. Structural colours may have any hue, but are particularly important with green, blue and violets. There is great variation between species in the appearance of sections of coloured feathers under the electron microscope. Examples of this variation will be given and in relation hereto the potentials of feather colours for the identification of feather remains will be discussed.
Keywords: AT TECH LIB; BSCE; IDENTIFICATION; MICROSCOPIC; SCANNING ELECTRON

ABBHA Ref. #: 232
Citation: EFANOV, B. Increase of efficiency of the mobile bio-acoustic system for scaring birds within the airport area. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 352-357.
Abstract: (not available)
Keywords: AT TECH LIB; BIOACOUSTICS; BSCE; CONTROL METHODS

ABBHA Ref. #: 233
Citation: EIS, S. Report on permissions granted by the Wildlife Administration in 1985 in accordance with the EEC Council Directive of April 2, 1979 on the conservation of wild birds. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 217-218.

Abstract: (not available)
Keywords: AT TECH LIB; BSCE; CONSERVATION; LEGAL ISSUES

ABBHA Ref. #: 237
Citation: EUDOT, A. Management of a birdstrike data base using an IBM-PC Compatible microcomputer. Bird Strike Committee Europe 19, WP 28; Madrid, Spain, 23-26 May, 1988: pp. 421-470.
Abstract: Data processing of birdstrikes with an IBM-PC Compatible microcomputer gives quick collation of statistics on the basis of a large number of factors (bird species, aircraft types, etc.). The program described was developed with a conventional package (dBase III Plus) and can be adapted to data from any country provided that it is first translated.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 238
Citation: FERRY, V.E. The first ten years of BSCE. Bird Strike Committee Europe 14, WP 3; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: Short history of BSCE (as recorded by annual meeting reports).
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 239
Citation: FERRY, V.E. About the procedures aimed at bird strike avoidance. Bird Strike Committee Europe 14, WP 31; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The arrival of subsonic jet aircraft into the commercial fleets and their rapid increase has emphasized a potent problem taken as minor for a long time. The recent introduction of high by-pass ratio engines has greatly enlarged this problem because the frontal area of each engine increases more than three times at the same time that the quantity of air passing through the intake has almost tripled. The fleet of these 6500 aircraft, flying on the daily average of 8 hours, used all over the world, experiences a daily significant number of strikes, some times very serious, caused by birds.
Keywords: AT TECH LIB; BSCE; ENGINEERING; ENGINES; STATISTICS

ABBHA Ref. #: 247
Citation: FRITZ, J. Bird control at Geneva - airport. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.17-19.
Abstract: Geneva airport is located about 4 km away, as the crow flies, from Lake of Geneva. Numerous species of birds live in this area and watching them is always a wonder. But we must add that we very much prefer to see them as far as possible away from our 3900 meters concrete runway on which some 345 aircraft movements occur every day.

Keywords: AT TECH LIB; BSCE; CONTROL METHODS; GENEVA IAP; SWITZERLAND

ABBHA Ref. #: 248
Citation: FURBETH, H. Radio-controlled bird defense system (Steffan System). Bird Strike Committee Europe 19, WP 12; Madrid, Spain, 23-26 May, 1988: pp. 185-189.
Abstract: There are a number of measures to prevent bird strikes in air traffic. However, many bird control measures lose effectiveness quickly because of the inability to be applied immediately to the situation at hand. The Steffan system can, due to its radio-control capability, be put into operation wherever birds settle or approach. The birds do not appear to habituate as quickly since the system works only when specific dispersal is necessary.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; GAS CANNONS; REMOTE CONTROLLED

ABBHA Ref. #: 249
Citation: GAUTHREAUX, S.A. The influence of weather variables on the density of nocturnal migration in spring. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 165-181.
Abstract: Until the availability of radars that could detect birds migrating aloft at night, studies emphasizing the influence of meteorological variables on the density of nocturnal bird migration suffered because the techniques of study were either indirect (e.g., counting grounded migrants) or limited by certain weather variables. In this paper, I analyze the influence of weather variables on the nocturnal migration of passering birds in spring using multivariate statistics and review the conclusions of similar studies.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; OBSERVATION; RADAR; UNITED STATES; WEATHER

ABBHA Ref. #: 251
Citation: GAUTHREAUX, S.A., Jr. Image intensification: a new method of studying nocturnal bird migration. Bird Strike Committee Europe 14, WP 8; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: This presentation will discuss a new technique of detecting, monitoring, and quantifying the density of nocturnal bird migration. The apparatus takes advantage of the latest developments in the field of electro-optics and the system is composed of an image-intensifier (AN/TSV-5), a low-light level closed circuit television camera, a video tape deck. The image intensifier amplifies incoming light by a factor of 50,000 and has a magnification of 6.3 power. In geographical areas with sufficient ground light, the apparatus may be directed skyward to detect migrating birds flying aloft and very dimly illuminated from the ground below. In areas without ground lighting, a narrow beam 300 watt spotlight can be directed vertically to provide sufficient illumination. Initial tests indicated that the technique readily detects even small nocturnal migrants at considerable altitudes above ground level, and larger birds (e.g.

waterfowl) can be observed migrating at even greater altitudes. Analysis of the migratory movements can be made directly and immediately from the television video monitor, or analysis can be completed at later time from the video tape. A brief 16-mm film made directly from the television monitor will demonstrate the capability and utility of technique. Additional applications of this new technique will be discussed.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; ELECTRONIC MEDIA; MIGRATION; OBSERVATION

ABBHA Ref. #: 253
Citation: GLENNUNG, A.M. Birds at Copenhagen Airport. Bird Strike Committee Europe 19, WP 16; Madrid, Spain, 23-26 May, 1988: pp. 247-249.
Abstract: Discusses bird control measures and successes at Copenhagen Airport.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; COPENHAGEN IAP; DENMARK; GULLS

ABBHA Ref. #: 255
Citation: HARRISON, M.J. American initiative in bird control on a national scale. Bird Strike Committee Europe 14, WP 6; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: This paper summarized current initiatives in the United States regarding bird hazard reduction. Since our last participation with the Bird Strike Committee Europe (BSCE) at the 12th BSCE Meeting we have been active in developing a national program to reduce bird hazards on airports serving commercial air carriers. We have made significant progress in the reporting of bird strikes, airport bird control, research and development of a national organization to address the problem.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION; REPORTING; UNITED STATES

ABBHA Ref. #: 256
Citation: HARRISON, M.J. Avoiding bird strikes. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 324-325.
Abstract: (not available)
Keywords: AT TECH LIB; AVOIDANCE; BSCE; HAZARD MANAGEMENT; INFLIGHT MANUEVERING; ORGANIZATION; PREFLIGHT PLANNING

ABBHA Ref. #: 258
Citation: HEIRMAN, J. A Belgian bird strike risk map based on numbers of birds to the unit of area. Bird Strike Committee Europe 10, WP 11; Stockholm, Sweden 9-13 June, 1975: pp. 178-183.

Abstract: At a small meeting of the Bird Movement Working Group on 11/12th of December 1974 in Porz-Wahn, Belgian and German representatives agreed to draw up a simple European Birstrike Risk Map with risk indications. This map should be based on objective criteria, to allow comparisons among countries.
Keywords: AERODROME DESIGN; AT TECH LIB; AVOIDANCE; BELGIUM; BSCE; MAPS

ABBHA Ref. #: 259
Citation: HEIRMAN, J. Further lapwing investigations on Beauvechain airport. Bird Strike Committee Europe 10, WP 10; Stockholm, Sweden 9-13 June, 1975: pp. 173-177.
Abstract: Investigations included the establishment of long grass aisles at both sides of the main runway and a weekly record of the distribution of lapwings. Virtually no birds were seen in the treated part. It was noted that lapwings were seen on farmland and not on grass and that they seem to prefer some plots more than other ones. Additional treatments and observations were performed to determine the effectiveness of the long grass. In itself, long grass is not sufficient to remove all lapwings from an area since most of them occur on tillage.
Keywords: AT TECH LIB; BELGIUM; BIRD POPULATIONS; BSCE; CONTROL METHODS; HABITAT MODIFICATION; LAPWINGS; LONG GRASS

ABBHA Ref. #: 262
Citation: HERZIG, M. Approaches to protect endangered areas on airports from bird population by Xironet, Bird protection netting. Bird Strike Committee Europe 13, WP 15; Bern, Switzerland; 29 May-2 June, 1978: pp. 223-227.
Abstract: The purpose of this presentation is to put forward some ideas on the use and application of Xironet nettings against birds on airports.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; EXCLUSION

ABBHA Ref. #: 263
Citation: HILD, J. New procedures for publication of bird warnings and forecasts. Bird Strike Committee Europe 14, WP 14; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: This paper discusses the development of a birdstrike-risk- forecast system that provides a basis for "birdtams." These birdtams are published only at intensities of 6-8 and only on the basis of radar observations. The system is proposed as a standard for NATO forces.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; FORECASTING; HAZARD MANAGEMENT; RADAR; STANDARDS; WARNING SYSTEMS

ABBHA Ref. #: 264
Citation: HILD, J. Birdstrikes, German Air Force 1974-1975. Bird Strike Committee Europe 11, WP12; London, U.K.; 24-28 May, 1976: pp. 176-178.

Abstract: Discusses German Air Force birdstrike statistics for 1974-1975.
Keywords: ARTIFICIAL BIRDS; AT TECH LIB; BSCE; GERMANY; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 265
Citation: HILD, J. Birdstrikes on helicopters in German Air Force. Bird Strike Committee Europe 13, WP 4; Bern, Switzerland; 29 May-2 June, 1978: pp. 65-71.
Abstract: Some years ago, birdstrikes on helicopters were rare; but, with introduction of the new generation of helicopters, such incidents and accidents increased. The data shows that, for a helicopter, a birdstrike is still an uncalculated risk. Figure 2 shows the engine number 2 of a CH53 damaged by a pigeon. Figure 3 shows the cockpit of an Alouette II broken by a pigeon. Analysis of the distribution of helicopter-birdstrikes over the months suggests there are not so remarkable picks as on jets. The single pick in the summertime could not be declared by the higher frequency of flights but movement periods are not to analyze. The flight stages on which strikes happen show an expected maximum up to 200 ft (AGL). The bird species involved are gulls, crows, and buzzards. Figure 5 shows the costs of damages. Perhaps it is interesting to note that mostly the rotor and engines were damaged. The real birdstrike danger for the helicopters has yet to be seen.
Keywords: AT TECH LIB; BSCE; ENGINEERING; HAZARD MANAGEMENT; HELICOPTER; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 266
Citation: HILD, J. Growth prohibiting substances and effects on grassland areas. Bird Strike Committee Europe 11, WP 13; London, U.K.; 24-28 May, 1976: pp. 179-181.
Abstract: Discusses bird control measures with respect to controlling vegetation growth.
Keywords: AT TECH LIB; ATTRACTANTS; BODY DENSITY/WEIGHT; BSCE; CONTROL METHODS; HABITAT MODIFICATION; HAZARD MANAGEMENT; VEGETATIVE

ABBHA Ref. #: 267
Citation: HILD, J. Birdstrike - risk - forecast. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: 93-94.
Abstract: In the German Air Force, three types of warning or information exist: Notam/birdtam, bird movement forecast, and birdstrike risk forecast.
Keywords: AT TECH LIB; AVOIDANCE; BIRDTAM; BSCE; FORECASTING; MAPS; WARNING SYSTEMS

ABBHA Ref. #: 268
Citation: HILD, J. About effects of agricultural and grassland use on airfields - reducing bird

populations. Bird Strike Committee Europe 13, WP 14; Bern, Switzerland; 29 May-2 June, 1978: pp. 212-222.
Abstract: (not available)
Keywords: AGRICULTURE; AT TECH LIB; ATTRACTANTS; BSCE; CONTROL METHODS; LEGAL ISSUES; VEGETATIVE

ABBHA Ref. #: 269
Citation: HILD, J. Large scale weather situations and influence on bird migration during seasons of the year. Bird Strike Committee Europe 13, WP 17; Bern, Switzerland; 29 May-2 June, 1978: pp. 230-247.
Abstract: During the last years Denmark, Sweden and Switzerland obtained information about relationships between weather parameters and bird migration. They developed special models with the aim to forecast birdstrike-risk and bird movements over medium and longer periods.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; FORECASTING; HAZARD MANAGEMENT; MAPS; MIGRATION

ABBHA Ref. #: 270
Citation: HILD, J. Biophenological observation and information service in German Air Force, a help for birdstrike-risk forecast. Bird Strike Committee Europe 13, WP 20; Bern, Switzerland; 29 May-2 June, 1978: pp. 263-270.
Abstract: Strong correlation exists between the appearance of birds in a region and the availability of crops for food.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; FORECASTING; GERMANY; HAZARD MANAGEMENT; MAPS; MILITARY AVIATION

ABBHA Ref. #: 271
Citation: HILD, J. A new problem on airfields induced by planting trees and shrubs. Bird Strike Committee Europe 11, WP 14; London, U.K.; 24-28 May, 1976: 182-184.
Abstract: Describes airfield bird attractants related to woody vegetative growth
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; HABITAT MODIFICATION; VEGETATIVE

ABBHA Ref. #: 272
Citation: HILD, J. Agenda for meeting bird movement working group. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 111-112.Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 273

Citation: HILD, J. Bird strikes in German Air Force 1968-1976. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 144-146.
Abstract: During the period 1968-1976, the GAF had a decreasing number of birdstrikes until 1971, but a highly increasing number 1976 and moreover 1977. This paper provides a breakdown of the statistics and suggests factors of influence.
Keywords: AT TECH LIB; BSCE; GERMANY; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 274
Citation: HILD, J. Fundamental experiences and suggestions for biotope-management-procedures on international airports. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 239-244.
Abstract: In order to minimize birdstrike-risk, Lufthansa German Airlines started a special ecological advisory program especially for airports in Asia, Africa, Middle and South-America serviced by DLH. This report deals with the result in different types of birdstrike problems. Before this could be done it was necessary to study the special ecological situation in these areas, for only on the basis of such ecological investigation and consideration will it be possible to solve local bird hazard problems.
Keywords: AT TECH LIB; ATTRACTANTS; BIRD POPULATIONS; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT

ABBHA Ref. #: 275
Citation: HILD, J. First ICAO bird hazard reduction workshop Mexico-City, 5-9 October 1987. Bird Strike Committee Europe 19, WP 35; Madrid, Spain, 23-26 May, 1988: pp. 569-570.
Abstract: Discusses ICAO workshop focusing on Central and South America birdstrike issues.
Keywords: AT TECH LIB; BSCE; CENTRAL/SOUTH AMERICA; CIVIL AVIATION; HAZARD MANAGEMENT; ICAO; ORGANIZATION

ABBHA Ref. #: 276
Citation: HOLM-JOENSEN, A. European bird hazard map. Bird Strike Committee Europe 10, WP 23; Stockholm, Sweden 9-13 June, 1975: 217-218.
Abstract: Two maps were prepared as the Danish contribution to the joint European bird hazard map discussed.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; MAPS; STATISTICS

ABBHA Ref. #: 277
Citation: HOLM-JOENSEN, A. The use of waterfowl count data in bird-strike work in

Denmark. Bird Strike Committee Europe 10, WP 32; Stockholm, Sweden, 9-13 June, 1975: 242-244.
Abstract: During the seven year period 1968-1974, 321 bird-strikes involving Danish military aircraft operating in Denmark were registered. In 153 (48%) of the cases the species of bird was determined. In 90 bird-strikes the aircraft was damaged, and in 38 (42%) of these cases the bird was determined.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 278
Citation: HORTON N. Advising on aerodrome bird control: Some requirements and complications. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 321-325.
Abstract: Aerodrome advisors have a responsibility to the area they are advising and must be qualified, experienced and conversant with current research and development. This paper illustrates these requirements and gives examples of misconceptions arising out of apparently sound advice.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; SURVEYS

ABBHA Ref. #: 279
Citation: HORTON, N. Distinguishing between ducks, geese and swans by means of feather micro-biometrics. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 327-337.
Abstract: Use of a comparison microscope allows relatively easy separation of ducks from geese from swan because of easily seen differences are difficult to detect barbule features. However, such differences are difficult to detect using a single microscope and a simple biometric method is described which separates these groups using three measurements with an accuracy of 88%. Such a method may also be of use in breaking down the weight ranges of other Orders and examples are discussed.
Keywords: AT TECH LIB; BSCE; FEATHERS; IDENTIFICATION; MICROSCOPIC

ABBHA Ref. #: 280
Citation: HOUGHTON, E.W. A radar study of wild duck. Bird Strike Committee Europe 10, WP 4; Stockholm, Sweden 9-13 June, 1975: pp. 38-82.
Abstract: This is a study of the mallard. Flight and echo data were obtained by means of a high-resolution auto-following pulse radar from wild birds released from the ground. A map of the operational zone with X-Y tracks and height and velocity diagrams are given for the best flights. Static radar echoing areas are compared with dynamic echoing areas obtained from the results of a flight. Bird activity modulation waveforms and spectral diagrams have been analyzed for some

of the longer flights. Released mallard flight and echo results are compared with results taken on "wild ducks" tracked at night during the peak of the autumn migration. Correlation methods are introduced for the first time in analyzing bird echo waveforms.
Keywords: AT TECH LIB; BSCE; DETECTION; DUCK; MALLARD; RADAR

ABBHA Ref. #: 281
Citation: HUNT, F.R. Bird density and the birdstrike risk. Bird Strike Committee Europe 11, WP 15; London, U.K.; 24-28 May, 1976: pp. 185.
Abstract: Not available
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; MAPS

ABBHA Ref. #: 282
Citation: HUNT, F.R. Automatic warning of hazardous bird conditions. Bird Strike Committee Europe 10, WP 33; Stockholm, Sweden 9-13 June, 1975: pp. 245-253.
Abstract: The vertical automatic detection system was designed to provide warning of large scale nocturnal bird migrations composed of mainly passerine species. This paper discusses the construction and improvements on the equipment.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 284
Citation: JACOBS, T. Experiment of presentation of actual bird intensity in a "0 to 8" scale on a display unit. Bird Strike Committee Europe 11, WP10; London, U.K.; 24-28 May, 1976: pp. 166-170.
Abstract: The Belgium Air Force has developed a means of electronically counting the number of birds, as represented by their radar echoes, in a particular radar sector. The density is converted into a relative (0-8) intensity and displayed on a video screen. This information is broadcast to interested flyers which can undertake precautionary measures or avoid dense concentrations of birds.
Keywords: AT TECH LIB; AVOIDANCE; BELGIUM; BSCE; MILITARY AVIATION; WARNING SYSTEMS

ABBHA Ref. #: 286
Citation: JACOBY, V.E. Analysis of bird collision with planes and possibility of utilization of the bird strike prevention measures. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 75-82.
Abstract: Usually after serious birdstrikes, measures are undertaken to prevent similar cases in future. Careful analysis of the bird strike, including bird behavior and various ecological factors, suggests the reasons that birds conflict with the aircraft's route and consider various measures to

prevent repetition of such incidents. Examples of collision of landing plane with starling flocks, flying up from land, and collision of plane at high altitude 3000 m with swift show impossibility bird strike prevention without timely revelation of birds. Some approaches for solution of this problem are presented.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; MAPS; TESTING

ABBHA Ref. #: 287
Citation: JACOBY, V.E. Radar and visual observations of sea duck's mass spring migration in the west Estonia and the transmission of BIRDTAM from Tallin Airport to Helsinki-Vantaa Airport. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 253-254.
Abstract: Radar and visual observation of the mass spring migration of three species of sea ducks show that about 300,000 of these birds, in the period of May 15-30, fly through West Estonia by these routes: along the West Estonian coast and toward the northeast, crossing the land by using only tail winds and high altitudes. There are transmissions of BIRDTAM between the Tallin and Helsinki-Vantaa Airports. In the International Baltic Birds Conference-5 there are recommendations to spread BIRDTAM to include other countries as well as other bird species.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; ESTONIA; EUROPE; MIGRATION; WARNING SYSTEMS

ABBHA Ref. #: 288
Citation: JACOBY, V.E. Is it necessary to destroy birds on aerodromes? Bird Strike Committee Europe 14, WP 26; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The problems of bird destruction on aerodromes appears usually after each serious bird strike. Some aerodrome specialists consider the bird destruction on aerodromes to be the fastest and most effective way of bird strike prevention. Hundreds, thousands, even hundred thousands of birds are known to be destroyed with the help of shooting, trapping, and chemical substances in the area of the aerodromes. But as far as I know - there is no reliable information about the reduction of bird numbers as a result of such destruction or trapping ended by longterm decrease of birdstrikes.
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; DEPREDATION; SHOOTING; TRAPPING

ABBHA Ref. #: 289
Citation: JACOBY, V.E. Plane as a deterrent and attractant. Bird Strike Committee Europe 12, WP 15; Paris, France; 20-28 October, 1977: pp. 199-204.
Abstract: This paper discusses a variety of subjects relating to the control of bird behavior.
Keywords: AIRCRAFT APPEARANCE; AT TECH LIB; ATTRACTANTS; BSCE; LIGHTING; LIGHTS; RUSSIA

ABBHA Ref. #: 290
Citation: JACOBY, V.E. Ethological aspects of plane's protection against birds. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 128-132.
Abstract: The birds have more chances to see a plane and to avoid collision than a pilot. The birds are training to extrapolate the direction and speed of a plane flight which exceeds more than two times the speed of birds. This explains why: (1) Migrating birds and local young birds fall victims to planes; (2) Destruction of birds on an aerodrome doesn't decrease the bird hazard to aircraft; (3) The number of bird strikes increases relatively in the night, in clouds, and when birds flight direction is changed; (4) A plane from an indifferent stimulus is becoming a repellent and some times an attractant; (5) The means to increase the distance of a plane discovery (landing and flashing lights, laser) don't always frighten birds away from a plane because a) birds don't know that a plane represents a danger, b) birds sit on runway or fly back to a plane, c) the landing lights in the night actually attract birds, d) birds attention is distracted when searching for food, e) young birds attack unproportionally large prey, f) the flocks of starlings and snipes react by mistaking a plane as a bird of prey. Taking into consideration all circumstances favouring conflict situations, it is possible to outline concrete means, place and time of their application so they will not be repeated in the future.
Keywords: AT TECH LIB; BEHAVIOR; BIRD POPULATIONS; BSCE; TRAPPING

ABBHA Ref. #: 291
Citation: JACOBY, V.E. Migrating birds and their danger to aeroplanes. Bird Strike Committee Europe 11, WP 5; London, U.K.; 24-28 May, 1976: pp. 137-139.
Abstract: The analysis of more than 1700 birdstrikes in the USSR civil aviation has show the peaks during the spring and autumn migrations and in the summer. Making the airfield ecologically unattractive is more effective in reducing birdstrikes than killing or catching birds. It is possible to forecast mass bird migrations in connection with meterological and other conditions.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; FORECASTING; MIGRATION

ABBHA Ref. #: 293
Citation: KARLSSON, J. Surveys of bird concentration areas as a tool in aviation safety work with an example from Sweden. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 190-196.
Abstract: To facilitate the avoidance of birds, great efforts have been made to map bird concentration areas. The bird density, when measured on a country-wide scale, varies considerably. An area with a certain amount of birds may be considered a "concentration area" in one region, but not another. This discrepancy makes it difficult to lay down international rules for designation of bird concentration areas.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT;

SURVEYS; UNITED STATES
ABBHA Ref. #: 294
Citation: KARLSSON, J. Bird strikes in Sweden, 1967-1974. Bird Strike Committee Europe 10, WP 28; Stockholm, Sweden, 9-13 June, 1975: pp. 226-241.
Abstract: Data on bird strikes with Swedish military and civil aircraft has been systematically collected for many years, and it is of some fundamental aspects. This report presents military bird strikes for the years 1967-1974 and collisions with civil aircraft registered in Sweden for the period 1968-1974.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 295
Citation: KEIL, W. Work instructions for the birdstrike representatives of the commercial airports in the Federal Republic of Germany. Bird Strike Committee Europe 14, WP 15; The Hague, Netherlands; 22-26 October, 1979.
Abstract: On 13th February 1974, the regulations for the prevention of birdstrikes in air traffic were published by the Federal Ministry of Transport, which were based on the requirements made by commercial airports serving airline traffic. An essential requirement of these directions is the appointment of a birdstrike representative by the airport operator to supervise the measures to be taken. This paper also deals with the biotope expertise, and individual measures to be taken on the airport. As well as this, the representative should receive skilled training and also have the possibility of taking part in suitable advanced courses.
Keywords: AT TECH LIB; BSCE; GERMANY; HAZARD MANAGEMENT; LEGAL ISSUES; REGULATIONS; TRAINING

ABBHA Ref. #: 296
Citation: KEIL, W. Experiences with the bird strike regulations of the Federal Ministry of Transport since 1974. Bird Strike Committee Europe 14, WP 16; The Hague, Netherlands; 22-26 October, 1979.
Abstract: In the five years since the publication of the first birdstrike regulations, the experience could be classified as good. The regulations foster cooperation and progress at reducing birdstrikes.
Keywords: AT TECH LIB; BSCE; LEGAL ISSUES; REGULATIONS; STANDARDS

ABBHA Ref. #: 297
Citation: KLAVER A. Influence of bird-shooting on the relation: numbers present/incidents. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 31-44.
Abstract: Recent BSCE meetings have underlined or left open the possibility of shooting birds

in bird control operations as an aid in the range of making the airport area unattractive to birds or dispersing birds from the airport. This is also reflected by the action with respect to the European bird directives whereby the shooting of (protected) birds in relation to air traffic safety remains allowed.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; DEPREDATION; SHOOTING

ABBHA Ref. #: 298
Citation: KUCKUCK, H. Bird strike tests with radomes and windscreens of the HFB 320 Hansa Jet and Transall C 160. Bird Strike Committee Europe 13, WP 15; Bern, Switzerland; 29 May-2 June, 1978: pp. 346-355.
Abstract: This report contains a summary of bird strike tests which were carried out on different aircraft in accordance with requirements. All tests which are described below were carried out using a standard 1.844kg (4-lb) bird shot from a compressed air gun whereby it was possible to reach a velocity of between 478-612 km/h.
Keywords: AIRCRAFT SYSTEM; AIRFRAME; AT TECH LIB; BSCE; ENGINEERING; TRANSPARENCIES

ABBHA Ref. #: 300
Citation: LARSSON, B. Height distribution of bird movements in southern Sweden measured by radar Sept-Oct 1976. Bird Strike Committee Europe 11, WP 7; London, U.K.; 24-28 May, 1976: pp. 143-150.
Abstract: Surveillance radars have been used for several years to detect and define areas of especially high concentrations of migrating birds over southern Sweden. Another radar was used to determine the height distribution of migrating birds. With the wind finding equipment, it is possible to measure the height of a bird echo with an accuracy of +/- 50 meters within a distance of 15 km. At present it is not possible to determine the bird species.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR; SWEDEN

ABBHA Ref. #: 301
Citation: LARSSON, B. Continuous work with the migratory bird forecasting system presented at BSCE 12/WWC3. Bird Strike Committee Europe 13, WP 16; Bern, Switzerland; 29 May-2 June, 1978: pp. 228-229.
Abstract: As the results from the introduction of bird warning system in 1977 were rather good we are going to run another experimental period this year. If the results still are good this forecasting model is going to used in a permanent bird warning system in the future. The model for the sea-flying birds was not good enough so we are going to change it using more representative counting collected at the east coast of Sweden (instead of counting made at Falsterbo used in the first model).
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; FORECASTING;

MIGRATION; SWEDEN; WARNING SYSTEMS

ABBHA Ref. #: 302
Citation: LATY, M. Experiments taking place: tests for the frightening away of birds by means of a laser gun. Bird Strike Committee Europe 20, WP 45; Helsinki, Finland, 21-25 May, 1990: pp. 527-531.
Abstract: The object of the exercise is to prevent birds from staying in one particular place. For this, the impact of a laser beam is used to provoke the flight of the birds. Being dazzled, the bird can no longer locate the source of disturbance and will move away to a safe distance. Because of the many mitigating variables, it still must be determined as to whether lasers can be considered a possible means of scaring birds from the airfield.
Keywords: AIRCRAFT APPEARANCE; AT TECH LIB; BSCE; CONTROL METHODS; LASERS

ABBHA Ref. #: 303
Citation: LATY, M. Current trials of RETA bird repellent. Bird Strike Committee Europe 13, WP 28; Bern, Switzerland; 29 May-2 June, 1978: pp. (In French.)
Abstract: Discusses the use of synergized aluminum ammonium sulfate (tradename RETA) on the Marseille-Marignane aerodrome
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; MARSEILLE-MARIGNANE IAP

ABBHA Ref. #: 304
Citation: LATY, M. The blackheaded gulls are assigned their quarters on airfield. Bird Strike Committee Europe 10, WP 13; Stockholm, Sweden 9-13 June, 1975: pp. 188-191.
Abstract: In French
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; GULLS; HABITAT MODIFICATION; HAZARD MANAGEMENT

ABBHA Ref. #: 305
Citation: LATY, M. Geographical influence on flights of migratory birds in Southeast of France. Bird Strike Committee Europe 14, WP 7; The Hague, Netherlands; 22-26 October, 1979. (In French.) Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; FRANCE; MIGRATION

ABBHA Ref. #: 306
Citation: LAVAU, C. Global statistical approach to the birdstrike. Bird Strike Committee Europe 10, WP 19; Stockholm, Sweden 9-13 June, 1975: pp. 196-212.

Abstract: The paper has two purposes: to deal with a general model of bird strike and to bring up some statistical results from Bird Strike Report forms.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; MATHEMATICAL MODELS; STATISTICS

ABBHA Ref. #: 307
Citation: LESHEM, Y. The development of a bird migration real time warning system for the Israeli air force utilizing ground observers, radar, motorized glider and drones; and a preliminary report on the use of transmitters received by satellite as a new warning method. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.93-102.
Abstract: In 1985-88 a joint research was carried out by the Israel Air Force (IAF), the Israel Raptor Information Center (IRIC), Tel Aviv University and the Ministry of Science and Technology, with the purpose of precisely identifying the central migration routes of birds soaring over Israel, their flight elevation, dates of their arrival, and the effect of climatic changes on the character of the migrations.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; ISRAEL; MIGRATION; MILITARY AVIATION; OBSERVATION

ABBHA Ref. #: 308
Citation: LESHEM, Y. Following soaring bird migration from the ground, motorized glider and a radar at a junction of three continents. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 193-214.
Abstract: The geographical position of Israel at the junction of three continents is responsible for its importance as a focal point for the largest concentrations of soaring birds (raptors, storks, and pelicans) during spring and autumn migrations. The purpose of the research work conducted in Israel was to map the migration routes of a number of species, to learn about the flight altitudes and velocities and to study and analyze the extent to which the above variables, as well as the routes themselves, are influenced by weather conditions, time of day, and time of year. Three data-gathering systems were employed in conjunction: a network for ground observation crews, a motorized glider and two radar systems--one at Ben Gurion International Airport and the second a meteorological radar system. The data thus gathered produced a clear picture of the geographical positions of the migration routes, the altitudes, velocities, and daily progress of the migration, and its relation to changes in weather conditions. The Israel Air Force sustained heavy damage to its aircraft as a result of collisions with migration soaring birds. Recognizing this, it provided the financing for this research. The data collected and analyzed were submitted to the IAF, which ceased flying at the times, routes, and heights at which migration occurs. Consequently, no planes have been destroyed or seriously damaged over the past five years (1983-1987).
Keywords: ASIA AND MIDDLE EAST; AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; ISRAEL; MIGRATION; RADAR; VISUAL

ABBHA Ref. #: 309
Citation: LIND, H. The identification of bird remains as part of the bird strike reporting procedure. Bird Strike Committee Europe 13, WP 3; Bern, Switzerland; 29 May-2 June, 1978: pp. 60-64.
Abstract: Discusses the process for identifying birdstrike remains in Denmark
Keywords: AT TECH LIB; BSCE; DENMARK; IDENTIFICATION; STATISTICS

ABBHA Ref. #: 310
Citation: LIND, H. Attempts to control the breeding population of the Herring Gull (Larus argentatus) near Copenhagen airport. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 190-196.
Abstract: This paper discusses the control of the breeding population of Herring Gulls to reduce the population of that species at an airfield.
Keywords: AT TECH LIB; BEHAVIOR; BIRD POPULATIONS; BSCE; CONTROL METHODS; EGGS/NESTS; GULLS

ABBHA Ref. #: 311
Citation: LIND, H. The problem of Black-Headed Gulls (Larus ridibundus) breeding near airports. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 209-216.
Abstract: Experiments with color markings of Black-headed Gulls breeding on the island of Saltholm 5 km east of Copenhagen Airport show that (1) the locally breeding gulls frequently visit the airport during the breeding season, (2) the radius of the feeding range is about 20km (sometimes perhaps 40 km), (3) the scarcity of alternative feeding grounds within short distances of the colonies makes the airport a valuable feeding place, and (4) adults as well as juveniles tend to leave the breeding range soon after the end of the breeding season. It seems likely that an increase of the breeding population during the last three years has caused a corresponding increase during the breeding season in the number of Black-headed Gulls occurring in the airport. The effect of population control in the risk of strikes with Black-headed Gulls in the airport is discussed.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DENMARK; GULLS; MARKING/BANDING; RESIDENT

ABBHA Ref. #: 312
Citation: MARCAL, G. Documents de travail. Propositions de recommendations. Bird Strike Committee Europe 13, WP 31; Bern, Switzerland; 29 May-2 June, 1978: pp. 320-336. (In French.)

Abstract: Discusses three proposals: (1) that the aerodrome fire control units be responsible for bird control; (2) bird strikes should be classified as to the degree of danger to aircraft; (3) airports should be classified according to the degree of risk to aircraft.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; LEGAL ISSUES; STATISTICS

ABBHA Ref. #: 313
Citation: MARCAL, G. Bird risk and air safety. Bird Strike Committee Europe 14, WP 29; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: Proposals and recommendations of Air France
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT

ABBHA Ref. #: 314
Citation: MAROON, J. Bird strike problems of the projected airport Munched II. Bird Strike Committee Europe 11, WP 27; London, U.K.; 24-28 May, 1976: pp. 269-272.
Abstract: This paper discusses the ornithological issues inherent in establishing a major jet airport at a new site.
Keywords: AERODROME DESIGN; AT TECH LIB; BSCE; GERMANY; LEGAL ISSUES; SITING

ABBHA Ref. #: 316
Citation: MERRITT, R.L. Bird strikes to U.S. Air Force aircraft: 1988-1989. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 511-518.
Abstract: Each year the U.S. Air Force suffers significant aircraft damage due to bird strikes. From 1988 to 1989, 6,444 strikes have been reported to the Bird Air Strike Hazard (BASH) Team. During this period, two aircraft were destroyed resulting in no fatalities and an average annual cost of over 20 million dollars. The following are summaries of the two Class A mishaps in the past two years.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 317
Citation: MORERA, P. Evaluation of bird populations at Spanish airports: outline and results. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 291-309.
Abstract: The general context of the bird problem at Spanish airports is described. The airports are then classified according to their bird populations, and the methodology and the result of the various studies are explained. The primary conclusions include: 1) the distinction between four groups of airports-Inl and; Cantabria and Galicia; Mediterranean; and the Canary Islands-, 2) the

main problems arise from wintering birds, 3) agricultural land use and rubbish dumps are two negative factors which affect the majority of the airports and 4) these studies are extremely valuable tools for establishing adequate corrective measures.
Keywords: AERODROME SURVEYS; AT TECH LIB; BSCE; EUROPE; HAZARD MANAGEMENT; SPAIN; SURVEYS

ABBHA Ref. #: 318
Citation: MOSSLER, K. Laser and symbolic light on birds in order to prevent bird/aircraft collisions. Bird Strike Committee Europe 14, WP 17; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: This report will deal with the possibility of reducing bird strikes by means of using laser and ordinary light. First previous research on this subject is related, and then experiments with symbolic light of different colors and laser on gulls in nature are discussed in detail. In the experiments with light, the gulls were found to react with fear to a flapping movement in the horizontal plane. The flight readiness as a function of color was greatest when blue, red and white were used, while green and yellow were less efficient in frightening the gulls. The experiments with a laser (a helium-neon one of 30 mW) on the gulls showed that the birds reacted to the beam with an avoidance behavior.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; CONTROL METHODS; GULLS; LASERS; SENSORY; VISUAL

ABBHA Ref. #: 322
Citation: NECHVAL, N.A. On predicting accidents and serious incidents to civil aircraft due to bird strike in a future time period from known observation. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp 147-155.
Abstract: The problem of predicting the number of accidents and serious incidents to civil aircraft due to bird strikes during a future time period with the specified number of aircraft movements, knowing accidents and serious incidents during time intervals (with the known numbers of aircraft movements, respectively) in the past, is considered. It is known that in many familiar situations, the predictive estimators based on the principles of maximum likelihood and of minimum variance unbiased estimation are uniformly worst among all predictive estimators which one would consider using. In this paper, we suggest (as a particular possibility) the use of uniformly undominated. It is assumed that accidents and serious incidents to civil aircraft due to bird strikes follow a binomial distribution. An illustrative example is presented.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 323
Citation: NEVEUX, C. Resistance of windscreen to bird impact during cold weather. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 349-351.

Abstract: A study on the behavior of glass windscreen in case of bird impact, when there is no warming and cold weather, shows that there is no deterioration in bird impact resistance for glass windscreen with thin interlayers.
Keywords: AT TECH LIB; BSCE; ENGINEERING; GLASS; MATERIALS; TRANSPARENCIES

ABBHA Ref. #: 324
Citation: PERREMANS, K. Rachidial structures of feathers and their potential use for determination purpose. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 45.
Abstract: A first approach in solving the problem of collisions between birds and aircrafts is the identification of the bird species involved.
Keywords: AT TECH LIB; BSCE; FEATHERS; IDENTIFICATION; MICROSCOPIC

ABBHA Ref. #: 325
Citation: PERREMANS, K. External surface structure of rachis, rami and rachidial barbules of feathers and their potential for determination purposes. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 21-30.
Abstract: Microstructures were discovered by SEM analysis of the surface of the rachis, rami and rachidial barbules of bird feathers. These appear to be intraspecifically stable. Up to now 108 bird species belonging to 54 families and 17 orders were studied. Many structures were found, appearing in numerous combinations. These data will be used for determination purposes and will eventually elucidate some classification problems in the class of Aves.
Keywords: AT TECH LIB; BSCE; ELECTRON MICROSCOPY; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 326
Citation: PETERSEN, N.E. HWH airport lawn mower type HS-2 triplex and experience gathered at Aalborg airport, Denmark. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 255-261.
Abstract: For years, Danish airports and airbases have been trying to find more efficient ways to maintain their vast grass areas. Aalborg Airport, Denmark, has now found a very satisfactory solution to this problem. This report was written in order to inform other airports and airbases of the method, and it is our hope that it may serve as a source of inspiration or even as the basis for a decision to introduce the novel method.
Keywords: AALBORG IAP; AT TECH LIB; BSCE; CONTROL METHODS; DENMARK; HABITAT MODIFICATION; HAZARD MANAGEMENT

ABBHA Ref. #: 327
Citation: RENOUX, D. Communications to and from the pilot. Bird Strike Committee Europe

18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 123-126.
Abstract: "Communication" is the exchange of information. Concerning bird hazard in aviation, these informations can be written on paper or...radio waves. In both cases, pilots send or receive them.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; NOTIFICATION

ABBHA Ref. #: 328
Citation: RICHARDS, P.F. Operational control of airspeed for minimizing bird impact hazard. Bird Strike Committee Europe 13, WP 21; Bern, Switzerland; 29 May-2 June, 1978: pp. 272-275.
Abstract: In considering the operational control of airspeed for minimizing bird impact this paper deals with the structural aspects only, although it will be clear that any measures taken in these respects only will probably help to reduce engine damage. For a number of years the British Civil Airworthiness Requirements have required that transport aircraft structure at the highest forward airspeed likely to be achieved up to 8, 000 ft. altitude during normal operation.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; ENGINEERING; ENROUTE MANUEVERING

ABBHA Ref. #: 331
Citation: RILEY, M. Preliminary laboratory and field trials of the chemical repellent synergised ammonium aluminum sulfate on rodents and principally birds. Bird Strike Committee Europe 13, WP 25; Bern, Switzerland; 29 May-2 June, 1978: pp. 276-282.
Abstract: This paper discusses the application of SAAS on agricultural crops with extrapolation to aerodrome environs.
Keywords: AGRICULTURE; AT TECH LIB; ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS

ABBHA Ref. #: 333
Citation: ROED, A. Bird strike problem from air technical point of view. Bird Strike Committee Europe 10, WP 34; Stockholm, Sweden 9-13 June, 1975: pp. 254-257.
Abstract: Discusses issues with developing birdstrike tolerant aircraft.
Keywords: AT TECH LIB; BSCE; ENGINEERING; MATERIALS

ABBHA Ref. #: 334
Citation: ROGACHYOV, A.I. Bioacoustic scaring of birds in airports. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 73-74.
Abstract: First results are presented for broad implementation of bioacoustic bird scaring device "Berkut" in civil airports. A list of scaring signals used in the airports is given. The prospects of new scaring signals obtaining are also described.
Keywords: AT TECH LIB; BIOACOUSTICS; BSCE; CONTROL METHODS

ABBHA Ref. #: 335
Citation: RUIZ, J. Present state of bird strike hazards at Spanish Airports. Index. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 313-328.
Abstract: The present state of strike hazards at Spanish airports is analyzed, focusing on the following aspects: (i) administrative organization, (ii) the gathering of information, (iii) measures adopted in different times and (iv) future trends. All aspects of strike hazards are dealt with by the Laboratory Services of the Spanish Airports Authority, working closely with the 38 airports and military bases open to civil air traffic. Their information sources are ICAO questionnaires, maintenance technician's reports and general data from airport staff. The work of the Laboratory Services is aimed at increasing airport staff awareness of the problem. The measures aimed at reducing strike hazards are separated into three phases: (i) emergency measures, including falconry, detonating cartridges, gas explosions, and acoustic alarm signals, (ii) short and medium-term measures aimed at substituting or optimizing previous emergency measures and finally (iii) long-term measures to be taken in the future are analyzed, distinguishing those to be carried out within airport compounds from those in external areas.
Keywords: AIRFIELD PROCEDURES; ASIA AND MIDDLE EAST; AT TECH LIB; AVOIDANCE; BSCE; CONTROL METHODS; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 336
Citation: SALTER, A. Analysis of military birdstrike data - 1973. Bird Strike Committee Europe 10, WP 58; Stockholm, Sweden 9-13 June, 1975: pp. 118-156.
Abstract: Presents data analysis of participating States' military aircraft operating in Europe.
Keywords: AT TECH LIB; BSCE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 337
Citation: SANCHE, J. The operational use of bird strike information from a pilot's view. Bird Strike Committee Europe 13, WP 38; Bern, Switzerland; 29 May-2 June, 1978: pp. 326-328.
Abstract: Discusses the informational and technical issues related to flying with the birds. Opines that the development of better bird scaring methods is the most effective means of minimizing bird strike hazards.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; ENROUTE MANUEVERING; FORECASTING; PREFLIGHT PLANNING

ABBHA Ref. #: 339
Citation: SCHWARZENBACH, T. The bird strike reporting system in SWISSAIR. Bird Strike Committee Europe 13, WP 6; Bern, Switzerland; 29 May-2 June, 1978: pp.77-83.
Abstract: The bird strike reporting system in the Swissair is described, emphasizing information under a separate code in the computerized maintenance control system (MCS).
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; REPORTING

ABBHA Ref. #: 340
Citation: SCORER, T. Prevention is better than legal liability. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 491-502.
Abstract: The terms of reference of BSCE are necessarily predicated on the detection and prevention of the bird hazard to aircraft. In the search for increased safety in the air and on the ground considerable effort and expense is involved each year by airport authorities, aircraft manufacturers, aircraft operators and others in attempting to eliminate bird strikes. The effort and expense involved in bird control can also be justified when the safety objective has not been achieved and a bird strike takes place. When this occurs, an airport operator may face a hazard of a different type in the form of a claim for compensation for death, injury or damage to property. While there have fortunately been comparatively few legal liability cases arising from bird strikes, the consequences of such a claim can have serious financial consequences to an airport operator and his insurers. This paper addresses those legal liabilities and how they may be avoided by the adoption of effective, efficient and well documented bird control procedures.
Keywords: AT TECH LIB; BSCE; LEGAL ISSUES; LIABILITY; MISHAP INVESTIGATION

ABBHA Ref. #: 341
Citation: SEUBERT, J.L. Reducing gull hazard to aviation by controlling nesting populations. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990.
Abstract: Gull nesting colonies established adjacent to airports cause serious aviation hazards, and the colony in Jamaica Bay, N.Y. is a current example. These birds can cause damage or the loss of aircraft and occupants when ingested into the loss of aircraft and occupants when ingested into one or more turbine engines, usually during takeoffs, and populations have increased in many countries exacerbating hazards. Gulls are controlled routinely to benefit other birds, but less often for aviation safety. If significant hazard reduction cannot be accomplished by other methods, there should be no reluctance to making habitat unsuitable for nesting or killing gulls using humane methods. Adult gulls become hazards and should be controlled. Various strategies are discussed for alleviating or eliminating hazards from nesting colonies adjacent to airports. Gull hazards that originate beyond airport boundaries should be controlled even if the authority to do so must be based on litigation.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; DEPREDATION; GULLS

ABBHA Ref. #: 342
Citation: SEUBERT, J.L. Current activity concerning the U.S. bird/plane strike problem. Bird Strike Committee Europe 10, WP 35; Stockholm, Sweden 9-13 June, 1975: p. 262.
Abstract: Discusses the U.S. government programs that deal with the birdstrike issue.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ORGANIZATION; UNITED

STATES

ABBHA Ref. #: 343
Citation: SEUBERT, J.L. Bird hazards at John F. Kennedy International Airport -- The problem and suggested remedies. Bird Strike Committee Europe 11, WP 9; London, U.K.; 24-28 May, 1976: pp. 156-165.
Abstract: On November 12, 1975, a DC-10 was lost at John F. Kennedy International Airport because of bird strikes. The Overseas National Airways jet with 139 people on board collided with many gulls on takeoff roll when the aircraft was accelerating past 100 knots. The time was 1310, the runway was wet, and visibility was 15 miles. The gull flock, estimated at about 100 birds, apparently was on the runway and a gull (or gulls) was ingested into number 3 engine, which exploded and separated from the aircraft. Abort procedures were initiated and the aircraft was stopped near the end of the 14,572-foot runway. All 139 people aboard, NO employees, survived the accident. The aircraft was destroyed from fire.
Keywords: AT TECH LIB; BSCE; GULLS; LEGAL ISSUES; MISHAP INVESTIGATION; UNITED STATES

ABBHA Ref. #: 345
Citation: SHERGALIN, J.E. Soviet bibliography about aviation and radar ornithology 1982-1990. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: 207-220.
Abstract: This bibliography compiled for acquaintance of foreign colleagues with literature about aviation and radar ornithology after 16th BSCE meeting (Moscow, 1982). This literature been published mainly in rare separate editions with limited circulation, as a rule, only in Russian, without summaries. In other cases language is shown. Reports of soviet specialists on BSCE meetings and other articles in foreign languages were not included here. Bibliography covers 160 reports of 92 soviet specialists.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; DETECTION; LITERATURE SURVEY; RADAR; USSR

ABBHA Ref. #: 346
Citation: SHERGALIN, J.E. Bird strike analysis in Estonia 1951 - 1988. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: 183-189.
Abstract: About 370 birdstrikes reported with 12 types of aircraft of Estonian Civil Aviation Department between 1951 and 1988 have been analyzed. The analysis includes strike rate for aircraft types and airports (partly based on aircraft movements), bird species and weight, part of aircraft struck, effect of strike. The paper shows that gulls were involved in 61 of the incidents where the bird strikes involves birds of over 4 lbs. The major effects have been damage to 20 engines, 2 precautionary and 1 forced landing.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; ESTONIA; STATISTICS

ABBHA Ref. #: 347
Citation: SHIMA, S. Report on preliminary evaluation of engine spinner markings. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 359-369.
Abstract: Occurrences of bird strikes may vary due to various factors such as yearly variation of bird habitats or changes in carrier's route structure. Occurrences of engine removals could be considered "accidental" in nature since severity of engine damage even by the same bird species may substantially vary according to the part of engine struck, i.e. at the outer circumference near the by-pass or the entrance to the core engine. Thus it would appear to be difficult to arrive at any definite conclusions from the above mentioned data of the effects of engine spinner markings, not withstanding the fact that a part of the data indicated the markings, may have some positive effects. As it was considered that the markings would not produce an adverse effect on bird strikes, the markings have now been painted on all engines of B747s and B767s in ANA's fleet. This fact also makes it difficult to compare the bird strikes between engines with and without markings. Comparison of data with another airline that operates the same type of aircraft on the same routes may be the next step to evaluate the effects of the spinner markings.
Keywords: AIRCRAFT APPEARANCE; AT TECH LIB; BSCE; ENGINEERING; ENGINES; MARKINGS

ABBHA Ref. #: 348
Citation: SHORR, B.F. Design of aviation engine elements for bird strike action. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 555-561.
Abstract: The approximate engineering method for the calculation of the bird strike action on the blades of the fan or compressor is suggested. This method rests on sufficiently proof substantiations and is suitable for performing the optimized calculations at the design stage. The results of the typical design are given.
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; ENGINEERING; ENGINES; MATHEMATICAL MODELS

ABBHA Ref. #: 349
Citation: SHORT, J.J. Birdweight Distribution of low-level birdstrikes. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 519-526.
Abstract: Over 20 percent of all U.S. Air Force (USAF) birdstrikes occur during low-altitude, high speed training flights. These low-level birdstrikes are usually the most damaging in terms of aircraft damage and loss of aircrews. Since 1980, the USAF has lost five aircraft and seven aircrewmen during low-level and range training flights. According to the BASH Team records, the total cost of low-level birdstrikes during the last decade is in excess of $250 million. The cumulative birdstrike frequency distribution for birds of different weight classes was calculated from over seven hundred actual low-level birdstrike events where the bird species was known. The analysis shows that the existing bird weight damage criteria may need to be higher than four pounds for aircraft flying certain types of missions.
Keywords: AT TECH LIB; BSCE; LOW LEVEL; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 350
Citation: SHORT, J.J. Characterization of the birdstrike hazards to the space shuttle orbiter. Bird Strike Committee Europe 19, WP 11; Madrid, Spain, 23-26 May, 1988: pp. 159-181.
Abstract: The National Aeronautics and Space Administration requested an evaluation of the Space Shuttle Orbiter windshield system with regards to the possibility of birdstrikes during landing. To support their damage assessment analysis, the Air Force Wright Aeronautical Laboratories Aircraft Windshield System Programs Office directed a characterization of the bird populations at the three primary Shuttle landing sites: Kennedy Space center, Florida; Edwards AFB and Vandenberg AFB, California. The objective of this effort was to determine the expected birdstrike risk of Shuttle approaches/landings. Using the Bird Avoidance Model database and methodology, birdstrike risks were highest at the Kennedy Space Center site due to large numbers of migrant birds that over winter nearby.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; MAPS; MIGRATION; RESIDENT; SHUTTLE LANDING FACILITY; UNITED STATES

ABBHA Ref. #: 351
Citation: SOETENS, G. Experimental bird counting with a real-time computer. Bird Strike Committee Europe 10, WP 12; Stockholm, Sweden 9-13 June, 1975: pp. 184-187.
Abstract: Discusses the development of equipment to provide an indication of the intensity of bird movements.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 353
Citation: SOUCAZE-SOUDAT, J.D.; SARL, D. Scaring away birds by laser beam. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 447-453.
Abstract: Since December 1987 we have carried out tests in various locations using a laser rifle to scare away birds. Results have been very encouraging. This article gives details of all the trials to date and proposes a further development, a system of automatic scanning.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; LASERS

ABBHA Ref. #: 354
Citation: SOUCAZE-SOUDAT, J.D. Self-contained portable laser transmitter. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 617.
Abstract: The international civil aviation organization recorded in 1985 4045 reports on bird impacts from 45 countries. Most of the impacts have occurred in airports or in their vicinity. Forty nine percent of those occurred at less than 30 meters from the ground and sixty two percent occurred at less than 150 m. If we look carefully at diagram 1 it can be noticed that all collisions, near the ground, are due to birds surrounding the landing strips. Relevant airport

security people have to send the birds away from these dangerous areas. Various means are used: falconry, fire of explosive cartridges, diffusion of recorded sounds through loud speakers, rigorous control if agricultural areas, etc. In addition to these methods, it appears today that birds can be scared away with the use of a new device. A self-contained portable laser transmitter.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; ICAO; LASERS

ABBHA Ref. #: 356
Citation: SPEELMAN, R. Evaluating the birdstrike threat to aircraft windshield systems- a probabilistic approach. Bird Strike Committee Europe 14, WP 18; The Hague, Netherlands; 22 - 26 October, 1979.
Abstract: The purpose of this report is to briefly describe and illustrate a recent effort to analyze the potential risk of birdstrike damage to an aircraft windshield system.
Keywords: AT TECH LIB; BSCE; ENGINEERING; MATHEMATICAL MODELS; TRANSPARENCIES

ABBHA Ref. #: 357
Citation: SPEELMAN, R.J. Enhancement of F/RF-4 transparency system bird impact resistance. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 190-201.
Abstract: Birdstrikes to the crew enclosures of USAF F/RF-4 aircraft have resulted in major aircraft damages and severe pilot injuries. Analysis of operational bird impact statistical data indicates that the trend of damaging bird impacts of the F-4 is continuing to rise. Impacts to the F-4 transparency system also continue to rise resulting in a continued flight safety risk to the aircraft and the aircrew. The Air Force Wright Aeronautical Laboratories, Improved Windshield Protection Office has initiated a program to develop a transparency system for the F-4 aircraft which has four-pound, 500-knot bird impact capability. The first step in this program was to experimentally determine the existing transparency system capability by bird impact testing full-scale flight hardware. Eight impact locations on the windshield and forward canopy were tested to failure with four-pound birds. Tests on experimental, laminated windshield side panels were also conducted to investigate the capability of the windshield frame. The baseline birdstrike test results are presented through the use of post-test photographs, test films, and an impact capability diagram. Program progress subsequent to the baseline testing will be reviewed.
Keywords: AT TECH LIB; BIRD IMPACT; BSCE; ENGINEERING; F-4; MILITARY AVIATION; TESTING; TRANSPARENCIES

ABBHA Ref. #: 360
Citation: STONE, R.J. Synergised aluminum ammonium sulfate in the control of birds at airports. Bird Strike Committee Europe 11, WP 23; London, U.K.; 24-28 May, 1976: pp. 231-242.
Abstract: Ammonium alum includes micro additives and is prepared in such a way that it has

synergistic properties as a repellent. The chemical has a broad sensory effect and is quite effectively used in several locations.
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; GULLS

ABBHA Ref. #: 361
Citation: STONE, R.J. Development of the theoretical construct of synergised aluminum ammonium sulfate for the control of birds at airports. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 151-160.
Abstract: The chemical control of behavior is affected by the neuro-secretory systems. This paper discusses the results of research related to application and dosage.
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; USSR

ABBHA Ref. #: 362
Citation: STOUT, J.F. Dispersal of gulls from the airport environment. Bird Strike Committee Europe 10, WP 8; Stockholm, Sweden 9-13 June, 1975: pp.157-179.
Abstract: According to US. Air Force records and information contained in the report of BSCE 9, gulls are the most frequent species involved in air strikes with both civil and military aircraft. As significant proportions of these gull-aircraft collisions have occurred during landing and take-off, long term dispersal of gulls from the immediate environment is important.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; GULLS; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 363
Citation: SU-ARETZ, S. Bird strike problems at Ben-Gurion Airport, LOD-Israel. Bird Strike Committee Europe 10, WP 24; Stockholm, Sweden 9-13 June, 1975: pp. 219-221.
Abstract: In December 1973, an El-Al plane full of passengers met during the take-off with a flock of birds - probably gulls. The pilot succeeded to brake, but as a result was hurt. This incident served as a warning. The airport management looked for ways to avoid possible accidents, and among others, approached the Nature Reserves Authority, and thus, I started to deal with the problem in January 1974.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ISRAEL; MISHAP INVESTIGATION; SURVEYS

ABBHA Ref. #: 364
Citation: SU-ARETZ, S. Bird strike problems at Ben-Gurion international airport. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 197-198.
Abstract: This paper discusses the bird strike measures in place at Ben Gurion IAP, Israel

Keywords: AT TECH LIB; ATTRACTANTS; AVOIDANCE; BSCE; HAZARD MANAGEMENT; ISRAEL

ABBHA Ref. #: 365
Citation: SUTER, W. Roosting and feeding flights of Black-headed gulls (Larus ridibundus) in the region of Zurich Airport. Bird Strike Committee Europe 13, WP 19; Bern, Switzerland; 29 May-2 June, 1978: pp. 257-263.
Abstract: In 1975, the youth group of ALA (Swiss society for bird study and bird protection), started investigations on the Black-headed gulls (Larus ridibundus) wintering in the Zurich area. As their roosting place, the lower part of Lake Zurich is a center of that winter population. In the daytime most of the gulls disperse over area, mainly to the north of the roosting place for feeding. A considerable number of gulls stay at the lake and in the city, where the birds are fed by people. Since Black-headed Gulls are often considered as problem birds, the investigation produced some useful results with respect to agricultural and aviation problems. This paper deals mainly with the aspects of interaction between birds and aviation.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; GULLS; RESIDENT; SWITZERLAND

ABBHA Ref. #: 367
Citation: THOMAS, C.S. Bird hazard management at Manchester airport. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 549-552.
Abstract: Bird strikes are a serious threat to aviation safety. The hazard at each airport is unique and a study of the habits of birds living in the vicinity of the airport is necessary before a control program can be developed. The habitat of an airfield can be modified to make it unattractive to birds; however, the corner-stone of a control program remains comprehensive bird detection and dispersal by a small dedicated unit.
Keywords: AT TECH LIB; BIOACOUSTICS; BSCE; CONTROL METHODS; DEPREDATION; MANCHESTER; UNITED KINGDOM

ABBHA Ref. #: 368
Citation: THOMAS, C. The development of an effective bird detection and dispersal program. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 143-152.
Abstract: Bird detection and dispersal operations require a detailed knowledge of the habits of the bird population at each airport. Bird dispersal can take hours or even days to become effective and requires persistence and dedication on the part of those staff involved in the task and also the trust and understanding of air traffic controllers. For dispersal operations to be concentrated amongst a small group of individuals who work to the demands of the birds. Effective bird detection and dispersal operations can lead to a reduction in bird strikes, a reduction in the number of birds which regularly come to the airfield and a reduction in the time

required to disperse those birds. The result of this can be a dramatic reduction in operation costs.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; DETECTION

ABBHA Ref. #: 370
Citation: THORPE, J. Analysis of strikes reported by European airlines 1981-1985. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 263-294.
Abstract: Birdstrike reported world-wide between 1981 and 1985 by European airlines from 12 countries have been analyzed. The analysis of over 7500 strikes includes the annual strike rate for countries, aircraft types and airports, all based on aircraft movements. It also covers bird species, weights and damage, part of the aircraft struck and the effect of the strike. The paper shows the overall strike rate was 5.7 per 10,000 movements, slightly higher than previously. Gulls were involved in 40% of incidents where the type of bird was known, slightly lower than before. Only 1.3% of bird strikes involved birds over 1.8 kg (4 lb). About 1.3% of incidents resulted in multiple engine strikes i.e. about 1 in every 75,000 flights. There were no deaths, injuries or aircraft losses but 488 engines were damaged. There was insufficient data to produce meaningful information on the cost of bird strikes.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 371
Citation: THORPE, J. The computer analysis project. Bird Strike Committee Europe 13, WP 8; Bern, Switzerland; 29 May-2 June, 1978: pp. 125-129.
Abstract: The current proposal is to use a system similar to that used by the Australian Department of Transportation. The number of incidents involving up to 18 bird species is tabulated against each feature of aircraft type, altitude, aerodrome, month of year, etc. This layout enables the problem species to be identified against each of the areas of investigation. These tables, used in conjunction with aircraft movement data should considerably ease the task of completing the standard tables of BSCE analysis data.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 372
Citation: THORPE, J. Some notes on analysis of bird strikes to UK general aviation aircraft 1968-1977. Bird Strike Committee Europe 13, WP 32; Bern, Switzerland; 29 May-2 June, 1978: 335-337.
Abstract: Discusses statistics of general aviation aircraft.
Keywords: AT TECH LIB; BSCE; GENERAL AVIATION; STATISTICS; UNITED KINGDOM

ABBHA Ref. #: 373

Citation: THORPE, J. Bird strikes to engines. Bird Strike Committee Europe 11, WP 3; London, U.K.; 24-28 May, 1976: pp. 95-105.
Abstract: Data on bird strikes to engines from four countries for 1973 and 1974 has been analyzed to show some of the factors affecting strikes and damage.
Keywords: AT TECH LIB; BSCE; ENGINEERING; ENGINES; STATISTICS

ABBHA Ref. #: 374
Citation: THORPE, J. Bird strikes during 1973 to European registered civil aircraft. Bird Strike Committee Europe 10, WP 5A; Stockholm, Sweden 9-13 June, 1975: pp. 82-116.
Abstract: In the past reports containing data on bird strikes have been produced by different organizations, such as airlines, aviation authorities and ornithologists. The information has been presented in various forms, using different guidelines. These reports have seldom contained data on aircraft movements, such that the most useful form of comparison, strike rate, can be determined.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 375
Citation: THORPE, J. Accident to HS 125 executive jet. Bird Strike Committee Europe 11, WP 21; London, U.K.; 24-28 May, 1976: pp. 220-222.
Abstract: This paper contains a brief description of the HS 125 Executive Jet accident at Dunsfold on 20 November 1975.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; MISHAP INVESTIGATION; STATISTICS; SWEDEN

ABBHA Ref. #: 376
Citation: THORPE, J. Bird strikes during 1974 to European registered civil aircraft. Bird Strike Committee Europe 11, WP 2; London, U.K.; 24-28 May, 1976: pp. 73-94.
Abstract: The strike reported during 1974 throughout the World by nine European operators, for aircraft greater than 5700 kg (12,500 lb) have been analyzed. The results are discussed, some areas highlighted and recommendations proposed.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 377
Citation: THORPE, J. Serious bird strikes to civil aircraft 1984 & 1985. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 74-81.
Abstract: The paper contains a sample of detailed histories of accidents and more serious incidents (e.g. double engine ingestion, holed airframe, fire, uncontained engine failure) for the years 1984 and 1985. The paper is divided into three groups: transport aircraft over 5,700 kg and executive jets, aeroplanes of 5,700 kg and below, all helicopters. No attempt has been made to

analyze the information although it is apparent that for transport aircraft the critical area is engines (20 out of 36 incidents in the paper) and for light aeroplanes and helicopters the windshield may be the critical area. As far as is known, during this period there have not been any hull losses. The author would welcome any new or additional information as it currently relies heavily on UK and ICAO information.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 378
Citation: THORPE, J. Bird avoidance. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 257-264.
Abstract: The paper contains the text of a Leaflet in the CAA General Aviation Safety Sense series. This has been widely distributed to UK General Aviation and Private pilots. Other countries may wish to use the text for similar leaflets with suitable alteration to reflect their own reporting procedures, bird species, publications, etc.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BOOKS/MANUALS; BSCE; HAZARD MANAGEMENT; TRAINING; UNITED KINGDOM

ABBHA Ref. #: 379
Citation: THORPE, J. Serious birdstrikes to civil aircraft 1985 to 1987. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 331-339.
Abstract: The paper contains a sample of detailed histories of accidents and more serious incidents (e.g. double engine ingestion, holed airframe, fire, uncontained engine failure) for the years 1985 to 1987. The paper is divided into three groups: Transport Aircraft over 5,700 Kg and Executive Jets, Aeroplanes of 5,700 Kg and below, and helicopters. No attempt has been made to analyze the information although it is apparent that for transport aircraft as before, the critical area is engines (27 out of 46 incidents in the paper) and for light aircraft and helicopters the windshield may be the critical area. As far as is known during this period there have not been any hull losses. The author would welcome any new or additional information as the paper relies heavily on UK and ICAO information.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 380
Citation: THORPE, J. Serious birdstrikes to civil aircraft 1987-1989. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 295-301.
Abstract: The paper contains a sample of detailed histories and more serious incidents (e.g. double engine ingestion with damage, holed airframe, fire, windshield damage) for the years 1987 - 1989. The paper is divided into three sections: -Transport Aeroplanes of 5700 kg and over; Business Jets; -Aeroplanes below 5700 Kg.; -Helicopters. The incidents have not been analyzed although it can be seen that the majority of cases involve engine multiple ingestion including the Ethiopian B737 accident which was the first recent transport jet fatality due to birds. The windshield appears to the critical area for General Aviation aeroplanes and

helicopters. The author would welcome any new additional information as the paper is mostly from ICAO, UK and insurance sources.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; MANCHESTER; STATISTICS

ABBHA Ref. #: 381
Citation: TRUNOV, R. Bird strikes to Aeroflot registered aircraft and some general airworthiness requirements. Bird Strike Committee Europe 14, WP 30, The Hague, Netherlands,; 22-26 October, 1979.
Abstract: The level of flight safety is characterized by the probability of an aircraft accident. For aircraft that are operated on scheduled world airlines the probability of an accident falling on one flight is now close to the value of 10 -6 (one in one million chance). It means that several accidents occurring due to various reasons fall in each million of flights. Out of this amount of reasons the role played by birds is relatively small, as also small is the part of each reason taken separately. However, no one will presently doubt the actuality of the problem involving protection of aircraft against birds the collisions with which although rarely lead to accidents, but cause great damage to aviation and create a constant hazard to flight safety.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; LEGAL ISSUES; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 382
Citation: TURESSON, L.-O. Report from an ICAO workshop on reducing bird hazards. Bird Strike Committee Europe 13, Working Paper 9; Bern, Switzerland, 29 May - 2 June, 1978: pp: 130-155.
Abstract: An International Civil Aviation Organization Workshop on reducing bird hazards was held in Bangkok, 20-23 March, 1978. Upon request from the ICAO, some BSCE members assisted in the workshop, presenting papers and moderating discussions. There were 32 participants from 14 states in the Far East and Pacific region and five participants from the International Air Transport Association. The workshop was planned and organized by the Air Navigation Bureau of ICAO.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; HAZARD MANAGEMENT; ICAO; ORGANIZATION

ABBHA Ref. #: 383
Citation: TURESSON, L.-O. Index for data base: BSCE papers and documents. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 270-309.
Abstract: According to decisions at BSCE 16 and 17 an index for data base concerning material within the sphere of interest of BSCE has been prepared. As the total possible material is very comprehensive the task has been reduced in this first edition to papers contained into the reports from the first eighteen meetings of BSCE. It's the hope of the author that it will be possible in

the future to enlarge the document to include also other papers, books and audiovisual means so that the benefit of it will become even greater.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 384
Citation: TURESSON, L.-O. Proposal concerning the distribution of bird strike reports. Bird Strike Committee Europe 11, WP 6; London, U.K., 24-25 May 1976: pp. 140-141.
Abstract: The present distribution of birdstrike reports within the European countries is arranged so that the pilot submits the report through his airline to the aviation authority of the country where the airline company is based. This leads to delays in obtaining the birdstrike information. This paper proposes a supplementary system.
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; REPORTING; STATISTICS

ABBHA Ref. #: 385
Citation: TURESSON, Lars-O. Code of practice of Bird Strike Committee Europe. Bird Strike Committee Europe 14, WP 5, The Hague, Netherlands; 22-26 October, 1979.
Abstract: The desirability of some type of document to describe the activities of BSCE has been discussed during the last years. It has not, however, been possible to formulate the total purpose of such a document nor to decide about the content or size of it. Different opinions have favored either a comprehensive work going more into details of the practical work in the field than the ICAO "Airport Services Manual Bird Control and Reduction", or just a rather short description of the Committee and its work including the activities of the six working groups. - Contributions to a document of the more reduced type under a title "Code of Practice of BSCE" have upon request of me and the former chairman of BSCE been delivered by some of the working group chairmen.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ICAO; ORGANIZATION

ABBHA Ref. #: 386
Citation: ULFSTRAND, S. How many birds are there in Sweden? Bird Strike Committee Europe 10, WP 34; Stockholm, Sweden, 9-13 June 1975: pp. 258-261.
Abstract: Since migrating birds tend to fly at low altitude, especially during the day, the density of birds in the air may at times be considerable. Intense migration is correlated to periods of relatively short duration. Since the migratory activity is correlated with predictable meterological conditions, different for species or species groups, it seems to be meaningful and possible to develop a forecasting system for fluctuations in space and time of bird migration intensity.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; FORECASTING; HAZARD MANAGEMENT; MIGRATION; SWEDEN

ABBHA Ref. #: 387
Citation: VAN OOSTENBRUGGE, R. Geese and air traffic in the Netherlands. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 485-498.
Abstract: In winter, large numbers of geese stay in the Netherlands. The total number may approximate to 1 million. So, the Netherlands has great international importance for the management of migrating and wintering geese. The availability of sufficient information about the distributions and movements of geese in breeding areas, migration areas and wintering grounds is important to conduct an adequate management. Counts of geese receive special attention in the Netherlands. The system used to count the geese not only provides an overall picture of the Netherlands, it also gives a good idea of developments in specific areas and in movements of geese. Movements of geese occur primarily between the breeding areas and the wintering grounds in spring and autumn. But the geese also move a lot in winter. Changes in weather conditions may cause large numbers of geese to move in the Netherlands and Europe. These movements occur partly during the day and partly during the night. An important category of movements are the flights between roosts and forage areas.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; GEESE; MIGRATION; NETHERLANDS

ABBHA Ref. #: 389
Citation: VERHEIJEN, F.J. Effects of light and light beams on birds. Bird Strike Committee Europe 14, WP 10; The Hague, Netherlands; 22-26 October, 1979.
Abstract: There is considerable disagreement about whether an aircraft-mounted light or a narrow beam would scare birds away, or, conversely, would attract them (Blokpoel 1976; Griffin et al. 1974; Larkin 1976; Jacobi 1978). I should like to discuss this problem with respect to midair collisions between nocturnal migrants and aircrafts. It will be suggested that the phase of the moon and the presence or absence of the moon above the horizon might well be crucial, but so far neglected, environmental variables which affect the outcome of these encounters.
Keywords: AT TECH LIB; ATTRACTANTS; BIRD POPULATIONS; BSCE; LIGHTING; SENSORY; VISUAL

ABBHA Ref. #: 390
Citation: WEAVER, A.T. Bird hazards to large transport aircraft engines. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 326-333.
Abstract: (not available)
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; ENGINEERING; ENGINES; PIGEONS

ABBHA Ref. #: 392
Citation: WILDE, K.K. ICAO activities related to bird strikes. Bird Strike Committee Europe 14, WP 28; The Hague, Netherlands; 22-26 October, 1979.

Abstract: The ICAO bird strike system originated in 1965 when the Airworthiness Committee decided it needed more information on bird strikes to aircraft for improvement of airworthiness criteria. The information received in response to this program has been most useful and the airworthiness criteria has been developed and included in the Airworthiness Technical Manual. In ICAO current activity related to bird strikes on aircraft emphasis is being given to the identification of areas/locations where the risk of a bird strike is high and to the study of other factors related to the prevention of collisions between aircraft and birds. Since 1965, many states have had considerable experience with the ICAO form and a number have developed reporting forms of their own. It was, therefore, considered timely to review the need for changes to the ICAO form.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; ICAO; ORGANIZATION; REPORTING

ABBHA Ref. #: 394
Citation: WOODING, M.S. Tests of a device for the protection of aircraft gas turbine engines against bird strikes. Bird Strike Committee Europe 14, WP 24; The Hague, Netherlands; 22-26 October, 1979.
Abstract: Damage to engines from collision with birds is a problem to which a solution has yet to be found, although for the last 30 years efforts have been made in this direction with no sign of success. Bird impact on the rotating first axial compressor stages has resulted in deformation of individual blades leading to shedding of metal debris and severe damage to the entire compressor assembly. Steps to prevent these occurrences have included strengthening of the engine itself and redesigning the compressor first stage blades to have adequate strength and stiffness and thus to avoid structural failure. However, this runs counter to modern compressor design trends where the blade sections are tending towards a lower t/c ratio and a more flexible component.
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; ENGINEERING; ENGINES

ABBHA Ref. #: 395
Citation: BECKER, J. Improving the birdstrike warning system in central Europe. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 357-361.
Abstract: The Bird Movement and Low-Level Working Groups shall identify preventive measures to minimize the bird hazard to low flying aircraft. Whereas, civil aviation is focused on the birdstrike problem at, or in the vicinity of aerodromes, military aviation needs birdstrike warnings covering larger areas. The Belgium, Danish, Dutch, and German observation and warning procedures have shown that an improvement of the systems is only possible if calibrated radar observations of bird movement are performed continuously, and birdstrike warnings are transmitted without delay and loss of information.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 396
Citation: BROM, T.G. Identification of bird remains for bird strike analysis: A literature synopsis. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 255-261.
Abstract: At the meeting of the Analysis Working Group during BSCE 17 in Rome discussions of the work in the analysis of feather remains showed that there was a need for the formation of a sub-group to deal with this specialized area. The main goal of this sub-group is to pursue the work on the identification of bird remains, with emphasis on the microscopic structure of feather remains. This paper intends to provide an introduction to relevant literature (including abstracts) in order to make knowledge and techniques for the identification of bird remains more accessible for those who are interested in this field of research and who wish to refine their identification methods. Publications featuring the research on identification of bird remains can be roughly summarized into five categories: 1) papers dealing with basic research of feathers, 2) papers denoting the need for proper identification of bird remains, 3) papers using the results of microscopic identification of feather remains, 4) papers on identification methods for complete bird bodies or big parts, such as bills, feet, wings, tail and skeletal, 5) papers on biochemical identification methods for blood, amino-acids, etc.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BIOCHEMICAL; BSCE; FEATHERS; IDENTIFICATION; LITERATURE SURVEY

ABBHA Ref. #: 397
Citation: BUURMA, L.S.; MACKENNA, R. Starling abatement at Princilik air station in Eastern Turkey. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp 129-146.
Abstract: Massive starling roosts near runways may pose a threat to aviation, especially when birds perform their aerial display flights shortly before sunset. But also the dropping of hundreds of thousands birds may cause unacceptable hindrance, while the extra weight put on wires and installations may result in serious damage. This report illustrates the problems and possibilities encountered at US air station Princilik in Eastern Turkey where Asiatic starling populations traditionally roost in extreme numbers. Earlier measures taken to relocate the birds failed. However, the abatement described here has proven to be successful. Emphasis is put on the need to understand the behavioral aspects of communal roosting in the starling.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; ROOSTS; STARLINGS; TURKEY

ABBHA Ref. #: 398
Citation: DAHL, H. Agenda for plenary meeting on Thursday 29, May 1986 and Friday 30, May 1986. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 268-269.
Abstract: According to decisions at BSCE 16 and 17 an index for data base concerning material

within the sphere of interest of BSCE has been prepared. As the total possible material is very comprehensive the task has been reduced in the first edition to papers contained into the reports from the first eighteen meetings of BSCE. It's the hope of the author that it will be possible in the future to enlarge the document to include also other papers, books and audiovisual means so that the benefit of it will become even greater.
Keywords: AT TECH LIB; BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 399
Citation: DEKKER, A.; BUURMA, L.S. Towards a European database of military bird strikes. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 105-128.
Abstract: The analysis of bird strike reports will only be a rewarding task when a multifold of biases can be avoided. In statistical terms this means that proper selections should be made. Depending on the questions to be answered the number of data available often is too small to achieve significant results. Therefore, there is a strong tendency to lump data as much as possible. But as a result, summary reports, such as those used in BSCE military statistics up to now, often cannot serve as comparison between countries. Even worse, they are not suitable for repeated analyses according to different criteria. The only way out is sharing the original bird strike forms while improving and standardizing the format. This report discusses a pilot study on the basis of 1988 data of six European Air Forces and gives some preliminary results.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; REPORTING; STATISTICS

ABBHA Ref. #: 400
Citation: KINGSTON, R. Military aircraft bird strike analysis - 1977. Bird Strike Committee Europe 14, WP 12; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The data used in this analysis was supplied by the following air forces: Royal Netherlands Air Force, Royal Norwegian Air Force, Royal Air Force, Swedish Air Force and US Air Force (Europe).
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 401
Citation: LATY, M. Startling of birds by light, experimental devices, current research. Bird Strike Committee Europe 11, WP 11, London, U.K. 24-28 May, 1976: pp. 171-175.
Abstract: This report states the progress which has been made in current studies and describes two systems of deterring birds by using light. Both systems are designed for the use at airports and the one can also be used by aircraft. In both cases, the lights were used to cause birds to fly off.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; FLASHING LIGHT; LASERS

ABBHA Ref. #: 402
Citation: MILSOM, T. The use of birdstrike statistics to monitor the hazard and evaluate risk on UK civil aerodromes. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 303-320.
Abstract: Birdstrike statistics are widely perceived as the primary instrument for monitoring the hazard and evaluating risk on individual aerodromes. However, those currently in use are not very informative and they are susceptible to variations in reporting standards. A number of new statistics are proposed to rectify these problems. The use of new statistics are proposed to rectify hazard at individual aerodromes is examined.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; STATISTICS; UNITED KINGDOM

ABBHA Ref. #: 403
Citation: THOMAS, C. How meaningful are bird strike statistics. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 559-566.
Abstract: Data are being collected throughout the world about bird strike incidents and many countries have established systems for collating and analyzing this information. The limiting factors in these systems are the level and quality of reporting by people on the airfield and on the flight deck. A number of sources of weakness have been identified and appear to require a comprehensive education campaign. The analysis of, and interpretation of bird strikes statistics and in particularly the way in which they are published can lead to misinterpretation by airport management, who may look for a simple statistical and biological limitations of such data.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; REPORTING; STATISTICS

ABBHA Ref. #: 404
Citation: THORPE, J. Bird strikes during 1975 to European registered civil aircraft. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 93-111.
Abstract: The paper contains a consolidation of the Tabulated Data from 12 European countries of bird strikes reported throughout the World during 1975, to aircraft of over 5,700 kg (12,500 lb).
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 405
Citation: TURNER, C.J. Military aircraft bird strike analysis, 1983-1984. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 334-348.
Abstract: Five countries contributed data for the years 1983-1984, a modest improvement in reporting over the previous 3 analyses. The following are the contributors since 1979: Belgian Air Force, Royal Danish Air Force, French Air Force, German Air Force, Royal Norwegian Air

Force, Royal Air Force, Swedish Air Force, United States Air Force. The small number of contributions, when compared with the number of countries participating in BSCE, may indicate that the usefulness of this report in its present format is in doubt.
Keywords: AT TECH LIB; BSCE; MILITARY AVIATION; REPORTING; STATISTICS

ABBHA Ref. #: 406
Citation: AGAT, I.; SUARETZ, S. Bird hazard at Ben-Gurion Airport. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 310-323.
Abstract: Israel's largest Int'l Airport lies in a rather moderate and comfortable weather region, which creates very good conditions for the development of fauna and flora, both natural and cultivated including birds. Like other regions in the country birds of various kinds and species live in this area. Among which residents, wintering and summering ones. Some live in the region the whole year and others are wintering, summering or passing by.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; ISRAEL

ABBHA Ref. #: 407
Citation: ALERSTAM, T.; KARLSON, J. Current work in the problem of collisions between birds and aircraft in Sweden. Bird Strike Committee Europe 11, WP 8; London, U.K.; 24-28 May, 1976: pp. 151-155.
Abstract: A project group with representatives from civil and military aviation communities and biologists from the university are carrying out investigations on bird collision problems. The primary goal of the group is to develop a system to forecast important concentrations of migrating birds. Radar and field observations have been conducted over several migration seasons. A book is being prepared to present the results and to disseminate knowledge on the subject.
Keywords: AT TECH LIB; BSCE; FORECASTING; HAZARD MANAGEMENT; SWEDEN

ABBHA Ref. #: 409
Citation: BESSE, J.; FUERTES, A. Behavior of Aramid epoxy composite structures to bird impact. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 7-59.
Abstract: Considering the development in Aeronautics of Aramid epoxy (Kevlar) structures, the French STPA has sponsored in CEAT an experimental investigation to know the behavior of these structures in a bird impact. The program of the investigation has been presented in the 17th BSCE. We recall this program, its development and the contribution of the French Aircraft manufacturers. The results of normal impact are presented both for the Kevlar 49 and partially for the Kevlar 29. The oblique impact tests, the experimental difficulties encountered and their solution are also shown.
Keywords: AIRCRAFT SYSTEM; AIRFRAME; AT TECH LIB; BSCE; ENGINEERING;

KEVLAR; MATERIALS

ABBHA Ref. #: 410
Citation: BEUTER, K.J.; WEISS, R. Properties of the auditory system in birds and the effectiveness of acoustic scaring signals. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 60-73.
Abstract: The effectiveness of sound signals for scaring gulls away from feeding areas have been investigated during the last years. Physiological and behavioral data were used to identify the most promising approach. Ultrasound and infrasound were tested as well as audible sound at different frequencies and with a large variety of modulations. The investigations have shown that ultrasound and infrasound do not produce the desired scaring effect, there is a group of frequency-modulated audible signals have proved effective for bird control. The scaring signal can be generated by an electroacoustic device. Based on the encouraging results of investigations conducted on behalf of two major German cities, functional models of the bird control device have been developed for an industrial client. Fundamental properties of the bird's ear and some results of a field test to scare away gulls from waste deposits are described in the following paper.
Keywords: AT TECH LIB; AUDITORY; BIRD POPULATIONS; BSCE; CONTROL METHODS; PHYSIOLOGY; SENSORY; SOUND; ULTRASONICS

ABBHA Ref. #: 411
Citation: BIRYUKOV, V.Y.; ROGACHYOV, A.I.; SHERGALIN, E.E. Means and methods of bird number reduction within the airport area. Bird Strike Committee Europe 19, WP 41; Madrid, Spain, 23-26 May, 1988: pp. 609-613.
Abstract: The airport of Tallin serves as an illustration of some bird hazard specific features in airports. The methods of the hazard investigation are described. The efficiency of different measures is analyzed directed at elimination of the causes of bird concentrations as well as at their timely detection and scaring. Major characteristics of various acoustic systems designed for the last three years are considered.
Keywords: AT TECH LIB; ATTRACTANTS; BIOACOUSTICS; BSCE; CONTROL METHODS; DETECTION; TALLIN; USSR

ABBHA Ref. #: 412
Citation: BLOKPOEL, H.; RICHARDSON, W.J. The predictability of spring migration of snow geese across Southern Manitoba, Canada. Bird Strike Committee Europe 14, WP 9; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The eastern population of the Lesser Snow and Blue Goose, "Anser c. caerulescens" (snow geese), winters along the coast of the Gulf of Mexico. In spring they migrate in a north-northwesterly direction through the US and into Southern Canada, where their first main migration stop-over area is located in southern-most Manitoba along the Canada/USA border.

When migrating from the plains in southern Manitoba to the coasts of James and Hudson bays, the snow geese fly in north-easterly directions, often in large flocks. A good proportion of this population (estimated at 2,000, 000 birds in the spring; Kerbes, 1975) crosses the Terminal Control Area of Winnipeg International Airport, an area with a radius of 56km (30 n mi) with the center at the airport. In spring 1969, a flock of snow geese was struck down by an airliner 22km northeast of Winnipeg. The aircraft was seriously damaged. Following this accident, the Associate Committee on Bird Hazards to Aircraft of the National Research Council of Canada was asked (1) to detect and warn of this spring migration and (2) to develop techniques to predict it.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; CANADA; DETECTION; GEESE; MIGRATION; NORTH AMERICA; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 416
Citation: BROM, T.G.; BUURMA, L.S. The quality of identification: a microscopic key to determination of feather remains. Bird Strike Committee Europe 14, WP 19; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: As it is very important to find out which species cause which damages, the Royal Netherlands Air Force attaches great importance to the correct identification of bird remains that are collected after collisions. In order to improve existing methods of identification, a study was made from January 1978 until August 1979. During the last twenty years it was tried to identify feather-remains at the Zoological Museum, Amsterdam. They were examined on shape and structure in order to establish whether they are wing-, tail-, or body-feathers. On account of the color and size the potential species were established. Then the feathers were compared with bird-skins from the collection of the Museum.
Keywords: AT TECH LIB; BSCE; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 417
Citation: BROUGH, T.; HORTON, N. Nocturnal bird problems on aerodromes. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 339-356.
Abstract: This paper describes an attempt to identify the pattern of occurrence of bird on UK aerodrome by night. The result of an inquiry covering 31 aerodromes indicates that the problem is diverse. Most aerodromes reported the presence of birds by night but only on occasion. Bird numbers may be influenced by precipitation, moon phase, tide states and winds. The dangers presented by birds at night are increased by their intermittent occurrence and the difficulty of detection.
Keywords: AT TECH LIB; BEHAVIOR; BIRD POPULATIONS; BSCE; REPORTING; UNITED KINGDOM

ABBHA Ref. #: 419
Citation: BUURMA, L.S.; BROM, T.G. The quality of identification: its effects on birdstrike

statistics. Bird Strike Committee Europe 14, WP 20; The Hague, Netherlands; 22-26 October, 1979.
Abstract: In order to reduce the chance of damage and risks due to collisions between aircraft and birds, it is essential to gather knowledge on the bird species concerned. Not all bird species are equally dangerous to aviation. They differ in numbers, weight, behavior and their specific ecological niche in nature. Considering the improvement in aircraft construction as well as in bird avoidance (detection by radar), bird removal and making the airfield environment unattractive to birds we therefore have to know what species actually cause damage.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; IDENTIFICATION; STATISTICS

ABBHA Ref. #: 420
Citation: BUURMA, L.S.; OCKELORN, M.W. ROBIN, the new bird extractor on RNLAF long range surveillance radar. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 597-599.
Abstract: ROBIN stands for Radar Observation of Bird Intensity and Notification. It is the acronym for the successor of KIEVIT, The Dutch electronic counting system at work since 1978. It consists of a computer configuration with hardware and software modules. Using pattern analysis algorithms, it processes digitized raw video into synthetic bird video. Functions are arranged in software as much as possible, to keep open the option of future improvements. The system is designed to serve as an operational instrument as well as a research tool. More details will be included in the booklet, "The Application of Radar for Bird Strike Reduction", to be issued during the second half of 1988.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 423
Citation: DEFUSCO, R.P.; LARKIN, R.P.; QUINE, D.B. Bird hazard warning using Next Generation Weather Radar. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 94.
Abstract: United States Air Force Bird-Aircraft Strike Hazard (BASH) Team is sponsoring research to utilize an algorithm designed to detect birds on the nation-wide Next Generation Weather Radar (NEXRAD) system currently being developed. A phased approach to the task of algorithm development separates flying radar targets into several classes: waterfowl, passerines, blackbird roosts, gulls, raptors, bats, and insects. Data was collected for all classes and a draft algorithm was prepared for waterfowl in the first phase. A second phase is underway to test the waterfowl algorithm and to draft and compare a migratory passerine algorithm. Research has confirmed that the NEXRAD system can distinguish the different classes of targets and can distinguish birds from weather. Ultimately this system will provide real-time bird hazard warning information on a continent-wide scale.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; MAPS; RADAR

ABBHA Ref. #: 424
Citation: DEKKER, A.; BUURMA, L.S. Visual Lapwing counts versus aircraft-Lapwing strikes. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 401-418.
Abstract: Using very frequent birdcounts, from 6 RNLAF airfields during the years 1982-1987 the pattern of presence of the Lapwing (Vanellus vanellus) during the year was defined. Differences between the 6 airfields can be explained by geographical location (surroundings) and the agricultural management of the airfield and surroundings. Comparison with the quantitative information on the autumn presence of the Lapwing in the Netherlands reveals that the "bird unfriendly" management of the airfields does pay off in the sense that numbers of the Lapwing on the airfields are relatively low. The distribution of the Lapwing strikes over the year shows distinct peaks in early spring, mid summer and especially in autumn (October). The high number of strikes in autumn appears to be caused mainly by local strikes. However, the relation between the presence of Lapwings on the airfields and the number of local Lapwing strikes is poor and certainly not a simple one. The chance of a collision is not determined by the actual number of Lapwings on an airfield but by the flying activity of Lapwings around and over airfields. Effective countermeasures include the removal of flocks and the adaptation of aircraft movements.
Keywords: AIRFIELD PROCEDURES; AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; LAPWINGS; NETHERLANDS; RESIDENT

ABBHA Ref. #: 425
Citation: DELOR, B.; BESSE, J. Studies on the resistance of structures to bird impacts (Etude de la resistance des structures aux impacts d'oiseaux). Bird Strike Committee Europe 13, WP 20; Bern, Switzerland; 29 May-2 June, 1978: pp. 283-301.
Abstract: Discusses various aspects of bird impact testing on aircraft structures. (In French)
Keywords: AIRCRAFT SYSTEM; AIRFRAME; AT TECH LIB; BIRD TESTING; BSCE; ENGINEERING

ABBHA Ref. #: 432
Citation: HEIJINK, J.; BUURMA, L.S. Practical and economical aspects of grassland management at some Dutch airbases. Bird Strike Committee Europe 13, WP 33; Bern, Switzerland; 29 May-2 June, 1978: pp. 338-341.
Abstract: In a densely populated country like Holland almost all suitable grasslands are used for agricultural production. There is, in Holland, hardly any marginal ground or waste land production. This intensive management also stretches out to grasslands on airfields. During the last ten years the number of local birdstrikes is growing mainly because of the strong intensification of agricultural production in Holland. Intensification of grass-management means: increase of use of fertilizers and organic manure, increase in fields of grass or hay per hectare, increase in number of cuttings a year, increase in length of periods with "short" grass. However,

birds are attracted by each single cut and also by the other following agricultural activities. Several bird species, like gulls and lapwings, are specialists, feeding themselves on grass stubble or a field where organic manure is spread. These gulls react even on the agricultural machines as soon as they leave the farm. The trouble some species are so-called "opportunistic feeders".
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; FOOD; NETHERLANDS

ABBHA Ref. #: 433
Citation: HEIRMAN, J.; BOOMANS, J.F. Low level flight bird strike risk map for Belgium. Bird Strike Committee Europe 11, WP 17; London, U.K.; 24-28 May, 1976: 187-190.
Abstract: A map of the low-altitude military training routes was prepared by the Belgian Bird Strike Committee at the request of the Belgian Air Force. The map is based on scientific research but has been simplified and adapted to operational purposes, in collaboration with ornithologists and aircrews. The map gives details on flight level, time and period of possible bird interactions.
Keywords: AT TECH LIB; AVOIDANCE; BELGIUM; BSCE; LOW LEVEL; MAPS; MILITARY AVIATION

ABBHA Ref. #: 434
Citation: HOUGHTON, E.; BLACKWELL, F.; BROUGH, T.; WILMOT, T. Radar study of waders. Bird Strike Committee Europe 11, WP 4; London, U.K.; 24-28 May, 1976: pp. 106-136.
Abstract: This is a preliminary study of the radar characteristics of two wader species, the dunlin, Calidris alpinsa, and the oystercatcher, Haematopus ostralaegus. Some results are given on the curlew, Numenius arquata, but these are limited because only two were captured. Flight and echo data were obtained by means of a high-resolution auto-following pules radar from wild birds released from a 90ft tower. A new method of obtaining the multi-aspect dynamic radar echoing area of a target is demonstrated and values are given for the dunlin and the oystercatcher. Bird activity modulation waveform, spectral and auto-correlation functions have been for the three wader species.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR; SHOREBIRDS

ABBHA Ref. #: 435
Citation: ILYICHEV, V.D.; NECHVAL, N.A.; BIRYUKOV, V.Y. A general statistical approach to identification of bird remains after collisions between aircraft and birds. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.169-178.
Abstract: The aim of this paper is to present a general statistical approach to identification of birds remains after collisions between aircraft and birds, which is based on bird strike statistics and can be applied in combination with some methods currently used and described by Brom (1988). The proposed approach is, therefore, trying to improve the situation by applying to the bird strike databases more sophisticated analytical techniques generally used

to analyze rather variable biological data. The sample sizes of the data set of bird strike reports are small and in some cases, multivariate analysis is not possible. The data are, therefore, statistically weak. However, in order to illustrate a suggested statistical approach is based on the results of Nechval (1988, 1989) and is immediately applicable when the alternative distributions have given functional forms but with unspecified parameters. The nonparametric cases can be treated in a similar manner, but no attempt has been made in this paper to offer explicit solutions. The main feature of the approach to identification of birds remains is the population elimination rule. When certain conditions are met, the decision is taken to eliminate specific populations from further consideration, and the identification process is continued with a reduced number of populations. An example is given.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; MATHEMATICAL MODELS; STATISTICS

ABBHA Ref. #: 441
Citation: KUUSELA, S.; STENMAN, O. Bird control at Helsinki-Vantaa Airport, Finland. Bird Strike Committee Europe 14, WP 33; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: Compared with many other European countries birds have presented few problems to air traffic in Finland. Three or four of the 87 bird strikes reported in 1970-78 had a serious effect on the aircraft. Most of these incidents occurred at the main international airport, Helsinki-Vantaa. In the 1970's 2-5 incidents were reported here yearly. These involved the following species: herring gull, black-headed gull, black grouse, and starling. In addition to these species, more than 30 other species are considered to pose a potential hazard to air traffic. The two most serious incidents to date happened in 1978. On June 11th and July 22nd, a DC-8 and a Caravelle respectively, were damaged by gulls. The damage cost approx. U.S. $250,000 to repair.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; HELSINKI IAP; LEGAL ISSUES; MISHAP INVESTIGATION; REPORTING

ABBHA Ref. #: 442
Citation: LARKIN, R.P.; GRIFFIN, D.R.; TORRE-BUENO, J.R.; WALCOTT, C. Reactions of migrating birds to lights and aircraft. Bird Strike Committee Europe 11, WP 25; London, U.K.; 24-28 May, 1976: pp. 246.
Abstract: Midair collisions between birds and aircraft pose a hazard for both. While observing migrating birds with a tracking radar, we find that birds often react, by taking evasive maneuvers, at distance of 200-300m to both searchlight beams and the approach of a small airplane with its lights on. Appropriately arranged lights on aircraft should decrease the hazard of collisions with birds.
Keywords: AIRCRAFT APPEARANCE; AT TECH LIB; AVOIDANCE; BSCE; DETECTION; LIGHTS; RADAR
ABBHA Ref. #: 443
Citation: LARKIN, R.P.; QUINE, D.B. Recognizing bird targets on next generation weather radar. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 217-235.

Abstract: By 1994, the present weather radars within the United States and at some overseas sites will have been replaced with a network of advanced Doppler radars, the Next Generation Weather Radar (NEXRAD). This paper discusses the final specifications of NEXRAD with respect to its performance in detection and recognizing bird targets hazardous to aircraft. Techniques are outlined for automatically discriminating bird echoes from echoes caused by weather and for testing the performance of the automatic discrimination.
Keywords: AT TECH LIB; BSCE; DETECTION; RADAR

ABBHA Ref. #: 444
Citation: LARSSON, B.; ALERSTAM, T. A forecast system for bird migration in Sweden. Bird Strike Committee Europe 14, WP 4; The Hague, Netherlands; 22-26 October, 1979.
Abstract: A preliminary forecast system for bird migration has been in use in Sweden during two test periods, in the autumns (August - November) of 1977 and 1978. Daily bird migration forecasts have been issued during these periods to military as well as civil air fields and authorities. In this report we will briefly describe the operational routines and also present an evaluation of the forecast system based on the experience from the two test periods. After critical testing of the bird migration forecast system, the Swedish Air Force has decided to use the system regularly in the next few years, and to support parallel work to refine and develop further the system.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; FORECASTING; MIGRATION; SWEDEN; WARNING SYSTEMS

ABBHA Ref. #: 446
Citation: MINGARRO, M.J.V.; MARTINEZ, C.R. Spanish birds and their influence on flight and mission. planning. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 107-135.
Abstract: The paper presents some ideas for hazard level comparisons between the different bird species. It addresses resident Spanish birds, especially vultures (Gyps fulvus) and similar ones. Later some facts about Spanish migratory movements and their relationship to weather conditions, isophenic lines, and the most dangerous season time are presented. Finally, the paper gives, conclusions about strike avoidance and some proposals.
Keywords: AT TECH LIB; AVOIDANCE; BIRD POPULATIONS; BSCE; MIGRATION; RISK ASSESSMENT; SPAIN

ABBHA Ref. #: 447
Citation: NECHVAL, N.A.; BIRYUKOV, V.Y. Some bivariate probability models applicable to aircraft collision with birds. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 71-80.
Abstract: Collisions between aircraft and birds are the subject of growing interests. Uncontrollable nature of those factors which cause these collisions suggests that a probability

model might be used to express the relationships between the number of birdstrikes and the number of damage cases and the relationship between the number of birdstrikes and the losses.
Keywords: AT TECH LIB; BSCE; ENGINEERING; HAZARD MANAGEMENT; MATHEMATICAL MODELS; STATISTICS; VISUAL

ABBHA Ref. #: 448
Citation: OUELLET, H.; VAN ZYLL DE JONG, S.A. Feather identification by means of keratin protein electrophoresis. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 53-71.
Abstract: Identification of feathers by visual means leaves a percentage of unidentifiable samples, particularly at the lower taxonomic levels. Optical or scanning electron microcopy can improve results but about 25% of the samples cannot be identified below the family level. Electrophoresis of proteins extracted from feather keratin, used previously in taxonomic research, can provide reliability and repeatability in identifying feather remnants from any source. Protein extraction has been refined and standardized, as well as the methodology for electrophorizing feather protein concentrates. Current results indicate that identifications to the species level provided the sample is at least 10 mg that can be obtained in most cases. There is little individual variation and the significant differences between species can often be assessed visually. When gels are scanned with a laser densitometer, the differences between each keratin profile are more obvious and can be measured. The values of the curve can be used for separating closely related species. Our results indicate a high success rate and precision in identifications exceeding the results obtained by other means for the samples that cannot be identified visually.
Keywords: AT TECH LIB; BIOCHEMICAL; BSCE; CHROMATOGRAPHY; IDENTIFICATION

ABBHA Ref. #: 450
Citation: ROCHARD, J.B.A.; HORTON, N. Birds killed by aircraft in the United Kingdom 1966-76. Bird Strike Committee Europe 12; Paris, France; 20-28 October, 1977: pp. 116-131.
Abstract: Bird remains from 1541 birdstrike incidents have been identified at least to ordinal level and the results analyzed. This paper presents and discusses the data obtained. Small gulls and lapings, which habitually feed on short grassland, predominated and most strikes involved species weighing 0.5 Kg or less. Numbers of birdstrikes are shown to vary with the seasonal distribution and abundance of birds; the most important factor being the influx on to airfields after breeding and the arrival of winter visitors.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; STATISTICS; UNITED KINGDOM
ABBHA Ref. #: 451
Citation: ROGACHEV, A.I.; TRUNOV, O.K. Some statistic data on birds' strike to aircraft and helicopters over the territory of the Soviet Union. Bird Strike Committee Europe 12; Paris,

France; 20-28 October, 1977: pp. 133-143. (Some common approach consists of three main interrelated aspects: (1) the determination of normalized adverse environmental effects; (2) the evaluation of the influed of the chosen parameters on a certain type of aircraft; and, (3) the development of operation methods.)
Abstract: The problem of birdstrikes is a part of the general problem of aircraft protection against adverse environmental effects.
Keywords: AT TECH LIB; BSCE; ENGINEERING; HELICOPTER; STATISTICS; USSR

ABBHA Ref. #: 452
Citation: RUIZ, J.; MORERA, P. Study structure of bird and ecosystems in Spanish Airports. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 358-381.
Abstract: The risk of collisions with birds in airports presents a complex problem which is often difficult to resolve. The Spanish Airport Authority, an autonomous body within the ministry of transportation, tourism and communications, commissioned a study led by the technical laboratories and the environmental section, to define a general methodology for the study of bird problems. The methodology, thus established, is currently being employed in the airports of Palma De Mallorca, Menorca, Ibiza, Tenerife/Sur, Barcelona, and Santander. The purpose of this report is to review the main features of the aforementioned studies and the methods applied, and to illustrate the results obtained during the first month of sampling via several real life examples.
Keywords: AT TECH LIB; BSCE; HAZARD MANAGEMENT; SPAIN; SURVEYS

ABBHA Ref. #: 457
Citation: SOLMAN, V.E.F.; THURLOW, W.J. Reduction of wildlife hazards to aircraft. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 103-110.
Abstract: (not available)
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; SPAIN

ABBHA Ref. #: 459
Citation: SPEELMAN, R.J.; MCCARTY, R.C. Improving birdstrike resistance of aircraft windshields. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp.46.
Abstract: USAF aircraft repeatedly prove that birds and aircraft cannot occupy the same airspace at the same time; over 3000 birdstrikes per year cause millions of dollars in damage to USAF aircraft. During the past 20 years sixteen aircrew members have been killed and 23 aircraft have been destroyed due to bird impact. More of these losses are due to birdstrike on the windshield subsystem than to any other subsystem. Windshield systems on several different aircraft are being redesigned to improve tolerance of the birdstrike event. These efforts to improve windshield systems birdstrike resistance and other efforts to improve cost-of-ownership

characterized of these windshields will be discussed. Some technical voids in designing for, and integration of, birdstrike resistance will be discussed.
Keywords: AT TECH LIB; BSCE; ENGINEERING; TRANSPARENCIES

ABBHA Ref. #: 460
Citation: SPEELMAN, R.J.; MCCARTY, R.C. Improving birdstrike resistance of aircraft windshields. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 139.
Abstract: USAF aircraft repeatedly prove that birds and aircraft cannot occupy the same airspace at the same time; over 3000 birdstrikes per year cause millions of dollars in damage to USAF aircraft. During the past 18 years 13 aircrew members have been killed and 21 aircraft have been destroyed due to bird impact. More of these losses are due to birdstrikes on the windshield subsystem than to any other subsystem. Windshield systems on several different aircraft are being redesigned to provide improved tolerance of the birdstrike event. These efforts to improve windshield system birdstrike resistance will be discussed in general terms as will the rationale behind these efforts. Some technical voids in designing for, and integration of, birdstrike resistance will be discussed.
Keywords: AT TECH LIB; BSCE; ENGINEERING; TRANSPARENCIES

ABBHA Ref. #: 461
Citation: STAHL, L.; JOHANSSON, S. Studies of bird reactions, caused when exposed to laser-light. Bird Strike Committee Europe 10, WP 20; Stockholm, Sweden 9-13 June, 1975: pp. 213.
Abstract: The presentation will be composed by the following points: (1) The birds sense of sight and range of sight; (2) Pilot's possibilities to use light in order to avoid birdstrike; (3) Disadvantage of ordinary taxi- and landing light; (4) Advantage of laser-light; (5) Studies of bird reactions, caused when exposed to laser-light; (6) Modified methods for future experiments; (7) technical facts.
Keywords: AT TECH LIB; ATTRACTANTS; BIRD POPULATIONS; BSCE; CONTROL METHODS; LASERS; LIGHTING; PHYSIOLOGY; SENSORY; VISUAL

ABBHA Ref. #: 463
Citation: SU-ARETZ, S.; AGAT, I. Summary of results of spraying with "RETA" repellant at Ben Gurion Airport 1974-1979. Bird Strike Committee Europe 14, WP 32; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The chemical repellant "RETA", marketed by the Assia Maabarot Co. under license, is an Aluminum-Ammonium-Sulfate powder of the formula Al.NH4(SO4)2 used for spraying in water solution. "RETA" causes irritation and its taste is bitter. We have yet to find out in what way birds are deterred by it, no harmful side-effects on birds having been detected even after spraying their food with "RETA".
Keywords: AT TECH LIB; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; ISRAEL
ABBHA Ref. #: 464

Citation: SU-ARETZ, S.; AGAT, I.; SHY, E. Bird strikes at Israel Ben-Gurion Airport 1982-1986. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 473-477.
Abstract: This report includes data about bird strikes at Ben-Gurion International Airport in Israel during a five year period. We will present the data according to the various factors that may influence the number of bird strikes, and according to the effect of bird strikes on normal airplane flights. This presentation does not include statistical tests, as in many of the cases sample sizes are too small, but rather show trends.
Keywords: AT TECH LIB; BEN GURION IAP; BSCE; ISRAEL; STATISTICS

ABBHA Ref. #: 467
Citation: THOMPSON, M.M.; DEFUSCO, R.P.; WILL, T.J. 1984-85 USAF birdstrike report. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 95.
Abstract: The United States Air Force Bird-Aircraft Strike Hazard (BASH) Team has maintained birdstrike records for the USAF since 1975. Although some data is available from as early as the 1960's, inconsistent reporting procedures and incomplete information limits its use. Not until 1982 have awareness programs and mandatory reporting procedures resulted in consistent birdstrike reporting throughout the Air Force. Finally, we are getting a more accurate picture of the overall impact birds are having on our aircraft. This paper presents 1984 and 1985 USAF birdstrike data and analyzes and compares data from 1983 (BSCE 17), 1984 and 1985.
Keywords: AT TECH LIB; BSCE; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 468
Citation: THOMPSON, M.M.; WILL, T.J. Toxic perches for control of pest birds in aircraft hangars. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 96-102.
Abstract: The United States Air Force Bird-Aircraft Strike Hazard (BASH) Team has taken a special interest in resolving problems with pest birds in aircraft hangars. A variety of pest bird removal methods has provided limited or unsatisfactory results, causing concern at several CONUS bases. The toxic perch method was evaluated in large hangers supporting as many as 20,000 House Sparrows, Rock Doves, and European Starlings. The perches contained a liquid solution of endrin or fenthion, which was absorbed through the birds' feet while perched. Results from six Air Force bases indicate the toxic perches successfully removed 95-100% of pest birds from inside the structures within 4-30 days without complications or secondary poisoning of non-target species.
Keywords: AT TECH LIB; BSCE; BUILDINGS/STRUCTURES; CHEMICAL/REPELLENT; CONTROL METHODS; PASSERINES; PIGEONS; REPELLENTS; UNITED STATES

ABBHA Ref. #: 469
Citation: THORPE, J.; VAN DUSSELDORP, J.G. Bird strikes during 1977 to European registered civil aircraft. Bird Strike Committee Europe 14, WP 11; The Hague, Netherlands; 22 -26 October, 1979.
Abstract: The strikes reported throughout the world in 1977 by operators from eleven European

countries have been analyzed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost and airlines affected. The strike rate in 1977 was similar to that in previous years. Gulls (Larus spp.) were involved in nearly half of the incidents. The major effect was damage to 60 engines. During the year bird strikes were estimated to have cost European airlines at least 3.7 million US dollars in engineering repairs.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; EUROPE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 470
Citation: THORPE, J.; VAN WESSUM, R. Bird strikes during 1984 to European registered civil aircraft. Bird Strike Committee Europe 18, Part II; Copenhagen, Denmark, 26-30 May, 1986: pp. 388-407.
Abstract: The strikes reported throughout the world in 1984 by operators from fourteen different European countries have been analyzed. The analysis includes rates for countries, aircraft types, and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effects of strike, and airlines affected. The strike rate in 1984 was at 5.0 per 10,000 movements, slightly lower than the two previous years. Gulls (Larus spp.) were involved in 41% of the incidents. The major effect was damage to 127 engines.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 471
Citation: THORPE, J.; HOLE, I. Bird strikes during 1985 to European registered civil aircraft. Bird Strike Committee Europe 19; Madrid, Spain, 23-26 May, 1988: pp. 267-288.
Abstract: The strikes reported throughout the world in 1985 by operators from twelve European countries have been analyzed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, airlines affected and cost. The strike rate in 1985 was at 4.6 per 10,000 movements, slightly lower that the 5.0 of 1984, probably due to one of the best reporting countries not being in a position to provide full information. Gulls (Larus spp.) were involved in 37% of the incidents. There were 16 cases where more than one engine suffered ingestion. The major effect was damage to 88 engines, and the cost was at least 35 million US dollars.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; COSTS; EUROPE; STATISTICS

ABBHA Ref. #: 472
Citation: VUILLERMET, P.H.; BRIOT, J.L. Bird control on aerodromes, French regulation. Bird Strike Committee Europe 20; Helsinki, Finland, 21-25 May, 1990: pp. 243-253.
Abstract: This information paper deals with the new regulation regarding bird control on French aerodromes. Under the authority of French civil aviation authority "DGAC", this service will be provided on 143 Airports. The paper describes - the reasons why this policy was implemented - the organization of the procedures - the role of the different partners as

far as funding is concerned.
Keywords: AT TECH LIB; BSCE; LEGAL ISSUES; POLICY; REGULATIONS

ABBHA Ref. #: 579
Citation: THORPE, J.; VAN WESSUM, R. Bird strikes during 1978 to European-registered civil aircraft. Bird Strike Committee Europe 15, WP 4; 4-8 May, 1981; Brussels, Belgium.
Abstract: The strikes reported throughout the world in 1978 by operators from eleven European countries have been analyzed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of the aircraft struck, effect of strike, cost and airlines affected. The strike rate in 1978 was the same as in the previous year. Gulls (Larus spp.) were involved in nearly half the incidents. The major effects were the destruction of a Boeing 737, and damage to 60 engines. During the year bird strikes were estimated to have cost European airlines at least US$3.2 million in engineering repairs, to which must be added the value of the Boeing 737 (about US$4.5 million).
Keywords: BSCE; CIVIL AVIATION; EUROPE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 580
Citation: KINGSTON, R. Military Aircraft Birdstrike Analysis: 1978. Bird Strike Committee Europe 15, WP 5; 4-8 May, 1981; Brussels, Belgium.
Abstract: This is the first analysis using the abbreviated format. Five countries supplied data for the analysis. The total number of strikes used in the analysis was 1080. Gulls were involved in 28 percent of the incidents of which the bird was positively identified. The distribution of the strikes on the aircraft was similar with the exception of an increase in the incidents involving the windscreen.
Keywords: BSCE; EUROPE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 581
Citation: LATY, M. Startling of birds by light: Experimental measures; current research. Bird Strike Committee Europe 15, WP 6; 4-8 May, 1981; Brussels, Belgium.
Abstract: This report states the progress which has been made in current studies and describes two installations. One is designed solely for the protection of airports. The other could fulfill two functions: self protection of aircraft in flight and the safety of airports. In both cases we attempted to cause the birds to fly off as a result of light sensations.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; FLASHING LIGHT; LASERS; SENSORY; VISUAL

ABBHA Ref. #: 583
Citation: SHERGALIN, J. Canada Geese and Great Cormorants as a threat for aviation in the Eastern Baltic area. Bird Strike Committee Europe 22, WP 2; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 21-25.

Abstract: There are not yet fortunately strikes with Canada Geese (Branta canadensis) and Great Cormorants (Phalocrocorax carbo) in the Eastern Baltic area as far as we know. But increasing populations of this species will become a real threat in 5-10 years near coastal aerodromes, because the breeding range of these species has expanded very quickly to the East.
Keywords: BALTIC; BIRD POPULATIONS; BSCE; CORMORANTS; DISTRIBUTION; EUROPE; GEESE

ABBHA Ref. #: 584
Citation: ALLAN, J.R.; FEARE, C.J. Feral Canada Geese (Branta canadensis) as a hazard to aircraft in Europe; Options for Management and Control. Bird Strike Committee Europe 22, WP 1; Vienna, Austria; 29 Aug - 2 Sep 1994: 25-42.
Abstract: The British Canada Goose population is around 50,000 birds and is increasing at 8 percent per year. Similar increases are being seen in a number of European countries. Canada Geese respond well to standard aerodrome bird scaring techniques and are unlikely to constitute a significant "on airfield" problem at sites with good bird control and habitat management, unless the airfield is immediately adjacent to a lake or river. Hazards from birds transiting airfields to and from nearby water bodies are likely to be more significant. Research into the effectiveness of population reduction techniques such as controlling reproduction and culling adults is underway. The development of Integrated Management Strategies to control bird numbers at the local level must be the first objective.
Keywords: AIRFIELD PROCEDURES; BSCE; CONTROL METHODS; HAZARD MANAGEMENT; TRAPPING

ABBHA Ref. #: 585
Citation: BUURMA, L.S. Superabundance in birds: trends, wetlands and aviation. Bird Strike Committee Europe 22, WP 4; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 43-50.
Abstract: Birds, like other living beings, survive by adaptation and specialization. Compared to other animals of similar body size, relatively many birds are opportunistically adapted to highly dynamic ecosystems. Birds are particularly noticeable in wetlands such as rivers, marshes and coastal zones. Human influences on bird populations in these "flatland" habitats are negative for highly specialized species, but may on the other hand be very positive for adaptable types, leading to rapid increase. This may conflict with the safety interest of other "birds" of the flat countryside: aircraft. Recently there has been a trend to reclaim previously cultivated lands and return the land to nature. As birds are extremely popular, high bird numbers are considered as signs of success. Therefore, it is imperative to bring together aviation and nature conservancy into spatial planning procedures for the sake of flight safety.
Keywords: BSCE; HAZARD MANAGEMENT; NETHERLANDS; PLANS

ABBHA Ref. #: 586

Citation: KLAVER, A. Nature conservation and flight safety: A controversy. Bird Strike Committee Europe 22, WP 5; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 45-54.
Abstract: Birdstrike prevention, bird control and aircraft tolerance to birdstrikes have been optimized at many airfields and for many engines. There may be interest in setting aside a workshop to address new concerns such as the conservation of bird habitat that interferes with flight operations.
Keywords: BSCE; CONSERVATION; HAZARD MANAGEMENT; LEGAL ISSUES; PLANS

ABBHA Ref. #: 587
Citation: AUBRECHT, G. Waterbird and Wetland Conservation - IWRB's Global Network and the Current State of the International RAMSAR Convention and Bonn Convention. Bird Strike Committee Europe 22, WP 6; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 55-63.
Abstract: This paper contains an overview of IWRB's (International Waterfowl and Wetland's Research Bureau) global activities in promoting the conservation of wetlands and their biodiversity, especially waterbirds. This paper also reviews the goals and current state of wetland and waterbird conservation within the international Ramsar Convention (Convention on wetlands of international importance, especially as waterbird habitat) and Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals). Emphasis is given on how international, non-governmental and governmental bodies are build a framework for the integrated conservation of wetlands around the world.
Keywords: BIRD POPULATIONS; BSCE; CONSERVATION; LEGAL ISSUES

ABBHA Ref. #: 588
Citation: STEFFEN, R. Anti-bird collision (ABC) light system to prevent birdstrikes in aviation. Bird Strike Committee Europe 22, WP 7; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 63-68.
Abstract: This paper briefly describes a pair of special strobe lights to be fitted to aircraft that increase in frequency during takeoff. This provides birds with both direction and speed information.
Keywords: AIRCRAFT APPEARANCE; BSCE; ENGINEERING; LIGHTS

ABBHA Ref. #: 589
Citation: PARKER, R. Harmonizing engine design rules United States - Europe. Bird Strike Committee Europe 22, WP 9; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 73-82.
Abstract: This presentation provides an overview of the efforts that have been in process over the past 15 years to improve the standards for engine design certification. An important feature is the co-operation between the US and Europe to develop, through harmonization, a common set of standards. Having common standards is important so that all engine manufacturers can design to a common level of safety that will be accepted world-wide. The purpose of the presentation is to inform the committee of the efforts from the manufacturing side of the industry. This positive exchange of information is intended to update the committee that effective protection from the bird hazard results from combined efforts throughout the industry.
Keywords: AIRCRAFT SYSTEM; BIRD TESTING; BSCE; CERTIFICATION STANDARDS;

ENGINEERING; ENGINES

ABBHA Ref. #: 590
Citation: ALLAN, J.R. The central science laboratory birdstrike research club. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 83-90.
Abstract: The Birdstrike Avoidance Team (BAT) of the Central Science Laboratory of the United Kingdom Ministry of Agriculture has been at the forefront of research into the alleviation of birdstrike hazards to aircraft over 20 years. In recent years the large scale research projects needed to further reduce the birdstrike hazard have become prohibitively expensive. CSL BAT has established a subscription club designed to spread both the costs and benefits of birdstrike research as widely as possible among the members: aircraft manufacturers, airport operators and regulatory authorities. The research has involved the evaluation of the physical properties of bird bodies and the structure of bird flocks; the development of unique stereo video imaging techniques to measure positions of birds in moving flocks; and the use of Magnetic Resonance Imaging to model the internal structure of bird bodies. Membership is open to any funding organization which wishes to participate. Projects involving collaboration with other research institutions, in Europe, or elsewhere, are especially welcome.
Keywords: BSCE; ENGINEERING; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 591
Citation: PILO, B.; KUMAR, A.; OOMMEN, S.; VINOD, K.R. Anti-bird collision strobe lights: Field experiments on Indian birds. Bird Strike Committee Europe 22, WP 8; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 69-72.
Abstract: The paper reports the field experiments with Anti-bird collision strobe lights against Indian birds such as Kites and vultures. Tests were conducted in the early morning an daytime on baited birds in their natural habitats and those resting on runways and the air terminal or soaring over the key. None of the birds showed any avoidance or fear response to the strobe light. Behavior of the birds with respect to the flashing lights indicates that the strobe lights may not be as effective against the heavy soaring Indian birds, probably due to the low visibility of flashes in increased daylight conditions.
Keywords: AIRCRAFT APPEARANCE; BSCE; ENGINEERING; LIGHTS
ABBHA Ref. #: 592
Citation: BRIOT, J.L.; EUDOT, A. French Exhibition on Birdstrike Hazards. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 91.
Abstract: During two weeks, in June 1994, an exhibition was organized in the Air France Communication Showroom to inform aircrews about birdstrike hazards. This exhibition was supported by a twelve minute loop mounted videotape which presented some examples of accidents due to birdstrikes, birdstrike reports and their analysis, environmental management, bird scaring methods, research in progress and bird-proof engines. The purpose of the exhibition was mainly to convey three messages: (1)avoiding aborted take-off at high speed (>100kt) after birdstrikes; (2)calling control tower for bird patrol intervention if birds are

detected on and along the runway; and, (3)recording information about birdstrikes on reporting forms even if no damage occurred. During the two weeks, about 400 aircrew visited the exhibition.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; ORGANIZATION; TRAINING

ABBHA Ref. #: 593
Citation: LISCHAK, W. Bird Control and Reduction. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 93.
Abstract: This paper summarizes methods used on Vienna International Airport to reduce bird hazards.
Keywords: AGRICULTURE; AUDIO-VISUAL; BSCE; CONTROL METHODS; EFFIGIES; LANDFILLS; LEGAL ISSUES; PYROTECHNICS; VIENNA IAP

ABBHA Ref. #: 594
Citation: SHORT, J.J. An Annotated Bibliography of Bird Hazards to Aircraft. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 95-102.
Abstract: A project to produce an annotated bibliography of bird hazards to aircraft, termed ABBHA, is underway in co-operation with the US Air Force Armstrong Laboratory's Technical Information Center. The goal of this project is to stimulate and facilitate additional research into the biological and risk management aspects of bird hazards to aircraft. A companion database on transparency durability research, which relates to birdstrike resistance engineering, is also under development. Currently the ABBHA brings together 264 BSCE citations pertaining to birdstrike avoidance, birdstrike engineering, bird management and control, and bird remains identification. Over 200 citations from other sources are included in the latest ABBHA version. The ABBHA is available in magnetic format to simplify searches and to be compatible with a variety of software. Standardized keywords were assigned to the individual citations to facilitate searches. Potential users have been involved in the development of the database and selection of keywords.
Keywords: BIBLIOGRAPHIC; BSCE; LITERATURE SURVEY

ABBHA Ref. #: 595
Citation: THORPE, J. Keyword Index for Bird-Aviation Bibliography. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 115-118.
Abstract: The paper proposes keywords which are an amalgamation of: (1) a proposal from JJ Short, USA at BSCE 21; (2) the work of a previous BSCE Chairman, L-O Turesson, Sweden who had indexed all previous BSCE papers; and, (3) the German Bird Strike Committee index. It is proposed that this paper be used as a basis for discussion and agreement by BSCE members with any comments or changes to the author by 30 October 1994. This is so the agreed system

can be published in the Proceedings and used on all BSCE 22 papers.
Keywords: BIBLIOGRAPHIC; BSCE; LITERATURE SURVEY

ABBHA Ref. #: 596
Citation: WEITZ, H. Comeback of the Grey Heron: Population Trends in Germany during the last fifty years. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 103-114.
Abstract: Due to the complete protection afforded to the Grey Heron in the years 1965-1975, this bird species is now again widely distributed over Germany. The breeding population has increased since that time is still growing. Changes in the phonology, behavior and the successful utilization of new feeding sources have positively influenced the survival strategies of the Grey Heron. Hard winters and limited food supply should not allow the Grey Heron populations to increase to excess. Several ways to reduce the birdstrike risk with Grey Herons is discussed.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; GREY HERON; HABITAT MODIFICATION

ABBHA Ref. #: 597
Citation: DEKKER, A. The European Military Bird Strike Database Progress Report. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 123-126.
Abstract: During the previous tow meetings of the BSCE and several AFFSCE meetings, the feasibility, set-up and standardization of a joined European database of military birdstrikes has been the subject of discussions. Since then more and more emphasis is put on the expansion of the contributions, both in number of participants and in the amount of data. By March, 1994, the database contained information on 25,569 birdstrikes from 9 air forces, covering a period of 3-17 years. Apart from the development of the database in this paper some characteristics of the material are presented.
Keywords: BSCE; DATABASES; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 598
Citation: RICHARDSON, W.J. Serious birdstrike-related accidents to military aircraft of ten countries: preliminary analysis of circumstances. Bird Strike Committee Europe 22, WP 10; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 129-152.
Abstract: This paper lists and summarizes the circumstances of 131 accidents in which military aircraft crashed and/or aircrew were killed as a result of encounters with birds. Over 40 aircrew were killed in these accidents. The accidents involved military aircraft of 10 countries during periods of variable duration, depending on the country. This paper excludes additional known accidents and fatalities in years and countries for which only fragmentary data were available. Of the accidents considered, 69 were in Europe, 9 in Canada, 32 in the USA, 5 elsewhere and 16 at unknown locations. Most involved jet fighter, attack and training aircraft, but two accidents

involved 4 engine bomber and patrol aircraft. The largest number of accidents was during high-speed, low-level flight (<1000 ft AGL). Most involved engine ingestions and/or windscreen penetrations. Gulls, and secondarily, buzzards, were the most commonly involved groups in Europe; vultures were the most serious problem in the USA. It is desirable to prepare a more comprehensive listing of serious military accidents based on fuller records for some of the accidents already considered, plus data from other years and more countries. This would provide the basis for a more complete and representative analysis of the problem.
Keywords: AUSTRALIA; BSCE; DATABASES; EUROPE; HAZARD MANAGEMENT; MILITARY AVIATION; NORTH AMERICA; STATISTICS

ABBHA Ref. #: 599
Citation: LESHEM, Y. Twenty-three years of birdstrike damage in the Israeli Air Force: 1972-1994. Bird Strike Committee Europe 22, WP 22; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 153-162.
Abstract: As a result of security regulations, the Israel Air Force(IAF) did not permit publication of birdstrike damage before 1994. Now that permission has been obtained, a summary of the number of bird-aircraft collisions in the IAF can be published for the first time. Data for 1972-1983, before the joint SPNI-IAF research project started, is compared to data for 1984-1994, while research was going on. This paper will present the data on birdstrikes in relation to month of the year, with emphasis on the heavy migration seasons characteristic to Israel, as well as in relation to altitude and will compare diurnal birdstrike data to nocturnal data. Data gathered during the last two decades on birdstrike and migration observations at high altitudes (15,000-50,000 feet) will be presented. Birdstrike data from flight areas will be compared to data from aerodromes, and that of fighter aircraft compared to hat from helicopters, carriers and light aircraft. Finally, birdstrike data before and after the research project began will be compared. This comparison shows that during the past decade, damage has been reduced by 88 percent and the IAF has saved an average of 30 million dollars per year.
Keywords: BSCE; DATABASES; HAZARD MANAGEMENT; ISRAEL; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 600
Citation: SATHEESAN, S.M. The more serious vulture hits to military aircraft in India between 1980 and 1994. Bird Strike Committee Europe 22, WP 23; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 163-168.
Abstract: The paper summarizes the more serious vulture hits to military aircraft in India that occurred between 1980 and 1994. These fifteen accidents, where the pilot got killed in one of them and aircraft perished in all, were caused by the collision of aircraft with the Indian Whitebacked Vulture, Pseudogyps bengalensis, weighing about 4.5 kg. The various ecological factors contributing to these accidents are also analyzed here. All the accidents, involving fourteen fighter jets and one helicopter, had occurred outside the aerodrome suggesting that the

attractions for vultures lay outside aerodrome. Majority of these accidents had occurred during the warmer hours of the day which coincide with the peak of vulture activity, especially of thermal soaring and foraging. Thirty-six percent of these accidents had occurred during low level flight of aircraft cruising at higher speeds when avoidance action was difficult. Of these accidents, 73.3% occurred between October and March which corresponds with the breeding season for these vultures when parent birds and new arrivals from nests are active. Suggestions for gathering more data on vulture activity in the flight path of aircraft and recommendations for controlling the population of vultures are also included.
Keywords: BIRD POPULATIONS; BSCE; DATABASES; INDIA; MILITARY AVIATION; STATISTICS; VULTURES

ABBHA Ref. #: 601
Citation: MURAR, B. Analysis of birdstrikes with military airplanes in Czechoslovak People's Army from April 1987 to December 1992. Bird Strike Committee Europe 22, WP 24; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 169-174.
Abstract: Presented report represents the data results obtained by classifying incidents of military airplanes with birds for the period from 1987 to 1992, when the split up of Czechoslovak republic into two separate states came about. We registered 219 birdstrikes in the Czechoslovak Peoples Army air forces: 166 on jet airplanes, 27 on turboprop aircraft and 26 on helicopters. Bird species involved were identified in 38 % of the incidents. Damage occurred in 58 (27%) of the birdstrikes. Most birdstrikes involved single birds of the following species: swallow, gull, pigeon, buzzard, swift and skylark.
Keywords: BSCE; CZECHOSLOVAKIA; DATABASES; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 602
Citation: MURAR, B. Analysis of birdstrikes with military airplanes in Slovak Air Forces in 1993. Bird Strike Committee Europe 22, WP 25; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 175-178.
Abstract: Statistical data in the Slovak Air Force are not plentiful. During 1993, there were 19 birdstrikes and in one case, there was a strike with a mammal--a rodent-- on the runway after landing. Total number of flight hours was 16,806. Number of take-offs and landings was 31, 268. From remains there were identified four bird species: Song Thrush (Turdus philomela), swallow (Hirundo rustica), stork (Ciconia ciconia), and dove (Streptopelia spp.). There was no loss of aircraft due to birdstrike but in three instances there was severe damage to aircraft engines (two Mig-29 and one Su-25).
Keywords: BSCE; HAZARD MANAGEMENT; IDENTIFICATION; MILITARY AVIATION; SLOVAK REPUBLIC; STATISTICS

ABBHA Ref. #: 603

Citation: THORPE, J. Serious birdstrikes to civil aircraft 1992-1993. Bird Strike Committee Europe 22, WP 26; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 179-188.
Abstract: The paper contains a sample of summarized accidents and more serious incidents due to birdstrikes in the years 1992-1993. The paper is divided into three sections: (1) transport aeroplanes over 5,700 kg and business jets; (2) aeroplanes of 5,700 kg and below; (3) helicopters. The data sample is too small for any in-depth analysis, but engine ingestion is clearly the critical area of transport aeroplanes. The windshield appears to be the vulnerable area of general aviation aircraft and helicopters. An appendix contains new information now available about incidents before 1992.
Keywords: BSCE; CIVIL AVIATION; DATABASES; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 604
Citation: ZALAKEVICIUS, M. Birdstrike Analysis in Lithuania. Bird Strike Committee Europe 22, WP 27; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 189-196.
Abstract: The paper contains results of analysis of birdstrikes for the periods 1958-1978 and 1987-1991. Fifty-five cases of collisions in civil aviation are investigated. Species composition of birds involved in incidents is presented. Annual, seasonal and 24-hour periods of bird strikes have been distinguished. Aircraft types, collision frequency in various phases of flight and damages incurred on aviation have been indicated. The present state of affairs in Lithuania is given.
Keywords: BSCE; CIVIL AVIATION; DATABASES; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 605
Citation: THORPE, J. Birdstrikes data from world regions. Bird Strike Committee Europe 22, WP 28; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 197-200.
Abstract: The paper briefly summarizes the main points from an analysis of data by world regions using the ICAO IBIS system 1986 - 1990. Although the sample sizes between regions varies from 204 in the Caribbean/South America to 6922 in the North American region, some useful conclusions can be drawn. It should be noted that a total of 1310 engines were damaged and 3 aircraft destroyed.
Keywords: BSCE; CIVIL AVIATION; DATABASES; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 606
Citation: ARRINGTON, D.P. US Air Force Bird Aircraft Strike Hazard (BASH) Summary Report for 1989-1993. Bird Strike Committee Europe 22, WP 29; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 201-208.

Abstract: From 1989 through 1993, the Air Force reported 13,427 bird/wildlife strikes to aircraft worldwide. These strikes resulted in the loss of eight aircraft, one pilot fatality and permanently disabled pilot. The damage estimates exceed $US85 million. Sixty-five percent (6,255) of all reported strikes with known phase of flight occurred in and around the airfield. Twenty five percent (2,394) of the birdstrikes were reported during low-level flight operations and 10 percent (1,013) were reported enroute. Birdstrikes were reported from nearly every Air Force installation with Barksdale AFB, Louisiana reporting 685 strikes followed by Little Rock, Arkansas (500), Vance AFB, Oklahoma (367), Randolph AFB, Texas (313), and Columbus AFB, Mississippi (296) completing the top five. Strikes occurred to all aircraft types with the KC-135 aircraft reporting 2,085 strikes followed by C-130 with 1,820 and T-38 with 1,354. The BASH Team identified approximately 35 percent of the birdstrikes. "Sparrows"(515) were most commonly identified followed by Horned Larks (334), "swallows" (200), Turkey Vultures (199) and "gulls" (120). Current research efforts continue to center on the geographic information system (GIS) based Bird Avoidance Model, the use of a small scale marine radar to study bird movements on bombing ranges, and the use of satellite telemetry to study altitude distribution of Turkey Vultures.
Keywords: BSCE; DATABASES; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 607
Citation: ALFIYA, H. Aircraft flights of the future demand a deeper understanding of nocturnal migration. Bird Strike Committee Europe 22, WP 30; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 209-218.
Abstract: In the future, most aerial fighting will take place at night. The improvements in nocturnal visual equipment and advance technology make low altitude night flights a real possibility. These changes will be expressed by the change in the proportion of night flights time in relation to day flights time. Low-altitude night flights in the Air Force necessitate a preliminary study of nocturnal migration, which is much greater numerically (two orders of magnitude) than diurnal migration. As a result the probability of birdstrike at night is much greater. The nocturnal migration study held in Israel, in the eastern Mediterranean, shows that the character and species composition of nocturnal migration is different than those of diurnal migration. Although the birds migrating at night fly actively, they do not cross the Mediterranean directly to north Africa, in order to avoid dehydration selective pressure has led birds to shorten the time spent over the sea to minimum, and most cross the Mediterranean between Europe and Israel in no more than 5-6 hours, continuing overland to Africa. This makes Israel a major intercontinental cross-roads for nocturnal migrants. The number of birds migrating over Israel in the spring and autumn reaches hundreds of millions each season. To continue flight training at high safety levels, it is necessary to find methods of co-existence between migration and flights, especially in nocturnal migration time and space. The "best" solution in this case is a real-time warning system, based on radar data.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; ISRAEL; MIGRATION; MILITARY AVIATION; RADAR

ABBHA Ref. #: 608
Citation: KELLY, T.A. BASH Team study at Dare County Bombing Range, North Carolina, USA. Bird Strike Committee Europe 22, WP 31; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 219-222.
Abstract: The paper contains a summary of the project at Dare County Bombing Range to quantify the effects of military aircraft on endangered species and the risk of bird strikes. An outline is given of the radar and telemetry equipment used.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; ENDANGERED SPECIES; MILITARY AVIATION; RADAR; TELEMETRY

ABBHA Ref. #: 609
Citation: BUURMA, L.S. High bird densities assessed by radar, a ROBIN report. Bird Strike Committee Europe 22, WP 32; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 223-242.
Abstract: The RNLAF is now issuing bird warning on the basis of radar observations for 30 years. As these warnings clearly reduce the number of 'en route' bird strikes, the air staff recently decided to develop a second version of its electronic bird echo extractor, ROBIN. This ROBIN 2 system will be more than an update of ROBIN 1; it will be adaptable to many types of radar and might help to clear the way towards a dedicated bird radar. The basis for the ornithological use of such a small 3-D radar is the same as it is in ROBIN2 at a big air defense radar; analysis of the motion of bird echoes. Motion analysis appears to be a prerequisite for the proper analysis of bird numbers aloft. It provides the possibility to separate automatically the different bird cohorts in the air and subsequently, to quantify their numbers with respect of side view effect and flying heights.
Keywords: BSCE; DETECTION; MILITARY AVIATION; NETHERLANDS; RADAR

ABBHA Ref. #: 610
Citation: BRUDERER, B.; LIECHTI, F. Quantification of bird migration--Different means compared. Bird Strike Committee Europe 22, WP 33; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 243-254.
Abstract: The paper briefly reviews and evaluates the methods used in the past to quantify bird migration and presents the results of a recent comparison of three methods. Combined observations by telescope in front of the moon, by passive infrared, and by a pencil-beam radar provided the possibility to calibrate the different means against each other, making use of the specific advantages of each of them. The paper emphasizes the limitations and advantages of the three methods and provides correction factors to render the results comparable within defined limits.
Keywords: BSCE; DETECTION; INFRARED; OBSERVATION; RADAR

ABBHA Ref. #: 611
Citation: SHERGALIN, J. Bibliography on Aviational and Radar Ornithology in the ex-USSR During 1992-93. Bird Strike Committee Europe 22, WP 34; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 255-256.
Abstract: The paper continues series of former papers (see BSCE 20/WP22 and BSCE 21/WP30) and contains several titles of literature, dedicated to aviational and radar ornithology in presently independent countries, before being formed into the ex-USSR. Owing to critical economical situation, almost all investigations are frozen and therefore, the number of publications is very low.
Keywords: BIBLIOGRAPHIC; BSCE; DETECTION; LITERATURE SURVEY; RADAR

ABBHA Ref. #: 612
Citation: BECKER, J. The Significance of BIRDTAMS/Birdstrike Warnings for Military and Civil Aviation. Bird Strike Committee Europe 22, WP 35; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 257-262.
Abstract: The paper describes the fundamental principles of birdstrike warnings introduced by several air forces and standardized in the NATO document STANAG 38-79 FS. It gives a short survey of the observation systems, and compares the number and intensities of warnings issued by different countries as well as the flight restrictions to military aviation. Moreover, the paper discusses the possibilities of using the existing warnings for the requirements of civil aviation.
Keywords: AVOIDANCE; BSCE; DETECTION; FORECASTING; HAZARD MANAGEMENT; WARNING SYSTEMS

ABBHA Ref. #: 613
Citation: RUHE, W. New developments for improving the German BIRDTAM/Birdstrike Warning Systems. Bird Strike Committee Europe 22, WP 36; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 263-274.
Abstract: The actual state of the German BIRDTAM/Birdstrike Warning system is presented, since some significant changes have been carried out during the last years. The so far, manual system has been changed into a widely automated system. Database and data processing are briefly explained as well as the new bird migration observing system use at air defense radar stations. Main emphasis is concentrated on the BIRDTAM/Birdstrike Warning - System and BIRDTAM generation algorithm, resulting in new output standards. Advantages of the new system are discussed and future plans are outlines.
Keywords: AVOIDANCE; BSCE; DETECTION; FORECASTING; WARNING SYSTEMS

ABBHA Ref. #: 614

Citation: SEUBERT, J.L. Assessing the Implementation of Wildlife Hazard Management Programs at Civil Airports. Bird Strike Committee Europe 22, WP 50; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 275-284.
Abstract: This paper describes a proposed system for assessing the implementation of wildlife hazard management programs at civil airports. Important management functions and control techniques for controlling wildlife hazards are listed; and habitats, land uses, and food sources are identified that are attractive to wildlife on or in the vicinity of airports.
Keywords: BSCE; CIVIL AVIATION; HAZARD MANAGEMENT; SURVEYS

ABBHA Ref. #: 615
Citation: CACCAMISE, D.F.; DOSCH, J.J.; BENNETT, K.; REED, L.M.; DELAY, L. Management of Bird Strike Hazards at Airports: A habitat approach. Bird Strike Committee Europe 22, WP 51; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 285-306.
Abstract: Management of birdstrike hazards is cost and time consuming, yet effectiveness is limited to special circumstances and short intervals. This project examined bird associations at an airport (ACY) typical of northeastern USA. Our goals were to: (1) identify bird strike hazards, (2) understand their biological basis, and (3) develop management approaches specific to ACY while holding the potential for application at a regional level. ACY provides unique and attractive habitats that support a diverse avian community of at least 127 species. Breeding Laughing Gulls (Larus atricilla) caused the greatest bird strike hazard because their high numbers occurred over the short interval when then provisioned young in colonies 18 km away. Gulls at ACY foraged mainly by abundant Japanese beetles were the primary attractant at ACY and whose emergence coincided with the period of peak food demand by nestlings. We are developing a management approach for Laughing Gulls based on reducing the foods that attract them especially the modification of habitats to reduce the availability of plant species required by Japanese beetles for growth and reproduction.
Keywords: ATLANTIC CITY IAP; ATTRACTANTS; AVOIDANCE; BSCE; CONTROL METHODS; GULLS; HABITAT MODIFICATION; INVERTEBRATES

ABBHA Ref. #: 616
Citation: KUSTERS, E. Man-made lakes and birdstrike risk: Changes in wintering bird communities during the lakes' aging. Bird Strike Committee Europe 22, WP 52; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 307-316.
Abstract: In the Donaumoos near Ingolstadt, Bavaria, gravel-pit lakes in the vicinity of two air bases were investigated with respect to the species succession of wintering waterfowl with increasing age of biological and morphological parameters of the lakes. The first species visiting yound lakes were herbivorous ones searching for food in the littoral zone. They were followed by omnivorous diving macrophytes. Next in line were birds diving for ground-dwelling animals. Though, even on lakes smaller than 4 ha, great numbers of bird could be seen in some cases, as a rule lakes had to be larger than 5 ha to be attractive for waterfowl. Apart from the size of the

lake, bird numbers were influenced by its structure and the amount of food. The most effective way of making large gravel-pit lakes less attractive for waterfowl and, thus reduce the birdstrike risk, is their subdivision by dikes.
Keywords: BSCE; CONTROL METHODS; EXCLUSION; WATERFOWL

ABBHA Ref. #: 617
Citation: YASHON, J. Bird Strike Deterrence and Threat Management at Ben Gurion International Airport, Israel. Bird Strike Committee Europe 22, WP 53; pp. 317-320.
Abstract: Ben Gurion International Airport is subject to a constantly shifting focus of threats from bird activity which depends upon multivariate factors that include bird migration, season of the year, weather and crop growth in the cultivated fields adjacent to the operational area. This calls for an active and aggressive posture from the Bird Control Unit in order to cope with the threat to aircraft safety in and around the airport which is inherent to this situation. The methods employed to deal with the problem are presented in this paper.
Keywords: AIRFIELD PROCEDURES; BSCE; CONTROL METHODS; ISRAEL

ABBHA Ref. #: 618
Citation: DRAVECKY, M. Bird Species composition, quantity and dynamics in areas of Slovak Air Force Airports and in their surroundings. Bird Strike Committee Europe 22, WP 54; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 321-327.
Abstract: Author of this article gives the basic information about the problems of birds at the airports of the Army of the Slovak Republic, about the species composition of avifauna and about the method of quantitative monitoring of birds on the airports listed above. The greatest risk of birdstrikes comes from the nesting population of the species, that nest in airports (and their close surroundings). Seven species (Hirundo rustica, Sturnus vulgaris, Larus ridibundus, Delichon urbica, Ciconia ciconia, Corvus frugilegus, Columba livia f. domestica) fall into the category mentioned above that are particularly dangerous to flight security.
Keywords: BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; SLOVAK REPUBLIC; SURVEYS

ABBHA Ref. #: 619
Citation: HIGGS, D. Aerodrome bird hazard control in the United Kingdom. Bird Strike Committee Europe 22, WP 55; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 329-332.
Abstract: This paper gives the background on bird hazard control on United Kingdom civil aerodromes, how they are regulated in relationship to bird hazard control, and outlines the subjects of a functional review into bird hazard control methods.
Keywords: BSCE; CONTROL METHODS; HAZARD MANAGEMENT; LEGAL ISSUES; POLICY; UNITED KINGDOM

ABBHA Ref. #: 620
Citation: FERNS, P.N.; COWIE, R.J.; SIMONS, J.; WOODBURN, R. Monitoring bird activity

on British airfields. Bird Strike Committee Europe 22, WP 56; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 333-342.
Abstract: The development of a simple form for systematically recording the activity of birds on British airfields is described. A single form is filled in each day and the extracted information stored in a PC database. Monthly summaries can then be extracted either before or after entry into the database. Yearly summaries can be prepared in a similar fashion. It takes approximately 18 person-hours to process the data arising from a single airfield in a year. Using this system, it is possible to quantify differences in bird abundance between sites, and to monitor seasonal and annual changes. It is also possible to monitor bird control operations.
Keywords: BSCE; DATABASES; HAZARD MANAGEMENT; STATISTICS; UNITED KINGDOM

ABBHA Ref. #: 621
Citation: DEKKER, A. Airfield Bird Counts, A Management Tool in the Prevention of On-Airfield Birdstrikes. Bird Strike Committee Europe 22, WP 57; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 343-360.
Abstract: In the successful prevention of on-airfield birdstrikes knowledge of birds plays an important role. This should not be limited to the available general knowledge but also imply detailed information on the local situation of the airfield. In this respect, the importance of regular bird counts is emphasized. Practical considerations in the setup of a counting scheme are dealt with, as well as the relation between birdstrikes and the avifauna of the airfield. Examples from RNLAF experiences show that bird counts can be used in many ways as a management tool. Not only in signaling deviations from normal patterns or in planning of activities in space and time, other important ways to use these counts are in monitoring the effects of habitat management, anticipation for expected bird numbers and in relation to land use in the airport vicinity.
Keywords: BSCE; HAZARD MANAGEMENT; NETHERLANDS; SURVEYS

ABBHA Ref. #: 622
Citation: HAHN, E. Birds as Bioindicators. Bird Strike Committee Europe 22, WP 58; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 361-366.
Abstract: Bioindication means revealing the content of information in living systems for human purpose. Active management of biotopes is the promising method of reducing birdstrike risks by impairing the attraction of areas for birds that cause birdstrikes. Biomonitors and indicators of ecological factors operate on the level of real environmental situations, but in practice, correlations are not found with only one factor. Bioindication applied in the field of birdstrike prevention needs indicator species, for which correlations with ecological factors are found by standardization experiments. When using this method there needs to be a lot of information about the correlations between existing environmental factors and biotope preference of a species. If there is a successful influence of key factors, there will be an enduring effect on frightening away birds.

Keywords: AIRFIELD PROCEDURES; BIRD POPULATIONS; BSCE; CONTROL METHODS; HABITAT MODIFICATION

ABBHA Ref. #: 623
Citation: HORESH, Z.; MILO, Y. Using traps to control pigeons populations in airfields. Bird Strike Committee Europe 22, WP 59; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 367-374.
Abstract: The Columba livia (Rock Dove) is a pigeon that has adapted to a wide range of habitats and has a high level of resistance to varying living conditions. in most place in the world this bird is non-migratory throughout most of the year, and because of its high rate of reproduction, this species has become a damaging nuisance. Throughout the world, efforts are being undertaken to control and prevent the damage caused by this common bird. On airfields, this species presents a serious safety problem, both to the structure and the airspace above them. Much damage is cause to equipment by pigeon dropping. Birds are captured using mechanical traps which has proven to be successful.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; PIGEONS; TRAPPING

ABBHA Ref. #: 624
Citation: DOLBEER, R.A.; BUCKNELL, J.L. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport, 1991-1993. Bird Strike Committee Europe 22, WP 60; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 375-395.
Abstract: The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Laughing gulls (Larus atricalla) comprised 47% of the birds colliding with aircraft from 1988 to 1990, averaging 170 birdstrikes per year. This species is present from May to September in association with a 7,600 nest colony (1990) adjacent to the airport. An experimental program to reduce gull collisions with aircraft was undertaken in 1991-93 in which 2-5 people stationed on airport boundaries used shotguns to shoot gulls flying over the airport from May to August. In 3,401 person-hours of shooting, 35,692 gulls were killed comprised of 32,534 laughing gulls and 3,158 other gull species. The number of laughing gulls struck by aircraft during the shooting period was reduced by 66% in 1991, 89% in 1992 and 90% in 1993, compared with the mean level of 147 strikes during the same time period for 1988-90.In spite of the removal of these gulls, the nesting colony declined by only about 20% from 1990-93. Thus although shooting is an effective means of reducing the incidence of birdstrikes, the program has not significantly reduced the nearby nesting colony. Our recommended solution is to relocate the nesting colony away from JFKIA. A seasonal shooting program should continue to minimize the number of gull-aircraft collisions until this relocation is accomplished.
Keywords: BSCE; CONTROL METHODS; GULLS; JFK IAP; PUBLIC RELATIONS; SHOOTING

ABBHA Ref. #: 625
Citation: CHAMBER, M.; CLAVERO, J. Falconry for Bird Control: The Spanish experience after 26 years. Bird Strike Committee Europe 22, WP 61; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 397-407.
Abstract: The paper contains a summary of the Spanish Air Force experience on the use of falcons for the bird control on the different Air Force Bases and Airports of Spain. The experience started in April 1968 with Operation "Bahari." directed by Professor Felix Rodriguez de la Fuente. A full description of the technique used today together with the operation costs, infrastructure, logistic needs and the number and type of birds flown in the daily operation are detailed in this work.
Keywords: AIRFIELD PROCEDURES; BSCE; CIVIL AVIATION; CONTROL METHODS; FALCONRY; MILITARY AVIATION

ABBHA Ref. #: 626
Citation: BRIOT, J.L.; EUDOT, A. Long range scaring bird cartridges. Bird Strike Committee Europe 22, WP 62; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 409.
Abstract: Today most of the "bangers" on the commercial market explode at 50 to 100 meters. The birds get trained to a "frightening distance" and fly away when the bird patrol car is approaching them, before fire, but not far away. Moreover, if the shot is performed from the control tower, the range is too short for scaring birds on the runway. Finally, safety problems occurred with 12-gauge bangers, which exploded in the gun very often. A new product was developed to solve these problems.
Keywords: AIRFIELD PROCEDURES; BSCE; CONTROL METHODS; PYROTECHNICS

ABBHA Ref. #: 627
Citation: THORPE, J. Bird Hazard Checklist. Bird Strike Committee Europe 22, WP 63; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 411-412.
Abstract: The checklist is a sequence of points leading from recognition of a bird strike problem to the implementation of full measures. It was developed during the ICAO Bird Hazard Workshop in Nairobi, June, 1989 and presented at the Santiago, Chile workshop in 1993.
Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 628
Citation: VOGT, P.F.; NACHTMAN, T.; CLARK, L. ReJeX-iT Bird Aversion Agents: The control of birds at landfills. Bird Strike Committee Europe 22, WP 64; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 413-424.
Abstract: Three case studies are presented that evaluate the effectiveness of ReJeX-iT AF-50 bird aversion agent at reducing the number of gulls present at landfills. In all cases, application

of the bird repellent, alone or in combination with other hazing techniques resulted in decreases in gull numbers. Whether periodic or continuous treatment is necessary depends largely on the proximity and number of other resources near the landfill that are attractive to gulls. Use of this gull control strategy will be of special interest to landfill operators and aviation authorities because it will decrease the attractiveness of the sanitary landfill to gulls. In the absence of an attractive resource near airports, the number of gulls in critical airspace will most likely decrease, leading to greater air traffic safety.
Keywords: BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; LANDFILLS; REPELLENTS

ABBHA Ref. #: 629
Citation: MONTEMAGGIORI, A.; DALL'ANTONIA, P.; ROMANO, G. The use of recoveries of ringed birds in order to assess potential bird hazards in aerodromes. Bird Strike Committee Europe 22, WP 65; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 425-448.
Abstract: In order to give to each aerodrome a rough risk value regarding the potential bird hazard, reoveries of ringed birds (data from the Italian Ringing Scheme) have been used. Six Italian international airports were selected as example sites (Milan, Venice, Genoa, Rome, Cagliari and Palermo) and recoveries around each site were analyzed. For each bird species a risk value was calculated considering weight, strike statistics, habitat and behavior. Examples of monthly and seasonal risk scales are shown for selected sites. This kind of analysis can be a useful tool in order to give important information for bird strike hazard prevention.
Keywords: BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; MARKING/BANDING; RISK ASSESSMENT; SURVEYS

ABBHA Ref. #: 630
Citation: FAZIO, G.; LEZZERINI, L.; SACERDOTI, G.; CAPORALETTI, M.; SACERDOTI, D.; VISCO, R. Supervision of Airport Areas by Techniques of Acoustic Survey and Analysis. Bird Strike Committee Europe 22, WP 66; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 449-467.
Abstract: The paper contains an experimental monitoring of Leonardo da Vinci Airport, to survey birds' presence in airport areas by acoustic methodology.
Keywords: BSCE; HAZARD MANAGEMENT; ITALY; SOUND; SURVEYS

ABBHA Ref. #: 813
Citation: STENMAN, O.; HELKAMO, H. Bird Strike Prevention at Helsinki-Vantaa Airport. Bird Strike Committee Europe 22, WP 67; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 467-470.
Abstract: The paper gives a first view of the birdstrike prevention at Helsini-Vantaa airport from 1979-93. There have been many changes in the bird patrol, which has taken care of bird controlling under a local birdstrike committee. Consequences of the bird control project are then discussed on the basis of quantity and quality of birdstrikes reported at the airport. The strike

statistics have been divided into several separate categories. This makes the possibilities for statistical analyses scanty. However, there are indications to show that the development of birdstrike prevention has continued in the right direction.
Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 814
Citation: HORTON, N. Aerodrome BirdStrike Statistics: How Useful Can They Be? Bird Strike Committee Europe 22, WP 68; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 471-473.
Abstract: Tim Milsom reported to BSCE at Helsinki in 1990 (WP#30) on how birdstrike statistics can be used to monitor the hazard and evaluate the risk at an individual aerodrome. He reported on how the established total birdstrikes per 10,000 movements was a weak monitoring statistic, although widely used throughout the world, as it did not reveal any underlying trends which have now been shown to be significant. Since 1990, two further years of data have been added to the database and a final report prepared which is soon to be published by the Central Science Laboratory: the major points are summarized here.
Keywords: BSCE; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 842
Citation: SALTER, A. Military aircraft birdstrike analysis: 1972. Bird Strike Committee Europe 9, WP 4.1, Frankfurt, Germany; 18-21 June, 1974.
Abstract: This report contains a brief assessment of the data which has been provided by BSCE members on strikes to military aircraft. The strikes to civil aircraft are reported separately in UK CAA Technical Note # 10, dated May 1974. The data received was unsatisfactory in both accuracy and content. The BSCE form used may not be ideally suited to the military case and if necessary, at the next BSCE meeting, ways in which the form can be simplified and improved should be discussed.
Keywords: BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 843
Citation: THORPE, J. Bird strikes during 1972 to European-registered civil aircraft. Bird Strike Committee Europe 9, WP 4.2, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The strikes, reported during 1972 throughout the world by European operators, to aircraft of greater than 5700 kg (12,500 lb), have been analyzed. The results are discussed and some problem areas highlighted. The overall rate for the seven European countries which have provided information is 3.11 per 10,000 movements.
Keywords: BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 844

Citation: JACOBY, V.E. Introduction to birdstrikes in USSR. Bird Strike Committee Europe 9, WP 4.3.1, Frankfurt, Germany; 18-21 June, 1974.
Abstract: All strikes would be reported in their greatest detail. The numerous, insignificant strikes provide much useful information as the comparably few which cause damage. The continuing, long-term collection of bird strike data will provide a fuller understanding of the many aspects of the problem.
Keywords: BSCE; CIVIL AVIATION; REPORTING; STATISTICS; USSR

ABBHA Ref. #: 845
Citation: JACOBY, V.E.; GORYACHEV, V.A. Analysis of birdstrikes in civil aviation of the USSR: biological and technical aspects. Bird Strike Committee Europe 9, WP 4.3.2, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The biological aspects of bird strike analysis has the greatest importance for the prevention of bird hazards on airports. Analysis of birdstrike cases allows the formulation of two main requirements concerning bird resistance of turbine engines: (1)there should be no engine failure in case of the maximum, number of small birds being ingested; and, (2)mechanical damage should not affect the essential components and structural integrity.
Keywords: BSCE; CIVIL AVIATION; ENGINEERING; ENGINES; STATISTICS; USSR

ABBHA Ref. #: 846
Citation: POLITT, W. The problem of birdstrikes in statistics and analysis. Bird Strike Committee Europe 9, WP 4.4, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The report covers problems connection with the statistical registration and analysis. Data illustrate the different subjects raised. To conclude, the author outlines the possibilities of international cooperation and analysis with the objective of improving safety in aviation.
Keywords: BSCE; HAZARD MANAGEMENT; STATISTICS

ABBHA Ref. #: 847
Citation: HILD, J. The birdstrike problem in German Air Force: Background, analysis and instruction. Bird Strike Committee Europe 9, WP 4.5, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The report covers the airfield bird hazard problems as well as methods of investigation and research, types of provisions and effectiveness, and publication and instructions given to help manage the problem.
Keywords: BSCE; HAZARD MANAGEMENT; MILITARY AVIATION; ORGANIZATION; WEATHER

ABBHA Ref. #: 848
Citation: BECKER, J. Birdstrikes German Air Force Part II: Actual advisory procedures. Bird

Strike Committee Europe 9, WP 4.5.2, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The report covers data processing of bird observations and long-term bird movement forecasting. The forecast can be based on eight years of bird observation and only must consider the weather forecast.
Keywords: BSCE; FORECASTING; HAZARD MANAGEMENT; MILITARY AVIATION; WEATHER

ABBHA Ref. #: 849
Citation: BRUDERER, B. Multiple regression analysis of weather and migration data in Switzerland. Bird Strike Committee Europe 9, WP4.6, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The migration data used for this pilot study were collected with a tracking radar during 44 nights of spring migration in 1968 and 1969. For the weather data we selected 18 variables; the most important variables are: temperature and its changes, visibility, time since rain, change and amount of tailwind-vector at surface, cloud height, and atmospheric instability. The important correlation is between the weather in the recruiting area at the time of departure and the intensity of migration.
Keywords: BSCE; EUROPE; FORECASTING; HAZARD MANAGEMENT; MIGRATION; RADAR; WEATHER

ABBHA Ref. #: 850
Citation: RABOL, J. Forecast models for bird migration intensities in Denmark. Bird Strike Committee Europe 9, WP 4.7, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The development of forecast models for bird migration intensity has been described in a preliminary report; here only a summary is provided. Four methods were used: intensity as compared with general weather situation; simple correlation coefficients between intensity and a number of weather factors; partial correlation coefficients; and, multiple regression analysis. Methods 1 and 2 produced good results and similar forecasts.
Keywords: BSCE; DENMARK; FORECASTING; HAZARD MANAGEMENT; MIGRATION

ABBHA Ref. #: 851
Citation: ALERSTAM, T. Visible bird migration and weather. Bird Strike Committee Europe 9, WP 4.8, Frankfurt, Germany; 18-21 June, 1974.
Abstract: In Sweden the relation between bird migration and weather are analyzed primarily on the basis of visible data. These data must be treated with due circumspection when used for the purpose of forecasting migratory activity over different regions. Extensive field and radar observations over much of southern Sweden during have provided data for proper evaluation.
Keywords: BSCE; FORECASTING; HAZARD MANAGEMENT; MIGRATION; SWEDEN; WEATHER

ABBHA Ref. #: 852
Citation: SOLMAN, V.E.F. Progress made in Canada since last BSCE meeting. Bird Strike Committee Europe 9, WP 4.9, Frankfurt, Germany; 18-21 June, 1974.
Abstract: During the past year the Associate Committee on Bird Hazards to Aircraft has continued research on reduction of bird hazards under a number of conditions. A summary of nine projects is provided.
Keywords: BSCE; CANADA; HAZARD MANAGEMENT; NORTH AMERICA

ABBHA Ref. #: 853
Citation: LOUETTE, M. Lapwing investigations on Beauvechain airport. Bird Strike Committee Europe 9, WP 4.11, Frankfurt, Germany; 18-21 June, 1974.
Abstract: At Beauvechain (central Belgium) vast numbers of Lapwings reside during the months of September through January. As birds prefer short grass an experiment was conducted using "islands" of long grass. A weekly count was performed and the distribution of birds recorded.
Keywords: BELGIUM; BIRD SURVEYS; BSCE; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 854
Citation: LUNIAK, M. Polish ornithological investigations having some significance to bird strike problems. Bird Strike Committee Europe 9, WP 4.12, Frankfurt, Germany; 18-21 June, 1974.
Abstract: No ornithological investigations have been undertaken in Poland relating to birdstrike hazards to civil aviation. Three areas are suggested: (1) distribution and ecology of species causing problems; (2) migration; and (3) methods of scaring birds.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; EUROPE; POLAND

ABBHA Ref. #: 855
Citation: HUNT, F.R. Radar detection of birds in an operational environment. Bird Strike Committee Europe 9, WP 4.13, Frankfurt, Germany; 18-21 June, 1974.
Abstract: In Canada, we feel we have practical answers now for the operational use of radar for the detection of both types of bird migration: broad area and flock migrations. It is important to persuade Air Traffic Control that the automatic detection equipment and displays can provide useful information for the controllers. ATC still must determine how vital migration altitude information is before a final determination may be made on system specifications.
Keywords: BSCE; DETECTION; MIGRATION; RADAR

ABBHA Ref. #: 856
Citation: BLACKWELL, F.; WILMOT, T.A.W.; HOUGHTON, E.W. Analysis and classification of bird flight and echo data obtained by radar. Bird Strike Committee Europe 9,

WP 4.14, Frankfurt, Germany; 18-21 June, 1974.
Abstract: The large scale movements of birds observed on the plan position indicator of a surveillance radar cannot be resolved to give the identity and size of single birds unless the bird movements are sampled by a high resolution radar capable of isolating and examining individual bird echoes. Radar flight and echo data is required for the study of bird movements, for gauging the birdstrike threat, for estimating the bird size and for possible identification of bird species. A large amount of flight and echo data can be obtained from a high resolution tracking radar during a two minute period of bird tracking.
Keywords: BSCE; DETECTION; LOCAL MOVEMENTS; RADAR

ABBHA Ref. #: 857
Citation: BROUGH, T.; HOUGHTON, E.W. Estimating the physical dimensions of birds by radar. Bird Strike Committee Europe 9, WP 4.15, Frankfurt, Germany; 18-21 June, 1974.
Abstract: This study of a sample population of 58 European birds shows that empirical relationships can be found between wing beat frequency and physical dimension. The dimensions of wing length can be estimated more accurately than weight. Equations are best calculated from a sample population of as many species as possible with values distributed as uniformly as possible along a regression curve and overlapping the desired dimension scaler.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; RADAR

ABBHA Ref. #: 858
Citation: LOUETTE, M. Bird-migration forecasting: some background problems. Bird Strike Committee Europe 8, WP 5.1, Paris, France; 23-24 May, 1973.
Abstract: This paper discusses some difficulties with trying to correlate weather phenomena with bird migration intensity. The effect of changes within one or two important species may produce a totally different sequence in migration periods from one year to another.
Keywords: BSCE; FORECASTING; MIGRATION; RADAR; WEATHER

ABBHA Ref. #: 859
Citation: ROBIJN, J. The use of a regression in forecasting bird migration and the choice of variables in the multiple regression model. Bird Strike Committee Europe 8, WP 5.2, Paris, France; 23-24 May, 1973.
Abstract: This paper summarizes the theoretical considerations on the multiple regression model of weather and bird migration intensity.
Keywords: BSCE; FORECASTING; MIGRATION; STATISTICS; WEATHER

ABBHA Ref. #: 860

Citation: HILD, J. Procedure of birdstrike warning, forecast and advisory in Germany. Bird Strike Committee Europe 8, WP 6.2, Paris, France; 23-24 May, 1973.
Abstract: The birdstrike warning system in Germany is based on visual and radar observation of bird movements and must be subdivided in a local and regional warning. Local warnings are given on the basis of visual or radar observation of birds in the control area of the single airfields by the meterological personnel. The regional warning system is based on visual and radar observations which are worked up in a central evaluation office regarding seasonal weather situations. There are three types of regional warnings: long-term bird movement forecasts, birdstrike risk forecasts, and Birdtams.
Keywords: BIRD POPULATIONS; BSCE; FORECASTING; GERMANY; HAZARD MANAGEMENT; WEATHER

ABBHA Ref. #: 861
Citation: HOUGHTON, E.W. Analysis and classification of bird flight and echo data obtained by radar. Bird Strike Committee Europe 8, WP 8.1, Paris, France; 23-24 May, 1973.
Abstract: A chain of radars, visual observation ports and meterological stations from Scandinavia to the Mediterranean have been employed to watch the migration of birds. Migration to be seen from Gibraltar are narrow-front movements of raptors and soaring birds, and broad-front movements of passerines and waterfowl across the Mediterranean, and seabird migrations in and out of the Mediterranean. Although the attempt to correlate bird movements and weather information is the chief feature of this cooperative project, it will be some time before each country has evaluated their analysis results.
Keywords: BSCE; DETECTION; EUROPE; FORECASTING; MIGRATION; RADAR

ABBHA Ref. #: 862
Citation: CLAUSEN, P.R. Electronic counting of birds. Bird Strike Committee Europe 8, WP8.1, Paris, France; 23-24 May, 1973.
Abstract: The determination of bird densities has been performed in Denmark by a photographic system since 1968. Because of certain disadvantages, an electronic counting system was developed to obtain more reliable, accurate, faster and cheaper bird warning system. A description of the electronic system is provided.
Keywords: BIRD POPULATIONS; BSCE; FILM/VIDEO; FLOCK DENSITY; VISUAL

ABBHA Ref. #: 863
Citation: BECKER, J. General considerations about entomological investigations on airfields. Bird Strike Committee Europe 8, WP9.1, Paris, France; 23-24 May, 1973.
Abstract: The reason so many birds are found on airfields is that large grasslands offer rich food sources of soil invertebrates. This paper addresses the entomological investigations on Cologne airfield beginning in September 1972.
Keywords: AERODROME SURVEYS; ATTRACTANTS; BSCE; EUROPE; FOOD; GERMANY; INVERTEBRATES

ABBHA Ref. #: 864
Citation: HILD, J. Special considerations about handling of grassland areas on airfields. Bird Strike Committee Europe 8, WP9.2, Paris, France; 23-24 May, 1973.
Abstract: Grassland is the most common type of vegetation on all airfields. The special type of bird population in the grassland of the various airfields depends on the district of the country, on precipitation, moisture of ground, composition of grassland and animal species living in soil as well as on the handling of grassland areas by mowing, cutting or spraying chemical substances. This paper addresses the results of nearly 8 years of observations of birds on airfield grasslands.
Keywords: AERODROME SURVEYS; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; EUROPE; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 865
Citation: KARLSSON, J.; TURESSON, L.-O. Preliminary works before the opening of Malmoe/Sturup airport for the purpose of reducing the risks of birdstrikes. Bird Strike Committee Europe 8, WP 9.3, Paris, France; 23-24 May, 1973.
Abstract: Some preliminary studies concerning bird problems began four years before the opening of the new airport Malmoe/Sturup. In 1972 a program to help reduce birdstrikes was prepared:(1) employment of a biologist; (2) plan for habitat modification; (3) research on the best grass cover; (4) tests of different bird scaring equipment; (5) radar observations; and, (6) bird intensity forecasting system.
Keywords: AERODROME DESIGN; AERODROME SURVEYS; BSCE; CONTROL METHODS; EUROPE; HAZARD MANAGEMENT; LANDSCAPING; PLANS; SWEDEN

ABBHA Ref. #: 866
Citation: THORPE, J. Bird strikes to United Kingdom civil aircraft 1966-1971. Bird Strike Committee Europe 8, WP 10.1, Paris, France; 23-24 May, 1973. (Document not included in proceedings. Available from author.)
Abstract: The strikes, reported on a world-wide basis by United Kingdom operators to aircraft of greater than 5700 kg (12,500 lb), during the 6-year period 1966-1971 have been analyzed. The results are discussed and the problem areas highlighted.
Keywords: BSCE; CIVIL AVIATION; STATISTICS; UNITED KINGDOM

ABBHA Ref. #: 867
Citation: SCHNEIDER, E.P. The result of the preventative birdstrike work in Denmark. Bird Strike Committee Europe 8, WP 11.3, Paris, France; 23-24 May, 1973.
Abstract: The preventative birdstrike work was accelerated in Denmark in 1969 and was first directed against the en route problem. Statistics are discussed showing that the birdstrike forecasting procedure resulted in a reduction of birdstrikes.

Keywords: BSCE; DENMARK; FORECASTING; HAZARD MANAGEMENT

ABBHA Ref. #: 868
Citation: HILD, J. The birdstrike problem and public relations (P.R.) in West Germany. Bird Strike Committee Europe 8, WP11.2, Paris, France; 23-24 May, 1973.
Abstract: Discusses approach to spread the information concerning the birdstrike problem. References public relations films on birdstrike problems caused by landfills and another film on general aspects of birdstrikes.
Keywords: AUDIO-VISUAL; BSCE; FILM/VIDEO; HAZARD MANAGEMENT; PUBLIC RELATIONS

ABBHA Ref. #: 869
Citation: LID, G. The birdstrike problem and public relations (P.R.) in Norway. Bird Strike Committee Europe 8, WP 11.3, Paris, France; 23-24 May, 1973.
Abstract: Presents statistics concerning the birdstrike problem in Norway. These type of statistics help make the air traffic personnel and the general public aware of the birdstrike problem. Included is a newspaper article regarding radar tracking of birds.
Keywords: BSCE; DETECTION; MILITARY AVIATION; NORWAY; PUBLIC RELATIONS; RADAR; STATISTICS

ABBHA Ref. #: 870
Citation: LATY, M. The bird problem in France: Research activity. Bird Strike Committee Europe 8, WP 11.4, Paris, France; 23-24 May, 1973. (in French.)
Abstract: Discusses bird movements in relation to the aerodrome: regional movements on-aerodrome and migration of birds outside the boundaries of the aerodrome.
Keywords: BIRD POPULATIONS; BSCE; FRANCE; LOCAL MOVEMENTS; MIGRATION

ABBHA Ref. #: 871
Citation: BLOKPOEL, H. Presentation of a book covering all aspects of bird hazards to aircraft. Bird Strike Committee Europe 8, WP11.5, Paris, France; 23-24 May, 1973.
Abstract: Over the last ten years much work has been accomplished regarding bird hazards to aircraft, and much more remains to be done. A book is underway that will present information on the problem in a lucid, simple style that will have a wide appeal to laymen interested in aviation or ornithology.
Keywords: BIBLIOGRAPHIC; BOOKS/MANUALS; BSCE; GENERAL

ABBHA Ref. #: 874

Citation: HOUGHTON, E.W.; BLACKWELL, F. Use of bird activity modulation waveforms in radar identification. Bird Strike Committee Europe 7, WP2.1, London, United Kingdom; 6-7 June, 1972.
Abstract: Generally, the echoes of large scale movements of birds can be separated out from those of weather, sea and ground clutter. The wing and body activity of flying animals, such as birds, bats and insects produce changes in their radar echoes which results in amplitude modulation of the echo signal. Those wing and body activity modulation waveforms generated by birds can be separated out from bats and insects by making use of waveform characteristics, echo intensity, trajectory and velocity characteristics recorded on a tracking radar. Some examples of bird activity modulation (BAM) waveforms and spectra are presented to illustrate differences between species.
Keywords: BSCE; DETECTION; RADAR

ABBHA Ref. #: 875
Citation: LOUETTE, M. The distribution of the Black-headed Gull (Larus ridibundus) in Belgium. Bird Strike Committee Europe 7, WP3.1, London, United Kingdom; 6-7 June, 1972.
Abstract: Among species responsible for birdstrikes in Belgium (based on Belgium Air Force data) the Black-headed Gull occupies the second place, immediately after the domestic pigeon. This investigation outlines the hazardous kind of this species by describing their distribution and behavior. This paper provides an in-depth evaluation of this species' movements throughout the year.
Keywords: BELGIUM; BIRD POPULATIONS; BSCE; GULLS; LOCAL MOVEMENTS; MIGRATION

ABBHA Ref. #: 876
Citation: STORTENBECKER, C.W. Bird dispersal with acoustical and visual means. Bird Strike Committee Europe; BSCE 7, WP2.3, London, United Kingdom; 6-7 June, 1972.
Abstract: This paper is a short account of the progress made in two research projects: response and habituation of starlings to acoustic stimuli, distress and alarm calls in particular; and, the effect of extended polystyrene models on gulls on airfields.
Keywords: BIOACOUSTICS; BSCE; CONTROL METHODS; EFFIGIES; GULLS; SOUND; STARLINGS

ABBHA Ref. #: 877
Citation: JACOBY, V.E. Ornithological research in the USSR in connection with the birdstrike problem. Bird Strike Committee Europe 7, WP2.4, London, United Kingdom; 6-7 June, 1972.
Abstract: The ornithological research being carried out in the USSR to prevent birdstrikes is being directed to investigate general aspects of bird behavior: (1) the study of bird behavior peculiarities when a new factor, such as a plane, appears in the environment; (2) bird attractants at airports; and, adaptive behavior of birds in connection with weather conditions, particularly

during migration. The observations and collection of data have been carried out during the inspection of several airports in the Baltic, Caucasian, and Ukranian regions.
Keywords: ATTRACTANTS; BIRD POPULATIONS; BSCE; MIGRATION; WEATHER

ABBHA Ref. #: 878
Citation: BRUDERER, B. Some statements and some questions to the bird problem at Zurich airport. Bird Strike Committee Europe 7, WP2.5, London, United Kingdom; 6-7 June, 1972.
Abstract: Collecting bird carcasses on runways and taxiways after collisions from 1963-71 provides insights as to the distribution and attractants of hazardous bird species.
Keywords: AERODROME SURVEYS; ATTRACTANTS; BIRD POPULATIONS; BSCE; EUROPE; SWITZERLAND

ABBHA Ref. #: 879
Citation: KEIL, W. Ecological research in the aerodrome traffic zone and its results. Bird Strike Committee Europe 7, WP2.6, London, United Kingdom; 6-7 June, 1972.
Abstract: The statistic shows that about 75-80 percent of the birdstrikes in civil aviation occur on the aerodrome or during the phases of landing or takeoff. Ecological research is conducted on the aerodromes and the surroundings. It was shown that the aerodrome surveys and implementation of appropriate measures reduced the birdstrike rate. In many cases, amateur ornithologists are doing the airfield surveys under direction of a birdstrike research committee and the aerodrome authorities.
Keywords: AERODROME SURVEYS; BIRD POPULATIONS; BSCE; EUROPE; GERMANY

ABBHA Ref. #: 880
Citation: KUHRING, M.S. Projects of Associate Committee on Bird Hazards to Aircraft:National Research Council of Canada. Bird Strike Committee Europe 7, WP2.7, London, United Kingdom; 6-7 June, 1972.
Abstract: A list of 21 projects undertaken by the Associate Committee on Bird Hazards to Aircraft, Canada.
Keywords: BIRD POPULATIONS; BSCE; CANADA; CONTROL METHODS; DETECTION; HAZARD MANAGEMENT

ABBHA Ref. #: 881
Citation: HILD, J. Proposal for Bird Hazard Maps Europe. Bird Strike Committee Europe 7, WP2.8, London, United Kingdom; 6-7 June, 1972.
Abstract: A collection of preliminary bird hazard maps is finished. The German Air Force is sending copies of all maps within the next few months with an attached description. Larger maps are planned and arrangements are made to ensure maximum dissemination.

Keywords: AVOIDANCE; BSCE; GERMANY; HAZARD MANAGEMENT; MAPS

ABBHA Ref. #: 882
Citation: HILD, J. Birdstrike situation in the German Air Force. Bird Strike Committee Europe 7, WP2.9 London, United Kingdom; 6-7 June, 1972.
Abstract: The organization of the birdstrike reduction program is discussed. The ecological evaluations were completed at all airfields. Airfields are revisited every 2-4 years to evaluate the implementation and efficacy of the recommendations. Measures to prevent "in-flight" birdstrikes are also discussed.
Keywords: AERODROME SURVEYS; BIRD POPULATIONS; BSCE; EUROPE; FORECASTING; GERMANY; HAZARD MANAGEMENT; LOCAL MOVEMENTS; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 884
Citation: GEZELIUS, J.O.; ALERSTAM, T. Bird-airplane collisions at low altitudes: Planned preventive actions of the Swedish Air Force. Bird Strike Committee Europe 7, WP2.10 London, United Kingdom; 6-7 June, 1972.
Abstract: The Swedish Air Force flies over 100,000 hours annually. The increased rate of bird-collisions during the last decade has led to the birdstrike problem being one of the most important tasks for the Flight Safety to solve. A "prognosis" of bird strikes may be obtained through proper coordination of information collected from a variety of sources. Simultaneous radar and field studies provide data necessary for statistical treatment of visible migration.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; HAZARD MANAGEMENT; LOW LEVEL; MIGRATION; MILITARY AVIATION; RADAR; SWEDEN

ABBHA Ref. #: 885
Citation: KEIL, W. An analysis of the bird strike reports from the Deutsche Lufthansa. Bird Strike Committee Europe 7, WP2.11 London, United Kingdom; 6-7 June, 1972.
Abstract: The German commercial carrier, Lufthansa, has recorded bird strikes since 1965. The first five years' data is incomplete because the aircrew did not report all birdstrike events. Since then, pilots have undergone additional awareness training which has caused a dramatic increase in the statistics.
Keywords: BSCE; CIVIL AVIATION; GERMANY; HAZARD MANAGEMENT; STATISTICS; TRAINING

ABBHA Ref. #: 886
Citation: THORPE, J. An analysis of bird strikes. Bird Strike Committee Europe 7, WP2.12 London, United Kingdom; 6-7 June, 1972.
Abstract: In depth summaries of bird strike reports are presented. It is important to structure the

data analysis to address the questions the interested parties want. The rationale is presented for dividing the statistics into different categories and the normalization of the data.
Keywords: BSCE; CIVIL AVIATION; REPORTING; STATISTICS

ABBHA Ref. #: 887
Citation: FERRY, V.E. Radar observation and avoidance procedures which can be employed by an air traffic controller. Bird Strike Committee Europe 7, WP2.13 London, United Kingdom; 6-7 June, 1972.
Abstract: Radars of 23 cm wavelength, used for the surveillance of air traffic, provide for the detection, under certain conditions, of birds flying singly or in groups. Air traffic controllers can identify the echoes caused by the birds and can transmit this information to aircrews.
Keywords: AVOIDANCE; BSCE; DETECTION; RADAR; VERBAL NOTIFICATION; WARNING SYSTEMS

ABBHA Ref. #: 888
Citation: BROUGH, T. Experimental use of long grass in the U.K. Bird Strike Committee Europe 6, WP2.1 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: On ten Royal Air Force airfields, the height of grass was maintained at 15-25 cm on both sides of and within 90 meters of the main runway instead of being kept short (5 cm). For two years report forms showing the distribution of birds on the airfield were completed four times weekly. Analysis of the reports showed that when birds were present, they occurred 2-4 times more frequently on the short grass areas.
Keywords: BSCE; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 889
Citation: LIND, H. An attempt to reduce the Herring Gull population of Saltholm, near Kastrup airport. Bird Strike Committee Europe 6, WP2.2 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: On Kastrup Airport (Copenhagen), the Herring Gulls constitute the main birdstrike problem. Many of these birds come from a small island so eggs were sprayed in order to reduce the populations of gulls. The reduction of fledged young was estimated at 50 percent.
Keywords: BSCE; CONTROL METHODS; DENMARK; DEPREDATION; EGGS/NESTS; GULLS

ABBHA Ref. #: 890
Citation: MOLLEN, G.U. The utilization of the distress call for scaring birds from airfields. Bird Strike Committee Europe 6, WP2.3 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: This paper gives a detailed account of the use of bird distress calls for dispersing birds from airfields. The procedures are examined as are interspecific differences in bird behavior to

the distress calls.
Keywords: BIOACOUSTICS; BSCE; CONTROL METHODS; SOUND

ABBHA Ref. #: 891
Citation: HILD, J. Mixtures of grass seed for airports. Bird Strike Committee Europe 6, WP2.4 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: This paper gives a detailed comparison of different species of turf grass for airfield vegetation. Generally, three criteria must be met by airport ground cover: (1) small numbers of dicotyledon species that would provide food for birds; (2) protection for aircraft that may leave the runway/taxiway; and, (3) limited annual growth to reduce mowings per year.
Keywords: AT TECH LIB; ATTRACTANTS; BSCE; HABITAT MODIFICATION; LONG GRASS; VEGETATIVE

ABBHA Ref. #: 892
Citation: DE LA FUENTE, R. Use of Falcons for the control of birds hazardous to aircraft. Bird Strike Committee Europe 6, WP2.5 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: Operation Bahari was initiated in 1968 at Torrejon Air Base near Madrid, Spain. Six Peregrine Falcons were used to control the use of the airfield by Little Bustards. Falcons can provide excellent control of birds on airfields at a reasonable cost compared to other control measures. Well trained birds and handlers are important to the success of a falconry program.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; EUROPE; FALCONRY; SPAIN

ABBHA Ref. #: 893
Citation: KEIL, W. Report about the bird strike situation in Lufthansa, 1970. Bird Strike Committee Europe 6, WP2.7 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: Lufthansa sustained 232 birdstrikes in 1970. The maximum occurred during the autumn migration (August - October). 81.6 percent of the birdstrikes took place on the airport or during approach and departure of aircraft; this means that in civil aviation the biggest problem has to be solved on or near the airport. The most important strikes occur on the engines. In 1970, Lufthansa had damage on 20 engines, 19 had to be changed at a cost of about $US 400,000. The lowest strike rate on engines was with the Boeing 727 aircraft where the engines are on the tail.
Keywords: AT TECH LIB; BSCE; CIVIL AVIATION; ENGINES; GERMANY; STATISTICS

ABBHA Ref. #: 894
Citation: HILD, J. Incidents depending on birdstrikes in air traffic of the Federal Defense Forces in 1968-70. Bird Strike Committee Europe 6, WP2.8 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: The quantity of birdstrikes increased seriously in 1970 compared to preceding years. The data is reported according to phase of flight, month, geographical area and by airfield.

Keywords: AT TECH LIB; BSCE; GERMANY; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 895
Citation: KEIL, W. Exchange of information about birdstrikes. Bird Strike Committee Europe 6, WP2.9 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: The German Birdstrike Committee suggests that information regarding birdstrikes should be shared between commercial airlines and national committees.
Keywords: AT TECH LIB; BSCE; GERMANY; REPORTING; STATISTICS

ABBHA Ref. #: 896
Citation: SOLMAN, V.E.F. Birds, weather radar working group. Bird Strike Committee Europe 6, WP2.10 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: The Scientific Affairs Division of NATO has approved a US$ 40,000 to be divided among the seven countries, Belgium, Denmark, France, Germany, Netherlands, Norway and the United Kingdom for work on tracking and warning of birds using weather radar. Each of these countries will collect data on bird movements using weather radar. The first analysis should be a search for correlations between intensity of bird movements and relationship of the observation station to the synoptic weather pattern.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; HAZARD MANAGEMENT; RADAR; STATISTICS; WARNING SYSTEMS

ABBHA Ref. #: 897
Citation: NOER, H. Recent development of the Danish bird migration forecast. Bird Strike Committee Europe 6, WP2.11 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: In 1969, research was initiated to study relationships between birds and weather with the aim to forecast potentially hazardous bird movements. Three years of radar observation of birds in Denmark are being collected. The initial results show dependence of meterological conditions on flock size.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 898
Citation: HOUGHTON, E.W. ATC and bird radar surveillance without tears. Bird Strike Committee Europe 6, WP2.12 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: This paper discusses the technical limitations to using air traffic control radars to warn of birds.

Keywords: AT TECH LIB; AVOIDANCE; BSCE; DETECTION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 899
Citation: BRUDERER, B. Bird/weather/radar work in Switzerland. Bird Strike Committee Europe 6, WP2.13 Copenhagen, Denmark; 15-17 June, 1971.
Abstract: Observations with surveillance radar at Zurich airport show that the prevailing bird migration in Northern Switzerland takes place on a broad front. The horizontal distribution of echoes is nearly the same during day and night migration. The principal direction is southwest in autumn and northeast in spring. Only about 4 percent of the migrants were large birds. Altitude distribution and intensity of migration vary on a large scale according to the weather development.
Keywords: AT TECH LIB; BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR; SWITZERLAND

ABBHA Ref. #: 900
Citation: WOLLESWINKEL, H.N. Bird impact capacity of civil aircraft. Bird Strike Committee Europe 4, Appdx IV, The Hague, Netherlands; 3-5 June, 1969.
Abstract: There are three ways to approach the bird problem: avoid strikes, protect the aircraft, and increase the inherent ability of the aircraft to tolerate birdstrikes. This paper focuses on the third approach and detailed discussion on bird weight, bird strike specifications, airframe components, and operational reduction of birdstrikes. A reliable forecast and warning system for large birds in combination with reduced speed at lower altitudes is recommended.
Keywords: AT TECH LIB; AVOIDANCE; BSCE; CERTIFICATION STANDARDS; ENGINEERING; WARNING SYSTEMS

ABBHA Ref. #: 901
Citation: JAKOBI, V.; SEVERTZOV, A.N. The elaboration of bird strikes means for some species and groups as a problem. Bird Strike Committee Europe 22, WP 69; Vienna, Austria; 29 Aug - 2 Sep 1994: p. 475.
Abstract: The identification of birdstrikes and the particular circumstances leading to the event can help in determining the means to prevent them. Sometimes it is difficult to determine how to reduce birdstrikes with certain types of birds, especially collisions with gliding, diurnal birds of prey, swallows, and swifts. We propose to use aircraft radar to help repel birds.
Keywords: AT TECH LIB; BSCE; CONTROL METHODS; HAZARD MANAGEMENT; MICROWAVES
ABBHA Ref. #: 902
Citation: MARTINDALE, I. Bird ingestion and Rolls-Royce wide chord fan. Bird Strike Committee Europe 22, WP 80; Vienna, Austria; 29 Aug - 2 Sep 1994: p. 477.
Abstract: This paper introduces the Rolls Royce wide chord fan and explains its advantages over

high aspect ration, snubbered fan blades. The latest generation superplastically formed fan blade is compared with other styles of fan, showing the principles of its construction and the duty it has to perform. One of the many requirements for the fan is that it must be able to withstand the impact of birds and still produce adequate thrust. The design work and tests which lead up to engine certification for bird ingestion are described.
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 903
Citation: SHORR, B.F.; INOSEMZEV, A.A.; RUDAVETZ, V.A. Numerical and experimental analysis of the bird strike fan resistance. Bird Strike Committee Europe 22, WP 82; Vienna, Austria; 29 Aug - 2 Sep 1994: p. 491.
Abstract: Some results of numerical evaluation of the bird strike resistance of turbofan blades in comparison with experimental data are presented.
Keywords: AIRCRAFT SYSTEM; AT TECH LIB; BSCE; ENGINEERING; ENGINES; MATHEMATICAL MODELS

ABBHA Ref. #: 904
Citation: OUELLET, H. Keratin protein electrophoresis and the identification of feather remains: New developments and update. Bird Strike Committee Europe 22, WP 90; Vienna, Austria; 29 Aug - 2 Sep 1994: p. 499 - 512.
Abstract: Feather identification by visual means leaves a percentage of unidentified samples at the lower taxonomic levels, genus and species, particularly, single feathers or small fragments. After an initial period of technical development and research, electrophoresis of proteins extracted from feathers has been used for the last six years with a high reliability and repeatability in feather identification regardless of their origin. Protein extraction from keratin has been refined and standardized concurrently with the methods used for electroporizing protein concentrates. Current results allow accurate identifications of unknown samples to the species level provided the samples contain enough plumaceous or panaceas feather elements to extract about 10 microliters of proteins. Comparisons of keratin profiles is now easier because the collection of gels and keratin profiles used as reference comprises over 800 North American species represented by more than one sample, in most cases, for a total of nearly 3,500 keratin profiles. Results show that there is little individual variation and no sexual variation. This methodology is reliable for feather samples of more than 10 micrograms not altered by high temperatures or by chemical products.
Keywords: BIOCHEMICAL; BSCE; ELECTROPHORESIS; IDENTIFICATION

ABBHA Ref. #: 905
Citation: SHAMOUN, J.; TOM-TOV, Y. Birdstrike remains identification for the Israeli Air

Force. Bird Strike Committee Europe 22, WP 91; Vienna, Austria; 29 Aug - 2 Sep 1994: p 513-522.
Abstract: Birdstrike remains from 1991-93 IAF birdstrikes were identified from all IAF airbases, micro-and macro-scopically for the first time. Remains were analyzed at Tel Aviv University. Thirty-five different species from 13 avian orders were identified. Passeriformes were responsible for 36 percent of all birdstrikes. Other orders which were responsible for a large proportion of the bird strikes were Apodiformes, Charadriiformes, Columbiformes, Accipiteriformes and Galliformes. Some of the species commonly encountered by aircraft are Skylarks, Swifts, Alpine Swifts, Stone Curlews, Turtle Doves, Chukars, White Storks, Steppe Buzzards, Kestrels and Lapwings. Sixty percent of the fires involved in bird strikes weighed up to 100 g. Most of the birds involved in airstrikes were ground and non-soaring aerial birds. The proportion of birdstrikes during March was higher than in all other months.
Keywords: BSCE; FEATHERS; IDENTIFICATION; ISRAEL; MACROSCOPIC; MICROSCOPIC; STATISTICS

ABBHA Ref. #: 906
Citation: PRAST, W.; ROSELAAR, C.S.; SCHALK, P.H.; WATTEL, J. A computer-based bird remains identification system. Bird Strike Committee Europe 22, WP 92; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 523-528.
Abstract: The demand for expertise on identifying bird remains is growing but requires expert knowledge. As the number of experts is limited, a user-friendly computer information and identification system for bird remains is being developed based on ETI's Linnaeus II software. The system consists of a multimedia database which stores detailed textual and pictorial information on feather structures and specific DNA sequences of birds. A computer guided identification system assists the user to recognize and use the identification characters and to identify the taxa. In addition, general information about bird species: descriptions, color, pictures of the bird and its eggs, distribution maps, specific calls and sonograms are stored. The first version of the bird remains identification system will concern 75 European species and will be released on CD-ROM format. An international network of ornithologists, working together to create a database of all bird species is proposed.
Keywords: BIBLIOGRAPHIC; BSCE; COLLECTION PROTOCOL; ELECTRONIC MEDIA; IDENTIFICATION

ABBHA Ref. #: 907
Citation: LAYBOURNE, R.C.; DOVE, C. Preparation of birdstrike remains for identification. Bird Strike Committee Europe 22, WP 93; Vienna, Austria; 29 Aug - 2 Sep 1994: pp. 529-534.
Abstract: A standard technique of preparing birdstrike remains for identification has been developed at the Smithsonian Institution (USNM). This technique is also used to identify species involved in U.S. Customs and wildlife law enforcement cases, ecological studies of prey remains, anthropological studies, determination of food contamination, forensics studies and in

systematic studies of birds. The USNM receives 300-500 fragmentary identifications with 99 percent of the cases identified to species. We feel that the careful cleaning process and proper microslide preparation that has been developed at the USNM is the key to our high rate of identifications.
Keywords: BSCE; CONSERVATION; IDENTIFICATION; PREPARATION

ABBHA Ref. #: 908
Citation: BUURMA, L.S.; DEKKER, A. "Birdman" Video. Bird Strike Committee Europe 22, WP 11; Vienna, Austria; 29 Aug - 2 Sep 1994: p. 535.
Abstract: A 20-minute video showed the work of the Royal Netherlands Air Force Bird Control Units.
Keywords: BIBLIOGRAPHIC; BSCE; FILM/VIDEO; NETHERLANDS

ABBHA Ref. #: 909
Citation: BROM, T.G.; FRANK, U. The Diagnostic Significance of Thickened and Pronged Hamuli in Feathers. Bird Strike Committee Europe 21, WP 5; Jerusalem, Israel, 23-27 March, 1992.
Abstract: The taxonomic distribution of thickened and/or pronged hamuli (hooklets) on distal barbules in the pennaceous part of feathers was studied with light microscopy (LM) and scanning electron microscopy (SEM) in order to assess the diagnostic significance of these structures. Comparison of the LM and SEM appearance of these structures indicates that thickened hamuli are artifacts, arising from the misinterpretation of rotated tape-like structures. Pronged hamuli, on the contrary, are non-artifacts. However, these structures have a much wider taxonomic distribution than was reported by earlier workers and prongs do not seem to be useful for identifying feather fragments.
Keywords: BSCE; FEATHERS; IDENTIFICATION; MICROSCOPIC; SCANNING ELECTRON

ABBHA Ref. #: 910
Citation: GRUBH, R.B.; SATHEESAN, S.M. Bird-Strike Remains Identification in India. Bird Strike Committee Europe 21, WP 6; Jerusalem, 23-27 March, 1992.
Abstract: Since 1966, the Bombay Natural History Society started receiving bird remains from Indian aerodromes. Since 1980, with the sponsorship of Aeronautics R & D Board of India (Ministry of Defense), the BNHS has launched a major ecological study of bird hazard at 22 aerodromes and also started receiving bird strike remains for identification from a larger number of aerodromes on a regular basis. Seventy species of birds and three species of bats have been identified from bird or animal remains from 1966 to 1991. Analysis of 460 bird and bat remains revealed that birds of prey have caused 56% of the incidents of which Milvus kites formed 25% and vultures 23% topping the list of problem birds. Some of the other birds encountered by

aircraft were pigeons and doves, ducks, egrets and herons, cranes, sandgrouse, lapwings, stone curlew, peafowl, crows, rollers, gulls, mynas and starlings as well as swifts and swallows. More than 50% of the birds and bats which hit aircraft in India weighed from half a kg to five kg.
Keywords: AERODROME SURVEYS; ASIA AND MIDDLE EAST; BSCE; IDENTIFICATION; INDIA; STATISTICS

ABBHA Ref. #: 911
Citation: SATHEESAN, S.M.; GRUBH, R.B. Migratory-Bird Strikes to Aircraft in India. Bird Strike Committee Europe 21; WP 7, JERUSALEM, Israel: 22-27 MARCH, 1992: 43-50.
Abstract: India, unlike Israel which has a high concentration of migratory birds because of its geographical location between Asia and Africa forming an isthmus between the two continents, serves merely as a destination or land route for several species of migratory birds. From bird-strike remains 13 migratory bird species were identified during the period 1966 and 1991 in India. The plant and animal food available to birds and the open, vast and tranquil aerodrome areas which provide the safety needed by the birds while feeding, resting and nesting, are irresistible attractions. By our national effort supported by the Aeronautics R & D Board of India, the Bombay Natural History Society and airport authorities the aerodrome environments are being made ecologically unattractive to birds and this is reducing aircraft strikes due to birds including migratory ones within aerodrome areas at ground level and lower altitudes.
Keywords: BIRD POPULATIONS; BSCE; HABITAT MODIFICATION; INDIA; MIGRATION

ABBHA Ref. #: 912
Citation: BUURMA, L.S.; DEKKER, A. Bird Strike Hazards to Helicopters. Bird Strike Committee Europe 21, WP 9; Jerusalem, Israel; 23-27 March 1992: 51-62.
Abstract: Within the European Rotorcraft Forum collisions between helicopters and birds have recently been discussed in relation to joint European airworthiness requirements (JAR 27 and JAR 29). This has triggered the RNLAF to analyze the Alouette-III and Bolkow 105 birdstrike statistics with respect of flying hours and the weight of the birds concerned. The surprisingly high ratios, compared to civil statistics used so far, stimulated to explore the newly formed European Military Bird Strike Database and to ask for experiences of NATO partners. An over-all rate of 5.4 bird strikes per 10,000 flying hours for 10 helicopter types (N = 1471) was found, including 7 - 29 % damage cases. The chance of serious accidents is estimated to be higher than 10". Different helicopter types showed persistently differing figures. Explanations for these differences are put into question. The empirical quantitative data may affect the decision making within the Helicopter Airworthiness Study Group.
Keywords: BSCE; CERTIFICATION STANDARDS; DATABASES; EUROPE; HELICOPTER; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 913
Citation: DEKKER, A.; BUURMA, L.S. The European Database of Military Bird Strikes: From Proposal to Reality. Bird Strike Committee Europe 21, WP10; Jerusalem, Israel; 23-27 March 1992: 63-80.
Abstract: The requirements a database of bird strikes will have to meet depends on the kind of questions to be answered. One limiting factor often is the number of available data; very frequently the sample is too small to obtain statistically significant results. In order to overcome this problem the adoption of a joined European database of military bird strikes was promoted at the 20th meeting in Helsinki. Since the joined database will have to serve as the main source of information for many different questions, the set-up has been chosen as broad as possible. This paper describes the Progress made so far. Standardization of the structure of the database and the conventions concerning the contents, proved to be extremely important. Both have been the subject of several discussions within the 'Bird Hazard at Low-level working group'. Once agreement was reached, emphasis was put on the introduction of a European Bird Strike Form. In conjunction with the completion of the form a computer program was developed enabling efficient handling of the data. Now computerized data storage is within reach, management and feeding of the joined database will be less time consuming and more potential users can be convinced to join the project. This leaves more time to the real purpose of the joined database: extracting information that is relevant to flight safety.
Keywords: BSCE; DATABASES; EUROPE; HAZARD MANAGEMENT

ABBHA Ref. #: 914
Citation: ALLAN, J.R.; CORDREY, L. The Potential of Lumbricide Chemicals for Use in Airfield Bird Control. Bird Strike Committee Europe 21, WP11; Jerusalem, Israel; 23-27 March, 1992: 81-90.
Abstract: At the 20th meeting of Bird Strike Committee Europe, Allan and Watson (1990) presented data on the first phase of a two part study designed to investigate the potential of lumbricide (worm killing) chemicals to reduce food supply available to birds from areas of airfield grassland where conventional long grass could not be grown. The second phase of the study is now complete, and full details will be published elsewhere. This paper summarizes the findings of the whole study and discusses the potential benefits and drawbacks of the use of lumbricides to control bird umbers on airfields. The data suggest that lumbricide chemicals may have a limited potential for use in bird control on airfields in the treatment of areas where the grass is kept short for operational reasons. Larger scale treatment is likely to result in a number of difficulties in terms of the effective application of the chemical on long grass swards, the possibility of short term attraction of birds to the sprayed areas, the long term destabilization of the invertebrate communities and the possible increased pesticide loading to the bird population on the airfield.
Keywords: ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; FOOD; INVERTEBRATES; UNITED KINGDOM
ABBHA Ref. #: 915

Citation: ALLAN, J.R.; MILSOM, T.P. The Influence of Tide and Wind On the Birdstrike Hazard At Coastal Aerodromes. Bird Strike Committee Europe 21, WP11; Jerusalem, Israel; 23-27 March 1992: 91-108.
Abstract: Information about the birdstrike hazard at coastal aerodromes suggests that the nature of the hazard and its severity may be different from that inland. Advice given to airfields in the U.K. is largely based on research carried out at inland sites. This paper presents data from a study commissioned by the U.K. Civil Aviation Authority into the nature and severity of birdstrike risk on coastal sites in the U.K. Data are presented on how two factors, tide and wind, influence bird behavior at coastal airfields. The paper shows the problems encountered in the statistical analysis of time-series data and offers an alternative approach based on rule breeding computer algorithms. The results show that tide state, height of the high tide, wind strength and wind direction can all influence the numbers of birds on airfields but that the importance of each factor varies between sites and bird species. Comparatively rare combinations of extremes of several factors are identified as most likely to cause severe birdstrike risk. The report recommends that awareness of the way that environmental factors influence bird behavior at coastal sites should be raised so that bird controllers can predict the combinations of factors likely to result in increased birdstrike risk at their own airfields.
Keywords: ATTRACTANTS; BEHAVIOR; BIRD POPULATIONS; BSCE; COASTAL; UNITED KINGDOM

ABBHA Ref. #: 916
Citation: NECHVAL, N.A. Radar Cfar Thresholding in Clutter Under Detection of Airborne Birds. Bird Strike Committee Europe 21, WP15; Jerusalem, Israel; 23-27 March 1992: 127-140.
Abstract: The study of radar returns from birds is an interesting but rather neglected area of practical importance to radar operations, the hazard of collisions between birds and aircraft, and environmental monitoring, as well as to the subject of ornithology itself. The abundant radar returns from birds should not always be regarded merely as spurious signals to be eliminated from surveillance radar displays, but as useful signals to be made available for their utility in combating bird hazards and in environmental monitoring. This view, however, does not seem to be widely accepted as yet by radar engineers. Tests have shown that radar returns from birds can be readily distinguished from radar returns from automobiles and aircraft. With experience, an observer can distinguish large birds from small birds and perhaps make more subtle distinctions. This paper is concerned with the problem of statistical classification of radar clutter into one of several categories, including airborne birds, bats, insects, weather, and target classes, as well as the corrupting background noise. The problem can be separated into two parts. The first part, the problem focused on here is to decide whether the received signal is a signal plus noise corresponding to the presence of any of various types of radar clutter corrupted by the background noise) or noise alone (corresponding to the presence of radar clutter including the corrupting background noise only). Noise is assumed to be Gaussian, but whose covariance matrix is totally unknown. The second part is the discrimination between various types of radar clutter corrupted by the background noise, i.e. classification of radar clutter into one of several

categories. A solution to this problem has been presented in Nechval (1991)and will not be considered further. Radar detection procedures involve the comparison of the received signal amplitude to a threshold. The technique presented in this paper allows one to find a detection threshold that achieves a constant false-alarm rate (CFAR) in the presence of intensity changes in the noise background.
Keywords: BSCE; DETECTION; MATHEMATICAL MODELS; RADAR

ABBHA Ref. #: 917
Citation: BECKER, J. State of Affairs Concerning the Birdstrike Warning System in Central Europe. Bird Strike Committee Europe 21, WP18; Jerusalem, Israel; 23-27 March 1992: 153-162.
Abstract: The Military Low-Flying Bird Strike Working Group shall develop preventive measures to minimize the bird hazard to low flying aircraft. As military aviation needs bird strike warnings covering larger areas, a dedicated observation and bird strike warning system was built up in several European countries. The paper gives a survey of the actual situation in the Netherlands, Belgium, Denmark, Germany, France and the United Kingdom and compares the bird strike warnings issued by adjoining countries in spring 1991. Future work must include improvements of the observation, reporting and warning system primarily with regard to military flight safety, but also civil aviation can benefit from the system.
Keywords: AVOIDANCE; BSCE; DETECTION; LOW LEVEL; MILITARY AVIATION; VISUAL; WARNING SYSTEMS

ABBHA Ref. #: 918
Citation: BROM, T.G. Collecting Efforts and Identification Standards in Relation to Bird Strike Statistics. Bird Strike Committee Europe 21, WP19; Jerusalem, Israel; 23-27 March 1992: 163-174.
Abstract: Different methods of feather identification are discussed and evaluated, such as macroscopical comparison with bird skins, microscopical examination of feather structure, and biochemical analysis of feather proteins. The results of the microscopical investigation of feathers as applied to bird strike analysis in the Netherlands are evaluated. It is demonstrated in which ways accurate identification procedures may affect bird strike statistics. The main conclusion is that proper identification of bird remains is fundamental and essential to bird strike statistics. Aviation authorities should direct their efforts towards the improvement of the general reporting and collecting standard, whereas biologists should optimize and standardize their identification methods, advertise the possibilities of different identification techniques, and make their expertise available.
Keywords: BSCE; COLLECTION PROTOCOL; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 919
Citation: EUDOT, A. PICA: a bird strike information program. Bird Strike Committee Europe 21, WP21; Jerusalem, Israel; 23-27 March 1992: 187-198.
Abstract: The PICA version presented is a compiled version which ca thus be used on any IBM-PC compatible micro-computer without using any software program other than the PICA. Data base management, consultation, exploitation (list editing sortings, table and graph editing). The version presented here is the French version of the PIC program, although an appropriate translation of the texts would enable it to be adapted to the requirements of any user.
Keywords: BSCE; DATABASES; REPORTING

ABBHA Ref. #: 920
Citation: PERREMANS, K. Diversity of Featherprints in the Charadriiformes and Anseriformes. Bird Strike Committee Europe 21, WP22; Jerusalem, Israel; 23-27 March 1992: 199-212.
Abstract: Scanning electron microscopy pictures (called featherprints) of the feather surface, of 65 charadriiform species belonging to 31 genera and 13 families, were studied to shed some light on their diversity and on their identification value. We started our descriptions with the different aspects of the obverse rachis, surface (site IX). Marked differences in the featherprint formulae nearly all species could be observed except in the Three-banded er Charadrius tricollaris (F. Charadriidae) and the Redshank, Tringa totanus (F. Scolopacidae). An identification key is presented. Sixteen anseriform species were examined similarly. Clear-cut differences were noticed between ducks, geese and swans.
Keywords: BSCE; FEATHERS; IDENTIFICATION; MICROSCOPIC; SCANNING ELECTRON

ABBHA Ref. #: 921
Citation: MCCLOUD, R.C. A Trial to Establish If Observation of Bird Activity in the UK Using Airfield Radars Can Provide a Measure of the Bird Hazard. Bird Strike Committee Europe 21, WP23; Jerusalem, Israel; 23-27 March 1992: 213-232.
Abstract: Military aircraft, operating in the UK low flying system often suffer substantial birdstrike damage. It is possible that a radar-based bird hazard warning system, similar to those employed by other European nations, may be able to identify days on which a particularly high birdstrike risk occurs in the UK. This report describes a trial to determine if bird activity can be observed in the UK lower airspace using a number of airfield radars. The degree of correlation between the radar observation data and the birdstrike statistics during the same period is a measure of the potential effectiveness of a active bird hazard warning system.
Keywords: AVOIDANCE; BSCE; DETECTION; LOW LEVEL; MILITARY AVIATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 922
Citation: ALFIYA, H. Methods for Studying Nocturnal Bird Migration Over Israel. Bird Strike Committee Europe 21, WP24; Jerusalem, Israel; 23-27 March 1992: 233-242.
Abstract: Israel is a land bridge between three continents and a major crossroads for birds migrating from rope and Asia, to Africa and back twice yearly, during spring and autumn. Most birds migrating over Israel (280 species) do so mainly at night. nocturnal migration rates and times over Israel were first studied In 1989, with an ASR-8 scanning radar. Since then, five different methods for tracking migration have been tried: direct observations, listening to calls, radar, night flights and Indirect data from aircraft bird strikes. Radar tracking has been found to be the most efficient method. Three years of research have shown that there is a regular pattern In times and rates of nocturnal migration. Radar data has shown that on peak migration nights a million birds fly over Israel in one nightring these three years It was found that the correlation between the migration rate during the first three hours of the night and the total rate for that night makes statistically significant predictions the expected migration rate possible.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; ISRAEL; MIGRATION

ABBHA Ref. #: 923
Citation: LESHEM, Y. Predicting Regularity of Bird Migration in Global Bottleneck Areas, On a Daily, Seasonal and Yearly Scale, and Its Implementation in Israel Air Force and Civilian Flight. Bird Strike Committee Europe 21, WP25; Jerusalem, Israel; 23-27 March 1992: 243-258.
Abstract: The strategic location of Israel, at the junction of three continents, makes it a "bottleneck" area into which significant portions of the world populations of soaring birds converge. This study used a combination of five different methods to gather data, with each method complementing and confirming the data from the others. The appearance times of migrating raptors and storks was found to be very precise (+/-3.5--+/-4.92 days). Variations In migration routes on a daily, seasonal and yearly scale were also found to be very regular. The results of this study have been implemented in the Israel Air Force and In the civilian flight system. Procedures for limiting flights during the migration seasons have reduced the average yearly damage to aircraft by 88% compared to the past, while permitting low altitude flights during days with light migration.
Keywords: BIRD POPULATIONS; BSCE; ISRAEL; LOW LEVEL; MIGRATION; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 924
Citation: HANSEN, M. A method of identifying bird species from a bloodstain or shred of tissue. Bird Strike Committee Europe 21, WP26; Jerusalem, Israel; 23-27 March 1992: 259-262.
Abstract: In many cases the remains of a struck bird are insufficiently complete to perform a reliable identification based on secondary characteristics, DNA technique Polymerase Chain Reaction, PCR, are by now applicable for species identification in bird strikes. Only minute amounts of DNA are needed, because this technique is capable of replicating enough identical

DNA for base sequencing. Collecting and preparing blood stains and tissue remains can easily be carried out by everybody. Blood and finely partitioned tissue is dropped in a Nunc cryo-tube filled with a buffer solution and can be stored at room temperature or in a refrigerator, Alternatively, materials can be collected in a clean plastic folie and stored in a deep freezer.
Keywords: BIOCHEMICAL; BSCE; IDENTIFICATION; SEROLOGY

ABBHA Ref. #: 925
Citation: SPEELMAN, R.J.; MCCARTY, R.C.; DVERSDALL, D.A. Improving Birdstrike Resistance of Aircraft Windshields. Bird Strike Committee Europe 21, WP13; Jerusalem, Israel; 23-27 March 1992: 119-120.
Abstract: USAF aircraft repeatedly prove that birds and aircraft cannot occupy the same airspace at the same time; over 3000 birdstrikes per year cause millions of dollars in damage to USAF aircraft. On an average, these birdstrikes result in one aircrew member being killed per year and one aircraft being lost per year. More of these losses are due to birdstrikes In the windshield subsystem than to any other subsystem. Windshield systems on several different aircraft are being redesigned to improve tolerance of the birdstrike event. Efforts to improve birdstrike tolerance and reduce cost-of-ownership characteristics of these windshields will be discussed. some technical voids in designing for, and integration of, birdstrike resistance will be discussed.
Keywords: BSCE; ENGINEERING; TRANSPARENCIES

ABBHA Ref. #: 926
Citation: DUPONT, G.; DEGRIECK, R. Bird Observation System Semmerzake (Boss). Bird Strike Committee Europe 21, WP14; Jerusalem, Israel; 23-27 March 1992: 121-126.
Abstract: During the years 90-91, the Belgian Airforce developed a new system to observe and quantify bird migration through the use of radar and a standard PC. Before, the observation program was integrated in the operational ATC computer and had some limitations. The actual system has the possibility to obtain radar information from 4 area radars and 3 airfield radars, all located in Belgium. Two of the area radars are 3-dimensional and give the capability of receiving the height information of the bird migration. The calculation of a "bird intensity" is based on tracking program, and through the automation it is possible to calculate the intensity without the need for interpretation by the user.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR

ABBHA Ref. #: 927
Citation: BIRYUKOV, V.Y.; LAPINSKIS, Z. Biotechnical Devices of Bird Scaring. Bird Strike Committee Europe 21, WP12; Jerusalem, Israel; 23-27 March 1992: 109-118.
Abstract: This paper summarizes the last ten years of research in the USSR with bioacoustic devices. Attention is paid to the construction of new generation microprocessor technology based synthesizers. The research has been carried cut by the specialists of the research team. Recommendations as the use of bioacoustic devices at aerodromes are presented in the appendix. The added photos show the development of the research.

Keywords: BIOACOUSTICS; BSCE; CONTROL METHODS; SOUND

ABBHA Ref. #: 928

Citation: ILYICHEV, V.D.; BIRYUKOVG, V.Y.; NECHVAL, N.A. Determination of The Total Flying Time Required for Testing the Performance of a New On-airfield Bird Strike Prevention Strategy Against the Standard One. Bird Strike Committee Europe 21, WP17; Jerusalem, Israel; 23-27 March 1992: 147-152.

Abstract: Once it is acknowledged that bird strike statistics should be collected, it also becomes clear that the collection (and treatment) of such data only makes sense when it is done in a correct and detailed manner. This paper explores the methodological aspects of the following problems: (1)determination of the total flying time required for testing the performance of a new on-airfield bird strike prevention strategy against the standard one,(2) comparison of two types of aircraft with respect to bird strike hazards. It is assumed that an observed series of collisions between aircraft and birds (bird strikes) is a realization of a Poisson process. An approximate test for the equality of the rate parameters of two Poisson processes is considered. The significance level, power and experiment length needed to achieve a specified power are compared to a previously studied approximate test. Both equal and unequal time intervals are taken into account. Numerical results show that this test, based on the variance stabilizing transformation, is superior in achieving-nominal significance levels and powers over a wide range of parameter values and experiment lengths.

Keywords: BSCE; MATHEMATICAL MODELS; STATISTICS

ABBHA Ref. #: 929

Citation: TURESSON, Lars-O. Bird impact capacity of civil aircraft. Bird Strike Committee Europe; BSCE 16, WP 2, Moscow, USSR; 18-21 August, 1982.

Abstract: Presented at the Roundtable discussion together with the XVIII Congress's Internationalis Ornithologicus. The Birds Strike Committee Europe is an organization made up of volunteers. This paper describes the method of operation of the BSCE and its working groups.

Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 930

Citation: AGAT, I.; SU-ARETZ, S. Operation of radio-controlled model aircraft. Bird Strike Committee Europe; BSCE 16, WP 3, Moscow, USSR; 18-21 August, 1982.

Abstract: The Birdstrike Prevention Unit in Israel is operated by the Nature Reserves Authority, under the auspices of the Airports Authority and with their financial aid. The Unit developed a variety of means for expelling birds from existing garbage dumps near Ben-Gurion airport. A number of traditional bird control measures were adopted over the last few years, effective, but not perfectly so. A radio-controlled aircraft was used with mixed results. This paper discusses the project to use radio-controlled aircraft in conjunction with other bird control devices.

Keywords: AIRCRAFT; BSCE; CONTROL METHODS; REMOTE CONTROLLED

ABBHA Ref. #: 931
Citation: HELKAMO, H.; STENMAN, O.; VICKHOLM, M. Bird Control at Helsinki-Vantaa Airport from 1978-81. Bird Strike Committee Europe; BSCE 16, WP 4, Moscow, USSR; 18-21 August, 1982.
Abstract: In the summer of 1978 there were two birdstrikes at Helsinki-Vantaa Airport that can be classified as serious. As a result, a Bird Strike Committee was established at the airport, in which both the airport authority and ornithologists are represented. The committee has directed the bird control measures and studied in two separate reports bird occurrence at the airport and a censusing places in its vicinity (2 dumps, 2 fur farms, 2 fields, and a reservoir). Bird control at the airport is performed by a bird patrol using a patrol vehicle with special equipment. Initially, the patrol tries to disperse the birds from the runway, but if necessary, the birds may also be shot. In addition to control, we also try to reduce the numbers of birds at the airport by changing the environment so that it does not attract the species hazardous to air traffic. The greatest problem has been caused by the herring gull, the common gull and the black-headed gull. To control birds on ponds near the runway, the ponds were covered with floating Leca gravel. Other problem species are primarily the black grouse and the lapwing. The control measures are disturbance of display areas and dispersal with prevention of nesting, respectively.
Keywords: ATTRACTANTS; BSCE; CONTROL METHODS; DEPREDATION; EXCLUSION; FINLAND; GROUSE; GULLS; INVERTEBRATES; LAPWINGS; NETS/WIRES; WATER/RESERVOIRS

ABBHA Ref. #: 932
Citation: VAN GEUNS, A.H. Bird Strike Prevention at Airports: A continuous story. Bird Strike Committee Europe; BSCE 16, WP 5, Moscow, USSR; 18-21 August, 1982.
Abstract: As far as birds visiting airports, Schiphol is among the most favorable sites worldwide. Several methods of control are employed: habitat modification using long grass; active control; and, flight operational changes. Communication about the hazard is very important. An extensive report is available on the complete situation at the airport.
Keywords: BSCE; CONTROL METHODS; EGGS/NESTS; NETHERLANDS; PYROTECHNICS; SCHIPOL IAP

ABBHA Ref. #: 933
Citation: BRIOT, J.L. New attempt of use of remote controlled model aircraft. Bird Strike Committee Europe; BSCE 16, WP 7, Moscow, USSR; 18-21 August, 1982.
Abstract: The idea to use radio-controlled scale models to frighten birds is not new since New Zealand, Netherlands and Canada have performed tests of this technique during 1965 and 1973. As these experiences appeared limited (few species frightened, no habituation test) but sometimes promising, it was decided to resume operations in France from 1976 with several

models in different ornithological situations. This article makes the synthesis of last tests and results obtained. The sole use of radio-controlled aircraft is not effective to control bird hazards on airfields but is another tool when conventional methods do not give satisfaction.
Keywords: AIRCRAFT; BSCE; CONTROL METHODS; FRANCE; REMOTE CONTROLLED

ABBHA Ref. #: 934
Citation: KLAVER, A. Longterm grassland exploitation at Schiphol Airport, Amsterdam. Bird Strike Committee Europe 16, WP 6, Moscow, USSR; 18-21 August, 1982.
Abstract: This article came into being to report on the influences of the successive ways of use and maintenance of the grassed surface going with the runways and taxiways in control with the Airport Authority. It was to examine whether the present grass maintenance schedule meets the operational requirements. Furthermore, it was important to determine if one method was more cost effective to implement than another. This study will form the basis of recommendations by the Aerodrome Working Group of the BSCE to prevent bird hazards in relation to the technical and economic effectiveness.
Keywords: BSCE; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 935
Citation: BRIOT, J.L. Treatment of lawns on the Paris Airport. Bird Strike Committee Europe; BSCE 16, WP 8, Moscow, USSR; 18-21 August, 1982.
Abstract: The presence of several hundred wood pigeons on side of the Paris-Orly runways was a permanent hazard to aircraft during spring and summer. Pigeons coming from the Paris city eat several species of clover abundant in these lawns. Spreading of three chemical products--two selective weeders and one growth inhibiting--on airport grass led to development of a ground cover unattractive to birds. The treatment led to the destruction of leguminous plants and to the growing of tall grass without cutting.
Keywords: BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS; ORLY IAP; PIGEONS

ABBHA Ref. #: 936
Citation: LATY, M. Birds on Airports: The reason for their presence. Bird Strike Committee Europe; BSCE 16, WP 9, Moscow, USSR; 18-21 August, 1982.
Abstract: This audio-visual presentation is aimed at explaining the reasons which make airports attractive for birds. The factors considered are the presence of food sources, shelter and relative peace. The setting is meant for persons in charge of managing and maintaining airports. It is part of a series devoted to birdstrikes in aviation.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BSCE; FILM/VIDEO

ABBHA Ref. #: 937
Citation: ROGACHEV, A.I. The status of aeronautical ornithology problem in the civil aviation of the USSR. Bird Strike Committee Europe; BSCE 16, WP 10, Moscow, USSR; 18-21 August, 1982.
Abstract: At present, among other environmental factors such as icing, turbulence, or atmospheric electricity, birds occupy a leading position as the most numerous cause of potential air accidents. Especially alarming is the fact that during the last years, the number of registered collisions with birds by Aeroflot aircraft has had a tendency to increase, reaching its maximum of 260 incidents in 1981. This paper provides an overview of the research and implementation of measure to reduce bird hazards on USSR aerodromes.
Keywords: AVOIDANCE; BSCE; CIVIL AVIATION; CONTROL METHODS; HAZARD MANAGEMENT; USSR

ABBHA Ref. #: 938
Citation: KOMAROV, V.T.; VASILENKO, V.A. Results and perspective of Radar Ornithology in the USSR. Bird Strike Committee Europe; BSCE 16, WP 11, Moscow, USSR; 18-21 August, 1982.
Abstract: Birds were intensively tracked by air traffic control radar in the USSR in the 1970s. Two methods were used to track the birds: using the information provided by the plan position indicator either visually or photographically, and experimental radiolocation and ornithology. Future investigations on different aspects of the bird's flight ecology will be continued focusing on the migration altitude and the influence of different weather parameters. Special studies will be conducted on the possibility of automating the collection of bird data. Attempts to define bird species and numbers will be pursued.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; RADAR; USSR

ABBHA Ref. #: 939
Citation: JACOBI, V.E. Sphere of action and efficiency of the means at aerodromes for the prevention of collisions between birds and aircraft. Bird Strike Committee Europe 16, WP 12, Moscow, USSR; 18-21 August, 1982.
Abstract: The use of active means for prevention of collisions with birds is common on the aerodromes of the USSR and other countries. A number of passive means by decreasing attractiveness of aerodromes are now very effective. No method is effective in preventing bird flight, either singly or in flocks, through the airspace at low altitudes. This paper examines the advantages and disadvantages of various bird control measures.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; DETECTION; USSR

ABBHA Ref. #: 940

Citation: AMINEV, G.A.; STRELKOV, V.B. Psychologic aspects of aircrew and controllers staff training for the wrecking situations caused by birdstrikes. Bird Strike Committee Europe; BSCE 16, WP 13, Moscow, USSR; 18-21 August, 1982.
Abstract: Special psychological training can improve the ability to cope with birdstrike accidents. Such a program includes four sections: a system of information; (2) formation of aircrew and controllers confidence; (3) psychotraining of aerodrome radar operators; and, psychotraining of the aircrew.
Keywords: BSCE; HAZARD MANAGEMENT; TRAINING; USSR

ABBHA Ref. #: 941
Citation: THORPE, J.; VAN WESSUM, R. Bird strikes during 1980 to European Registered Civil Aircraft. Bird Strike Committee Europe; BSCE 16, WP 14, Moscow, USSR; 18-21 August, 1982.
Abstract: The birdstrikes reported throughout the world in 1980 by operators from eleven European countries were analyzed. The analysis included rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost, and airlines affected.
Keywords: BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 942
Citation: LEEMING, G.H. Military Aircraft Bird Strike Analysis: 1979. Bird Strike Committee Europe; BSCE 16, WP 15, Moscow, USSR; 18-21 August, 1982.
Abstract: This is the second analysis in the abbreviated format. Report includes information on bird species struck, aircraft parts struck and effects.
Keywords: BSCE; EUROPE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 943
Citation: LEEMING, G.H. Military Aircraft Bird Strike Analysis: 1980. Bird Strike Committee Europe; BSCE 16, WP 16, Moscow, USSR; 18-21 August, 1982.
Abstract: This third report in the abbreviated format shows there is a marked reluctance on the part of the representatives to forward information. Further simplification of the requirements will be made in an effort to encourage greater participation in this analysis. This report includes information on bird species struck, aircraft parts struck and effects.
Keywords: BSCE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 944
Citation: THORPE, J. Accidents and serious incidents to civil aircraft due to birdstrikes. Bird Strike Committee Europe; BSCE 16, WP 17, Moscow, USSR; 18-21 August, 1982.

Abstract: This paper is a revised and updated second issue of two papers presented at BSCE 14 in the Hague in October 1979. The paper contains brief details of accidents and serious incidents due to birdstrikes, worldwide, up to and including 1980. It is divided into three parts: (1) transport aircraft over 5700 kg and executive jets; (2) light airplanes below 5700 kg; and (3) helicopters
Keywords: BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 945
Citation: BUURMA, L. Birdweight and aircraft speed in birdstrike statistics. Bird Strike Committee Europe; BSCE 16, WP 17, Moscow, USSR; 18-21 August, 1982.
Abstract: Comparing bird strike records related to bird weight, aircraft speed and type of damage shows that the occurrence of damage is not necessarily related to the size of the bird or the speed of the aircraft. Nearly 90 percent of the 2-pound birdstrikes caused damage when the aircraft was flying at 450 knots or more. Also, collisions with small birds caused damage in about one-third of the encounters which is not expected. Special care should be taken to identify all birdstrikes from the remains.
Keywords: BSCE; IDENTIFICATION; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 946
Citation: STENMAN, O. Economical and operations aspects of bird prevention measures. Bird Strike Committee Europe; BSCE 16, WP 18, Moscow, USSR; 18-21 August, 1982.
Abstract: The responses from the member states to a questionnaire on the costs of birdstrike prevention measures are summarized.
Keywords: BSCE; COSTS; HAZARD MANAGEMENT; LEGAL ISSUES

ABBHA Ref. #: 947
Citation: GRUBH, R.B. Whitebacked Vulture and Pariah Kite as two major problem birds at Indian aerodromes. Bird Strike Committee Europe; BSCE 16, WP 19, Moscow, USSR; 18-21 August, 1982.
Abstract: Whitebacked Vulture (Gyps bengalensis) and Pariah Kite (Milvus migrans govinda) take the first and second place of significance among the bird species known to cause birdstrikes in India; both species contribute more than 55 percent. Control tower observations and buffer zone studies provided the maximum amount of information on bird use and overflight of aerodromes.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; INDIA; KITE; VISUAL; VULTURES

ABBHA Ref. #: 948

Citation: GRUBH, R.B. Bird strikes in India. Bird Strike Committee Europe; BSCE 16, WP 20, Moscow, USSR; 18-21 August, 1982.
Abstract: The Indian Air Force has recorded than 800 birdstrike incidents during the past 11 years, a few of which (25+) resulting in total destruction of aircraft and others causing minor to major damage. Detailed information is not available for the civil aviation birdstrikes prior to 1979.
Keywords: BSCE; INDIA; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 949
Citation: ANONYMOUS. The application of EEC Council Directive 79/409. Bird Strike Committee Europe; BSCE 16, WP 21, Moscow, USSR; 18-21 August, 1982.
Abstract: The Council Directive concerning the preservation of wild birds came into force on 2 April 1981. This document and the accompanying supplements sum up the status of the actions taken by the French Civil Aviation authorities to secure the safe movement of aircraft at the aerdodromes they administer. This report covers two fields: (1) evaluation of the risk caused by the presence of birds at aerodromes on the basis of bird strike reports; and (2) description of the methods used for scaring away the birds; medium- and long-term measures initiated.
Keywords: BSCE; CONSERVATION; CONTROL METHODS; FRANCE; LEGAL ISSUES

ABBHA Ref. #: 950
Citation: ANONYMOUS. Incident analysis report. Bird Strike Committee Europe; BSCE 16, WP 22, Moscow, USSR; 18-21 August, 1982.
Abstract: Incident analysis reports are written to summarize the results of Flight Data Recorder analysis of individual occurrences and/or special events carried out by the SDAU of CAA-AD. They do not have the authority of the CAA-AD for publication. Circulation is generally restricted to those departments of the CAA-AD and the airlines which are directly involved. These reports may not be passed beyond the original circulation without the permission of CAA-AD and the airlines. This paper summarizes a single birdstrike incident involving a B-747 aircraft operating from Melbourne, Australia.
Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION; REPORTING

ABBHA Ref. #: 951
Citation: NANKINOV, D. Collisions of Bulgarian Civil Aviation Aircraft with Birds. Bird Strike Committee Europe; BSCE 16, WP 23, Moscow, USSR; 18-21 August, 1982.
Abstract: Seventy birdstrikes were registered to Bulgarian Civil Aviation aircraft from 194 to 1981. Most birdstrikes occur near large cities with heavy air traffic. Many birdstrikes occur in autumn when large masses of birds migrate from Europe and Asia across Bulgaia. A discussion of the control measures to scare the birds away from the aerodrome is provided.
Keywords: BSCE; BULGARIA; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 952
Citation: PRATT, G.K. Use of plastic netting to control birds in aircraft hangars. Bird Strike Committee Europe; BSCE 16, WP 24, Moscow, USSR; 18-21 August, 1982.
Abstract: Two techniques are summarized for installing plastic netting in aircraft hangars in the United States to control damage from birds. Advantages and limitations associated with this control measure are discussed.
Keywords: BSCE; BUILDINGS/STRUCTURES; CONTROL METHODS; EXCLUSION; NETS/WIRES

ABBHA Ref. #: 953
Citation: SHORT, J.J. Evaluating the Bird Avoidance Model. Bird Strike Committee Europe; BSCE 16, WP 25, Moscow, USSR; 18-21 August, 1982.
Abstract: The Bird Avoidance Model (BAM) was developed to determine the birdstrike potential while flying a military low-altitude training route in the continental United States. The purpose of this paper is to verify the accuracy of the BAM computations with past birdstrike mishap data from low-level missions. Generally, the BAM is effective at predicting two-thirds of the birdstrikes that occurred during these low-level flights. A discussion of the BAM and future validation efforts is provided.
Keywords: AVOIDANCE; BSCE; FORECASTING; MAPS; MATHEMATICAL MODELS; PREFLIGHT PLANNING

ABBHA Ref. #: 954
Citation: BRUDERER, B. Radar Studies On Bird Migration in the South of Israel. Bird Strike Committee Europe 21, WP28; Jerusalem, Israel; 23-27 March 1992: 269-280.
Abstract: Radar information on the directions and the temporal and spatial distribution of bird migration was requested for an expertise concerning the building of a large antenna system for Voice of America in the Arava Valley. Besides the primary task, the project may provide information for bird strike prevention in the Israeli Air Force and offers unique research possibilities on bird migration in a desert environment. The paper comprises the first description of the digital recording methods used In connection with the tracking radar "SuperflederMaus." Qualitative data consist of flight paths and wing-beat patterns of tracked birds. Recording of quantitative data is based on cone scanning at different elevations. It provides information on the spatial distribution of birds in a half-sphere of 5 km radius around the radar. A few examples of results are presented and discussed. The quantitative results of the radar observations will also be used for a comparison with different, more traditional observation methods, such as moon-watching, infra-red, and ceilometer observations.
Keywords: BSCE; DETECTION; ISRAEL; RADAR

ABBHA Ref. #: 955

Citation: THORPE, J. Serious Bird Strikes to Civil Aircraft 1989-1991. Bird Strike Committee Europe 21, WP31; Jerusalem, Israel; 23-27 March 1992: 291-302.
Abstract: The Paper contains a sample of summarized accidents and more serious incidents due to birdstrikes in the years 1989-1991. The paper is divided into three sections: (1)transport aeroplanes over 5,700 kg and business jets; (2)aeroplanes of 5,700 kg and below; and (3)helicopters. The data sample is too small for any in-depth analysis but engine ingestion is clearly the critical area of transport aeroplanes. The windshield appears to be the vulnerable area of general aviation aircraft and helicopters. The paper lists previous similar publications. The author would welcome any new or additional information which has not been included within the paper. A marginal line shows alterations between Issue 1 (distributed at Meeting) and Issue 2.
Keywords: BSCE; CIVIL AVIATION; HELICOPTER; STATISTICS

ABBHA Ref. #: 956
Citation: MONTEMAGGLARI, A. Avian Community At Rome International Airport of Fiumicino. a Study for Better Facing Bird Hazard. Bird Strike Committee Europe 21, WP32; Jerusalem, Israel; 23-27 March 1992: 303-314.
Abstract: The avian community of Rome International Airport of Fiumicino has been investigated from 1989 to 1991 with a project commissioned by the Operative Security Division of Aeroporti di Roma Society. Linear Transect Method has been used and more than 1700 daily recording forms were filled. 88 species of birds have been observed, 37 non passerine and 51 passerine. Herring Gull (Larus cachinnans), Black-headed Gull (Larus ridibundus), Lapwing (Vanellus vanellus), Starling (Sturnus vulgaris), and Hooded Crow (Corvus corone cornix) resulted to be the most important species for risk of collision with landing and taking of aircraft. Circannual data about their localization, number, periods of presence, flocking, habitat and time preferences, responses to scaring devices, etc., have been collected. The complete results of the research are at present used for planning a complete renewal program of all scaring devices system.
Keywords: AERODROME SURVEYS; BSCE; HAZARD MANAGEMENT; ITALY; ORGANIZATION; ROME IAP; SURVEYS

ABBHA Ref. #: 957
Citation: SHORT, J.J.; POULIS, A.J. An Annotated Bibliography of Bird Hazards to Aircraft. Bird Strike Committee Europe 21, WP34; Jerusalem, Israel; 23-27 March 1992: 321-332.
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 Support Agency's Technical Information Center. Compiling this information into 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: BIBLIOGRAPHIC; BSCE; LITERATURE SURVEY

ABBHA Ref. #: 958
Citation: YASHON, J.; SHY, E. Bird Strikes At Ben-Gurion Airport, Israel 1982-1991. Bird Strike Committee Europe 21, WP35; Jerusalem, Israel; 23-27 March 1992: 333-340.
Abstract: Ben Gurion International Airport resides in an area of intensive agricultural activity. As such it is a contiguous part of the regional ecosystem in which it is located. Indeed, within the boundaries of the airport itself there is ongoing agricultural activity in land adjacent to the runways. However, as distinct from the activity outside the airport boundaries, the type of agriculture allowed within the airport perimeter is subject to the prior consent of the Airport Authority which has veto power over any activity that could conceivably have adverse effects on aircraft safety either directly or indirectly. As a consequence of being located within an agricultural environment the airport is subject to bird activity congruent with this type of environment. In addition, the close proximity to the airport of a large municipal refuse dump serves as a powerful attractant to birds, especially during the winter months when migrating birds such as gulls and terns are resident in Israel. In order to cope with the threat from bird activity to aviation safety the Airport Authority maintains a Bird Strike Prevention Unit staffed by the Nature Reserves Authority. This arrangement allows the unit flexibility and the authority to take extraordinary measures regarding animal activity, when deemed necessary, which is not permitted to any other body outside of the Nature Reserves Authority. The priority is to ensure that aviation safety is maintained at the highest possible level with a minimal impact upon the local environmental balance of nature.
Keywords: BEN GURION IAP; BIRD CONTROL TEAM; BIRD POPULATIONS; BSCE; ISRAEL; STATISTICS

ABBHA Ref. #: 959
Citation: PELED, B. Food Preference of the Chukar Partridge and Domestic Pigeon At Military Aerodormes in Israel. Bird Strike Committee Europe 21, WP36; Jerusalem, Israel; 23-27 March 1992: 341-344.
Abstract: The Alectoris chukar (chukar) and the Columba domestica (pigeon) are common resident birds throughout Israel including Air Force bases in the north, center and south of the country. The Israeli Air Force suffers significant aircraft damage due to strikes from these two species. The chukar is a heavy (375-625 grams) 'clumsy' bird which escapes by running or low flight and is a hazard factor mainly during take off and landing. The chukar has a high breeding ability and few natural enemies within the bases. Often they appear in groups of 2-25 birds near or even on the runways. For that reason the chukar is a high hazard risk for multiple strikes.

Hundreds and thousands of pigeons cross some of the bases' air space at least twice a day on their way from their resting areas to the feeding zones and back. They are an annoyance almost everywhere. Apart from the strike danger they also cause other damage to equipment and to public health.
Keywords: ATTRACTANTS; BIRD POPULATIONS; BSCE; CHUKAR; ISRAEL; MILITARY AVIATION; PIGEONS

ABBHA Ref. #: 960
Citation: RUBIN, D.J. Low-Level Airspace Bird Strike Hazard Evaluations Using a GIS to Integrate Bird Population Dynamics Into an Aircraft Bird Avoidance Model. Bird Strike Committee Europe 21, WP 40; Jerusalem, Israel; 23-27 March, 1992: 387-390.
Abstract: Twenty-eight percent of all USAF bird strikes occurred during low-level flight operations between 1987 and 1991. These strikes resulted in more than $250 million in damage, the destruction of four aircraft, and five aircrew fatalities. Low-level airspace evaluation once focused only on the Bird Avoidance Model (BAM), which is a useful tool for estimating waterfowl hazards. However, additional bird species not modeled by the BAM, such as raptors, gulls, cranes, and pelicans, also pose significant hazards to aircraft operations. Hazards associated with these species are being examined separately using known bird population and migration dynamics. To reduce hazardous and costly bird strikes to aircraft, the USAF BASH Team is updating the BAM. The new BAM will calculate the relative risk of a bird strike by integrating biological and geographical data of a Geographic Information System (GIS). The GIS is allowing detailed analyses of ust databases, including the North American Breeding Bird Survey (BBS), Bird Banding Recovery, Christmas Bird Count (CBC), Hawk Migration Association of North America (HMANA), and Refuge databases which have helped verify bird distribution abundance in the BAM. The USAF BASH Team will continue to enhance the BAM through the future addition of weather components and the integration of bird cognition data provided by the Next Generation Weather Radar (NEXRAD). NEXRAD will provide a near real-time bird avoidance capability for low-level aircraft operations.
Keywords: AVOIDANCE; BSCE; FORECASTING; MAPS; WARNING SYSTEMS; WEATHER

ABBHA Ref. #: 961
Citation: DOLBEER, R.A. Evaluation of Shotgun Shooting to Reduce Aircraft Strikes By Laughing Gulls At John F. Kennedy International Airport, 1991. Bird Strike Committee Europe 21, WP41; Jerusalem, Israel; 23-27 March 1992: 391-392.
Abstract: The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York City. Laughing Gulls (Larus articilla) from an 8,000-nest colony next to the airport in Jamaica Bay on National Park Service (NPS) property, are the most frequently struck bird, averaging 169 birds struck (by 156 aircraft) per year from 1988 to 1990. An experimental program was undertaken in 1991 in which 2 to 5 people stationed on

airport boundaries shot gulls with shotguns on 62 days from 20 May to 8 August. In all, 14,191 Laughing Gulls and 695 other gulls [Herring - Larus argentatus, Great Black-backed - Laris marinus, and Ring-billed - Larus delawarensis] were killed in 896 person-hours of shooting. Over 93 percent of the Laughing Gulls killed were adults and 95 percent of these had brood patches, indicating they were nesting birds. Bands recovered from shot gulls indicated many of the adult gulls were hatched in colonies along the New Jersey coast at least 100 km away. The number of Laughing Gull strikes with aircraft was reduced by 60 percent compared with the mean level for the previous three years. The reduction in strikes appeared more closely related to a direct reduction in the population rather than to a change in flight patterns of gulls caused by shooting. The shooting program will continue in 1992. A detailed report of the shooting experiment will be prepared after the work in 1992 is complete. The long term solution will be to relocate the colony from Jamaica Bay and JFKIA.
Keywords: BSCE; CONTROL METHODS; DEPREDATION; JFK IAP; SHOOTING; UNITED STATES

ABBHA Ref. #: 962
Citation: DEVAUX, J.P. Substitute Bird Objectives and Constraints. Bird Strike Committee Europe 21, WP44; Jerusalem, Israel; 23-27 March 1992: 413-424.
Abstract: Wild and farming bird use for bird strike resistance testing is no longer allowable both for philosophical and technical reasons. Bird life must be preserve and it seems that animal use for technical experiment will no more be acceptable to non- concerned people. Technically speaking, wild or farming bird use for test representativity reasons is contestable as none of those bird can be representative of real bird strike-involved birds. Test repeatability, considered as the most important parameter in all qualification test, is not accessible with real birds. Many problems should be solved before using systematically substitute bird in engine and structure bird strike resistance tests. Substitute bird choice should square with well-defined and approved mechanical, aerodynamic and geometric criteria. Cooperation between BSCE members can be very useful to Civil Aviation Authorities in such a matter. CEPR conclusions on the substitute bird problem are given at the end of the article.
Keywords: ARTIFICIAL BIRDS; BSCE; ENGINEERING; TESTING

ABBHA Ref. #: 963
Citation: MERRITT, R.L. A Simple Risk Model For Assessing Bird Strike Potential. Bird Strike Committee Europe 21, WP38; Jerusalem, Israel; 23-27 March 1992: 351-358.
Abstract: A simple risk algorithm was developed to assess the potential for serious bird strikes at US Air Force installations within continental US. The model computes a relative risk using five variables that describe each installation's mission, aircraft type, geographical region, regional bird hazards, and local bird hazards. The model ranked installations with known hazards at the top of the hazard list and placed installations known not to have serious hazards near the bottom. A significant statistical correlation was found between the computed risk value for each

installation and the average number of strikes reported over the past six years.
Keywords: BSCE; HAZARD MANAGEMENT; MATHEMATICAL MODELS; RISK ASSESSMENT; SURVEYS; UNITED STATES

ABBHA Ref. #: 964
Citation: MERRITT, R.L.; DOGAN, R.L. Bird Strikes to U.S. Air Force Aircraft: 1987 - 1991. Bird Strike Committee Europe 21, WP42; Jerusalem, Israel; 23-27 March 1992: 393-402.
Abstract: Each year the U.S. Air Force (USAF) suffers significant aircraft damage from bird strikes. Between 1987 and 1991 USAF activities worldwide reported over 14,000 bird strikes to the USAF Bird Aircraft Strike Hazard (BASH) Team. During this period, five aircraft were destroyed, one suffered damage in excess of one million U.S. dollars, and five aircrew members were fatally injured, all due to aircraft collisions with birds. The average annual cost to the USAF is in excess of 59 million dollars (U.S.) not to mention the cost in human lives and agonizing suffering. The following are summaries of all Class A mishaps (mishaps that resulted in the destruction of the aircraft, involved loss of life, or sustained damage in excess of $1,000,000) due to collisions with birds for the period of 1987 through 1991.
Keywords: BSCE; COSTS; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 966
Citation: LAYBOURNE, R.C. Feathers in Forensics. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Feather identifications are important in Law Enforcement work and investigations of bird strikes with aircraft. In violations of the Migratory Bird Treaty, the Lacey Act, CITES and Game laws, it is necessary to identify bird species by examining parts of birds such as feathers, skeletal, beaks, talons and eggs. In bird strikes the birds or bird parts must undergo a cleaning process before identification. However, in all cases the feather material is examined macroscopically or if necessary microscopically. The method used is dependent upon the feather material involved. In this presentation, the emphasis is mainly on the microscopic examination of the feather material using the light microscope and the Scanning Electron Microscope, showing with slides how it is possible to determine the species of bird involved in the incident by the structure of the downy barbules.
Keywords: BSCUSA; FEATHERS; IDENTIFICATION; SCANNING ELECTRON

ABBHA Ref. #: 967
Citation: MERRITT, R.L. Techniques in Aircraft Mishap Investigations: Bird Strikes. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Since the BSC-USA meeting in August 1992, the U.S. Air Force has suffered five Class A aircraft mishaps involving bird strikes. These strikes resulted in four destroyed aircraft, one severely injured pilot and one pilot fatality. Additionally a multiple bird strike to a C-141

aircraft resulted in damage exceeding $500,000. Mishap prevention is the goal of the safety investigation board. When birds or other wildlife are suspects in the accident, it is important to obtain evidence as quickly as possible. A variety of techniques will be discussed and explained to assist the on-site investigator in the collection and preservation of animal materials so that those materials can be identified.
Keywords: BSCUSA; LEGAL ISSUES; MISHAP INVESTIGATION

ABBHA Ref. #: 968
Citation: LEBOEUF, E. FAA Update: Airport Wildlife Control Program in United States. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: With funding provided by the Federal Aviation Administration (FAA), the United States Department of Agriculture has been conducting airport wildlife studies. These studies, and recent regulatory changes by the Environmental Protection Agency, have prompted revisions to FAA policy regarding potential wildlife attractions that may affect airports. Revisions to be included in a new FAA Advisory Circular entitled "Wildlife Attractions On Or Near Airports" will be discussed.
Keywords: BSCUSA; LEGAL ISSUES; POLICY; UNITED STATES

ABBHA Ref. #: 969
Citation: HUPF, T.H. Federal Aviation Administration's Wildlife Research Program. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: In 1991, the Federal Aviation Administration (FAA) redirected its airport wildlife research to applied research through initiation of a cooperative agreement with the Denver Wildlife Research Center. Three research topics under investigation are harassment methods for wildlife, wildlife use of landfills, and regional airport wildlife habitat management studies. Five harassment methods will be tested, one a year for five consecutive years. Ongoing landfill studies have been designed to show relationships among birds, landfills and airports. Ten long-term, four-year regional airport wildlife habitat management research projects are planned. Airport wildlife habitat management research began in 1991 at Atlantic City International Airport, and the second airport study is proposed to begin 1994 at Chicago O'Hare International Airport. Additional studies will be initiated at the rate of one every two years. Airport wildlife habitat management and harassment technique research will provide new technology to abate wildlife problems at airports. Landfill studies will provide scientific data to mold and strengthen policy and guidance on siting solid waste facilities on or near airports. Airport selection for research activities is based on the airport having wildlife problems and mitigating technologies characteristic to that region of the United States. Airports with proactive wildlife programs have distinct advantages as research study sites, since quantitative data from ecological studies and bird strike records are available.
Keywords: BSCUSA; CONTROL METHODS; HAZARD MANAGEMENT; SURVEYS; UNITED STATES

ABBHA Ref. #: 970
Citation: MASON, J.E. Raptor Management At Lester B. Pearson International Airport, Toronto. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: The Number one concern at airports is Flight Safety. There are many contingencies that are crucial to keeping our airports safe for aircraft using their facilities. Pilots expect that all effective measures to reduce bird strikes are being employed. Raptors in some airport areas number in the hundreds and they must be controlled but not by elimination methods. A raptor control program must be part of the wildlife control program. Habitat improvement, harassment and live trapping are required to reduce the possibility of a raptor becoming involved in a bird strike.
Keywords: BSCUSA; CANADA; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 971
Citation: VOGT, P.F. ReJeX-iT TM FORMULATIONS OF METHYL ANTHRANILATE AS BIRD REPELLENTS: A STATUS REPORT. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: ReJeX-iTTM bird aversion agents for use on airports and landfills have passed most of Environmental Protection Agency review process without any problems. Final approval of the Technical Grade Active Ingredient (TGAI) ReJeX-iTTM MA and the end-use products ReJeX-iTTM AP-50 and ReJeX-iTTM TP-40 is now expected in September, 1993. ReJeX-iTTM Bird Aversion Agents are formulated from naturally occurring, biodegradable, food-grade products that meet or exceed U.S. Food Chemical Codex (FCC) and U.S. Pharmacopoeia (USP) Specifications. The products have extremely low toxicity to humans, mammals and birds. Acute oral toxicity (LD50 for rats) for all formulations is in excess of 5000 mg/kg with the oral LD50 = 3288 mg/kg for the TGAI in rats. The test for LC50 (lethal concentration) for mallards (Anas platyrhynchos) was stopped at 5620 ppm. Any quantity in excess of 290 mg/kg was regurgitated by the birds. The products are completely biodegradable in aerobic and anaerobic environments and do not accumulate in the environment. No significant hydrolysis was observed in water at pH 5-9 over the 38-day test period. Photo degradation led to small quantities of colored dimmer and trimmer formation with no other identified product. ReJeX-iTTM containing formulations work as sensory repellents and mimic irritation in the mouth cavity and stomach of birds who try to ingest the treated food or water; however these formulations do not cause adverse physiological reactions in the birds. As a result the birds will avoid feeding in places where these repellents are present. The product will provide an efficient additional method for the control of birds in the airport arena and adjacent landfills.
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS

ABBHA Ref. #: 972

Citation: GABREY, S.F. Relationship Between Rain and Bird-Aircraft Collisions At John F. Kennedy International Airport, 1986-1990. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Puddles of rainwater frequently form on paved surfaces at airports, attracting birds searching for fresh drinking or bathing water. Puddles may persist for several days after the rain event. Therefore, the risk of a bird-aircraft collision may be expected to be higher when puddles are present (up to 3 days after a rain event) than when puddles have evaporated. I examined the possible relationship between the time (days) after rain and the number of incidents (a bird-aircraft collision involving 1 or more birds) during each of 3 seasons (spring, summer, and fall), and for the 3 seasons combined at John F. Kennedy International Airport. Because birds often flock to puddles, I also examined the relationship between time after rain and the number of individual birds struck by aircraft. I used 2 levels of rain, >0.1"/day and >0.4"/day, for the analysis. For both levels of rain, the frequency of incidents occurring within the first 3 days after rain was similar ($P > 0.11$) to that of all remaining days for each season, and for all seasons combined. When seasons were analyzed separately, no significant correlation was found between the number of incidents and time after either level of rain. When seasons were analyzed separately, no significant correlation was found between the number of birds struck and time after either level of rain. With all 3 seasons combined, a weak (but statistically significant, $P < 0.05$) negative correlation was found between time after 0.1"/day of rain and both the number of incidents and the number of individuals struck. No correlation was found when all seasons were combined using 0.4"/day rain. Although no strong statistical relationship was detected between time after rain and the number of incidents or number of individuals struck, puddles do sometimes attract birds to the proximity of the runways. Thus, airport operations personnel should continue to remove standing water and to deter bird use of puddles.
Keywords: ATTRACTANTS; BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; JFK IAP; UNITED STATES; WATER/RESERVOIRS

ABBHA Ref. #: 973
Citation: DOLBEER, R.A. Shooting Gulls At JFK International Airport Reduces Strikes With Aircraft. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York City. Laughing gulls comprised 52% of the bird strikes from 1988-1990, averaging 156 aircraft strikes/year. This species is present from May-September in association with a 7,600-nest colony (1990) adjacent to the airport. Other gulls (Herring, Great Black-backed, and Ring-billed), present year-round, comprised 35% of the strikes. Another 52 species of birds comprised the remaining 13% of strikes. An active bird management program at JFKIA has involved habitat alteration and use of bird-frightening techniques to discourage birds from feeding, drinking, and loafing on airport grounds. However, these measures did little to prevent gulls from flying over the airport to other feeding sites. An experiment to reduce gull strikes by aircraft was undertaken in 1991-1993 in which 2-5 people with shotguns stationed on airport boundaries shot gulls flying over the airport from mid-May to early August. Shooters killed 26,038 laughing gulls and 2,314 other gulls flying over the airport

during 2,206 person-hours of shooting in 1991 and 1992. The shooting program at JFKIA substantially reduced the number of strikes between all species of gulls and aircraft, by 70% in 1991 and 89% in 1992 relative to the previous 3 years. The laughing gull nesting colony in its present location continues to present an unacceptable hazard to aircraft. The shooting program, although effective in reducing the number of gulls struck by aircraft, has not significantly reduced the size of the nesting colony. The colony still contained about 6,000 nests in 1993. Laughing gulls continue to immigrate to the Jamaica Bay colony from expanding populations in New Jersey and elsewhere, replacing the shot gulls. A long-term solution that will avoid the yearly shooting program is to relocate or disperse the colony from Jamaica Bay. However, the interim shooting program should continue on the airport to minimize the number of gull strikes until the laughing gull colony is dispersed from Jamaica Bay.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; JFK IAP; SHOOTING; UNITED STATES

ABBHA Ref. #: 974
Citation: PARKER, R.S. Update On Multiple-Engine Bird Strike Event Involving Franklin's Gulls. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: This talk provides a description of a recent Boeing 737 encounter with a dense flock of gulls during takeoff and the outcome of this encounter. The aircraft experienced multiple strikes to the airframe and to both engines. There was resultant loss of engine power. This encounter emphasizes the need for continued efforts toward eliminating bird-flock congregations at airports.
Keywords: B-737; BSCUSA; ENGINEERING; ENGINES; FLOCKING; GULLS

ABBHA Ref. #: 975
Citation: ALGE, T.L. Bird-Threat Trends By Geographic Region. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Costly and dangerous bird strike incidents continue to occur in civil transport operations on and around airports. To reduce the bird ingestion hazard, more aggressive corrective measures are needed to reduce the chances of serious incidents or accidents from bird ingestion encounters. This paper offers an overview of the worldwide bird threat trends for several key high-traffic geographic regions. It sounds the call to action for preventive and avoidance actions to counter the threat of bird strikes to aircraft.
Keywords: BIRD POPULATIONS; BSCUSA; ENGINEERING; ENGINES

ABBHA Ref. #: 976
Citation: THOMPSON, M.M. Using a GIS to Integrate Bird Data into an Aircraft Bird Avoidance Model. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Military aircraft are particularly vulnerable to bird strikes as they routinely operate at

low altitudes and high speeds. The U.S. Air Force reports 3,500 bird strikes each year. These incidents have caused the loss of numerous jet aircraft, many with resultant fatalities, and cost the U.S. Air Force an average of $65 million each year. To reduce hazardous and costly bird strikes to aircraft, the U.S. Air Force Bird Aircraft Strike Hazard (BASH) Team has developed a Bird Avoidance Model (BAM) designed to calculate the relative risk for an aircraft collision with a bird by integrating biological and geographical data into a Geographical Information System (GIS). Geographically referenced population and migration dynamics data for waterfowl, raptors, cranes, pelicans, gulls, and blackbirds were modeled for the continental United States. The risk algorithm includes differing bird types by considering population densities, species' weights, and bird behavioral differences. The temporal aspects of hazard, including time of year (seasonal variation) and time of day (diurnal variation) with altitude distribution for each temporal component, is incorporated in the risk assessment. To complement the BAM's historical migrant pathways and seasonal population distributions, satellite spectral imagery (vegetation, hydrology, and elevation) is used to help identify probable areas for bird concentrations with the low-level flight areas. The GIS output includes a graphical depiction of bird hazards and a pictorial representation of the most serious concerns.
Keywords: AVOIDANCE; BSCUSA; FORECASTING; HAZARD MANAGEMENT; MAPS; NORTH AMERICA

ABBHA Ref. #: 977
Citation: ALLAN, J.R.; HAMERSHOCK, D.M. Biological Validation and Standardization of International Aircraft Birdstrike Testing Techniques. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Each year, bird strikes to military and civil aircraft worldwide result in tens of millions of dollars of damage and occasional pilot/passenger injuries and deaths. The impacts to aircraft management organizations worldwide are the potential for injury and loss of life, destruction of expensive aircraft and their components, and thousands of hours of aircraft "down" time due to necessary repairs. Few valid biological data are available to test against, design for, and create regulations addressing the international aircraft birdstrike threat. Whole body density, internal body density, mass, length, circumference, wingspan, and flock structure data are to be collected, using methods established by the USAF, the United Kingdom (UK) Ministry of Agriculture, Fisheries and Food Central Science Laboratory (MAFF CSL), and the U.S. Department of Agriculture, on an international list of up to 40 bird species causing the most damage to aircraft. The goals of this research are to: aid standardization of international bird-strike testing techniques, establish the acceptability and validity of using "artificial" birds for aircraft bird strike testing, establish bird-strike resistance standards for aircraft components, and aid reproduction of bird bodies in analytical models. Investors in this research include the USAF Wright Laboratory, UK MAFF CSL, the UK Civil Aviation Authority, and Rolls Royce Aeroengines Division. Investment is desired from other potential users: General Electric Aircraft Engines, the Boeing Aircraft Company, the Federal Aviation Administration, Pratt and Whitney Aircraft Engines and other interested organizations.

Keywords: ARTIFICIAL BIRDS; BSCUSA; ENGINEERING; ENGINES; TESTING

ABBHA Ref. #: 978
Citation: MERRITT, R.L. Bird Strike Hazards: Using a 4.5-Pound Bird for Testing. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Each year the Air Force reports approximately 3,000 bird strikes to aircraft worldwide. Since 1987 these strikes have resulted in the loss of nine aircraft, six aircrew fatalities, and an average annual cost of over $45 million. The Bird Aircraft Strike Hazard (BASH) Team collects data from both damaging and non-damaging bird strikes. These data are used to identify installations with hazardous wildlife hazard trends, develop local control procedures, and as a baseline for bird-avoidance modeling. The data are also helpful in assessing damage to various aircraft components such as engines and windshield/canopy systems. A 4-pound strike capability has long been the standard bird weight for testing components. An analysis of data extracted from the database from 1985-1992 for strikes occurring during high speed low-level flight and with identified bird species and weights produces a cumulative frequency distribution curve that strongly supports using a 4.5- pound test standard.
Keywords: BSCUSA; CERTIFICATION STANDARDS; ENGINEERING; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 979
Citation: SLIWINSKI, R. Bird Hazards At O'Hare International Airport, Chicago. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: An 1-year ecological assessment of O'Hare International Airport, Chicago, Illinois was conducted by USDA Animal Damage Control biologists in 1992. Data collected included: composition of bird species using the airport, bird attractants, bird strikes with aircraft, and aircraft damage. Species composition changed monthly. The dominant hazardous species include ring-billed gulls (Larus delawarensis), red-tailed hawks (Buteo jamaicensis), American kestrels (Falco sparverious), starlings (Sturnus vulgaris), mallards (Anas platyrhychos) and Canada geese (Branta canadensis). The number of species on the airport varied by month with the highest numbers during migratory seasons (up to 60) and the lowest during the winter (13) with a total of 88 species observed. Aircraft damage was highest on Boeing 737's and 727's, which are numerous at the airport. Boeing 737's experienced the highest number of ingestions and engine replacements. Seventy bird strikes were compiled during 1992,56% of which were unknown to the Federal Aviation Administration (FAA) and the Air Transport Association (ATA). Sources for bird strike data included FAA 5200-7, ATA Foreign Object Damage (FOD) report, Operations personnel/Wildlife log, airport staff, personal observation and Roxie Laybourne at the Smithsonian Institute. Management strategies include habitat modification, attractive nuisance reduction, and pyrotechnic harassment with occasional lethal reinforcement. Greater wildlife awareness and better reporting have helped minimize wildlife aircraft conflicts.
Keywords: AERODROME SURVEYS; BSCUSA; CIVIL AVIATION; NORTH AMERICA;

O'HARE IAP; STATISTICS; UNITED STATES

ABBHA Ref. #: 980
Citation: CACCAMISE, D.F.; BENNETT, K.A. Laughing Gulls At Airports: Analysis of the Bird Strike Hazard. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Airports provide unique and valuable avian habitats in settings otherwise often unsuitable for exploitation by most birds. Due to bird strike hazards, conflicts arise when use of airports by certain species results in coincident use of airspace by birds and aircraft. This project examines the association of Laughing Gulls and airports with the goal of reducing attractiveness of airports to Laughing Gulls while minimizing the impact of management to benign wildlife, particularly state-endangered species that are present. We are conducting field studies at Atlantic City Airport (ACY) in southern New Jersey. We found that most Laughing Gulls at ACY were breeding adults. They were most abundant when young were provisioned in nests. Our studies of marked birds indicated that gulls at the airport came mainly from nesting colonies located on coastal marshes 15 k east of ACY. Insects constituted the largest part of the diet of gulls (60-80%) collected at ACY, and among these Japanese beetles (Popillia japonica) were the single most abundant food item. The diets of chicks in the colonies also contained mainly insects. Use of ACY habitats by Laughing Gulls appears closely tied to the foraging opportunities there. This in turn is determined by the availability of Japanese beetles, which serve as an important food for the young. This relationship is possible because the seasonal emergence of Japanese beetles coincides with peak food demand by chicks. We are developing a management approach for laughing gulls based on reduction of the foods that are the main attractant at ACY - Japanese beetles. We based our approach on habitat alterations designed to reduce availability of the plant species at ACY required by Japanese beetles for growth and reproduction.
Keywords: ATLANTIC CITY IAP; ATTRACTANTS; BSCUSA; CONTROL METHODS; FOOD; GULLS; HABITAT MODIFICATION; INVERTEBRATES; UNITED STATES

ABBHA Ref. #: 981
Citation: BENNETT, K.A.; CACCAMISE, D.F. A Habitat Approach to Lower Availability of Foods That Attract Laughing Gulls to Airports. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Laughing gulls (Larus atricilla) cause serious bird strike hazards at many coastal airports. They are often attracted to airports to forage for insects. At Atlantic City International Airport laughing gulls forage mainly on Japanese beetles (Popillia japonica) which are then fed to their chicks in coastal salt marsh colonies 18 km away. We are attempting to lower the attractiveness of the airport to foraging laughing gulls by managing the most important prey item there - Japanese beetles. Japanese beetle adults must forage on a select variety of plant leaves to form a full complement of eggs. We are attempting to manage beetle numbers by reducing the availability of their food plants. Our approach is to subject these woody perennials to a mowing regime that is unfavorable to their growth. We established experimental plots to investigate the

effect of managed mowing on Japanese beetle numbers. Our treatments on experimental plots resulted in a significant decline of the favored food plants of adult beetles. A similar decline occurred in numbers of beetles. We were also able to document a local migration of newly emerged beetles from grass habitats (where they develop as larvae) to scrub oak habitats where most adult beetles forage. We conclude that Japanese beetle numbers can be reduced through habitat manipulation. However, only a large scale experiment will determine if laughing gull numbers will decline in response to a reduction in their main prey item.
Keywords: ATTRACTANTS; BSCUSA; CONTROL METHODS; FOOD; GULLS; HABITAT MODIFICATION; INVERTEBRATES

ABBHA Ref. #: 982

Citation: GREEN, J.E.; DE VRIES, A.; ERWIN, R.F.; BUCKINGHAM, J. Research, Development and Evaluation of Strobe Light Deterrent System to Reduce Bird Strikes to Aircraft. Bird Strike Committee USA,1993. (Abstract only.)

Abstract: Transport Canada's Transportation Development Center (TDC), in collaboration with the Department of National Defence (DND) and Transport Canada's Airport Group (TCAG), is assessing the effectiveness of aircraft-mounted strobe lights to reduce bird strikes to aircraft. In 1992, laboratory evaluations of the responses of captive birds to different combinations of strobe light frequencies, wavelengths and flash patterns were completed. TDC is now preparing to field test the effectiveness of aircraft-mounted strobe lights in changing bird responses to approaching aircraft. Two test hypotheses will address (1) the distance at which birds first take evasive action, and (2) whether this distance is sufficient to reduce bird strikes. Field testing presents a number of problems including difficulties in data collection, cost effectiveness, risk of damage to equipment and risk to human safety. Due to these potential logistical problems and the need to provide quantitative data, we evaluated six ground-based testing procedures and nine in-flight testing procedures. Two of the six ground based options were considered cost effective but were not recommended because it was doubtful that these procedures would provide data of adequate quality or applicability to address either of the hypotheses regarding the effectiveness of strobe lights. Two of the nine in-flight testing options were recommended as potential testing procedures. One option involves tracking individual groups of birds with an aircraft-mounted radar during aircraft approach, while the other option involves focused monitoring of fleet aircraft with and without strobe light deterrents. The first option provides several methods of measuring response distances between aircraft and birds, as well as the possibility of direct observation and video recording of bird responses. The second option allows evaluation of the strobe light deterrent system under real operating conditions, but would not provide information on behavioral responses of birds to approaching aircraft or on response distances. TDC has recommended that the first option be pursued first. A feasibility study on the use of FM/CW radar to measure in-flight responses of birds to approaching aircraft will be conducted in late August to early September 1993.

Keywords: AIRCRAFT APPEARANCE; BEHAVIOR; BIRD POPULATIONS; BSCUSA; CONTROL METHODS; ENGINEERING; LIGHTS; SENSORY; VISUAL

ABBHA Ref. #: 983
Citation: MERRITT, R.L. Bird Strikes to U.S. Air Force Aircraft 1992. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: The U.S. Air Force reported 2,227 bird strikes during 1992. These strikes resulted in the loss of two aircraft and one pilot fatality. The total cost of these strikes exceeded $23 million. Peaks in bird strike activity were reported in the months of April, May, September and October reflecting the impact of migration. Strikes were recorded at all times of day, with 63.6% reported during mid-day periods. Birds were struck in all phases of flight with strikes in the aerodrome accounting for 67% of the total number reported. The most commonly struck birds included: sparrows (104), horned larks (52), turkey vultures (34), red-tailed hawks (21), and mourning doves (20). Although strikes were reported for nearly every aircraft type, 482 (21.7%) involved C-130 aircraft. Strikes during low-level phases of flight (377) accounted for 29.9% of all reported strikes, and 49% ($11.5 million) of the damage costs.
Keywords: BSCUSA; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 984
Citation: HAMERSHOCK, D.M.; SEAMANS, T.W.; BERNHARDT, G.E. Variability of Body Densities of Birds and Its Relevance to Damage to Aircraft. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Body density, mass, wingspan, and circumference measurements were completed on 12 bird species for use in bird/aircraft collision studies. Body densities differed ($P < 0.017$) among the 12 species, ranging from 0.602 - 0.918 g/cm3 with feathers intact and from 0.880 - 1.050 g/cm3 with feathers removed. Gulls (Larus spp.), waterfowl and turkey vultures (Cathartes aura) were among the least dense species whereas European starlings (Sturnus vulgaris), house sparrows (Passer domesticus), common grackles (Quiscalus quiscula) and Brown-headed cowbirds (Molothrus ater) were among the most dense species. The mean length-to-diameter ratio of the 12 species was 4.8 +/- 0.3. Negative correlations ($P < 0.01$) were found between dry density ($N = 144$) and wingspan, dry circumference and body length. The percent of body mass represented by feathers differed ($P < 0.05$) among species, but not by sex ($P > 0.79$) or sex x species ($P > 0.15$).
Keywords: BIRD POPULATIONS; BODY DENSITY/WEIGHT; BSCUSA

ABBHA Ref. #: 985
Citation: O'NEIL, P. Management of Gulls At Anchorage International Airport. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Anchorage International Airport (AIA) combines a busy commercial airport and the world's largest and busiest seaplane base in a wildlife-rich environment. Bird-strike problems involving gulls at AIA are reported in our files since at least the early 1960's. During construction and expansion in the early 1970's, a manmade island was created by dredge spoil to separate the runway and taxiway between Lakes Hood and Spenard. Resident gull and waterfowl

populations quickly adopted this island for nesting; numbers have fluctuated as traditional management techniques to reduce nesting have produced erratic results. Recently, pigs have been introduced to the island to discourage bird nesting. Initial results are encouraging but incomplete.
Keywords: AERODROME SURVEYS; ALASKA; ANCHORAGE IAP; BSCUSA; CONTROL METHODS; DEPREDATION; NORTH AMERICA; PREDATORS

ABBHA Ref. #: 986
Citation: BOGGS, H.C.; MONTONEY, A.J. Effects of a Bird-Hazard Reduction Force On Reducing Bird/Aircraft Strike Hazards At the Atlantic City International Airport, NJ. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: Bird-aircraft strikes at the Atlantic City International Airport (ACY), Federal Aviation Administration (FAA) Technical Center, New Jersey, increased from 18 in 1989 to 37 in 1990. During this time, the number of bird-aircraft strikes involving gulls (Larus spp.) rose from 6 to 27, a 350% increase. There were 11 runway closures due to gulls in 1990. The predominant species involved in these incidents was the laughing gull (L. atricilla). Laughing gulls are attracted to the airport habitats during the summer for feeding and loafing. The major foods used by laughing gulls on the airport are insects, found in grass and shrub areas adjacent to runways and taxiways. A Bird-Hazard Reduction Force (BHRF) was established at ACY in 1991 and 1992. The BHRF goals were to minimize or eliminate the incidence of bird-aircraft strikes and runway closures due to increased bird activities. A BHRF team consisting of U.S. Department of Agriculture, Animal Damage Control personnel patrolled ACY for 75 days in 1991 and 95 days in 1992. The BHRF used a combination of pyrotechnics, amplified gull distress tapes and live ammunition to harass gulls away from the airport from dawn to dusk. Gull-aircraft strikes were reduced by BHRF operations in 1991 by 81% and in 1992 by 86% when compared to the number of strikes incurred in 1990. Runway closures due to bird activity decreased in 1991 and 1992 by 91% and 100%, respectively, compared to 1990 closures.
Keywords: ATLANTIC CITY IAP; BIRD CONTROL TEAM; BSCUSA; CIVIL AVIATION; CONTROL METHODS; GULLS; HAZARD MANAGEMENT; NORTH AMERICA; STATISTICS

ABBHA Ref. #: 987
Citation: STEFFEN, R.F. Anti-Bird-Collision (ABC) Light System for Aircraft. Bird Strike Committee USA,1993. (Abstract only.)
Abstract: All efforts to keep birds from airports and their surroundings at the climb out and approach sectors have proved ineffective. Bearing this fact in mind, only an aircraft-linked system can be considered. Bird strikes can only be avoided when attention of the birds can be caught, information as to direction and speed can be transmitted as well as habituation and sun effects eliminated. These five factors are the key towards the prevention of bird strikes; biologists agree that birds are visual animals with an absolute instinct for an escape route. Due to the fact that true three-dimensional sight is very limited with the exception of night hunters such

as owls, birds are almost always surprised by fast aircraft. In an emergency, many try to fly a deviation maneuver directly into a bright landing light, which they interpret as being the sun with an obstacle-free escape route. This behavior I call "sun effect". A solution is offered in the form of two horizontal strobe lights, mounted approximately 5-25 meters apart on the wings or fuselage, to deliver direction information. Both lights begin to flash with increasing frequency during take-off, whereby a speed increase is simulated and attention goes up 200 times. Apart from this, the birds are frightened away by the very powerful strobe lights and the sun effect is eliminated. When airborne the frequency remains high, with an always changing phase displacement of +/- 100 mil./sec. After landing, the frequency of the flash is reduced, showing a speed reduction. The habituation effect is eliminated by this change of rhythm.
Keywords: AIRCRAFT APPEARANCE; BSCUSA; ENGINEERING; LIGHTS

ABBHA Ref. #: 988
Citation: LONERGAN, W. Wildlife Management At the world's Busiest Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: The City of Chicago owns and operates O'Hare International Airport. The city is responsible for the day-to-day management of the tremendous air transportation facility that sees as many as 65 million passengers travelling through each year. The airport operates under guidelines set forth by the Federal Aviation Administration, FAR 139. FAR 139.337 addresses wildlife hazard management and the city has carefully studied and taken steps to manage wildlife at O'Hare. We feel that our wildlife management program is the best in the country and is a credit to the City of Chicago, Department of Aviation, the airlines, U.S. Department of Agriculture/Animal Damage Control program and most importantly the air travelling public. The paper summarizes the development of the wildlife management program at O'Hare and the integration of issues such as training, public relations, other airport studies, FAA support and involvement, wildlife logs, safety patrols, public meetings, tenant/airline meetings, biological and environmental assessments, that have led to a successful wildlife management program.
Keywords: BSCUSA; CONTROL METHODS; LEGAL ISSUES; O'HARE IAP; REGULATIONS

ABBHA Ref. #: 989
Citation: RATHBURN, R.; HORN, J.; SUZUKI, N. Ecological Evaluation of Wildlife Adjacent to a Small Urban Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: A seasonal evaluation of wildlife was performed to assist regulatory agencies in assessing the impacts of a 400-acre gravel mining operation on flight safety. A detailed inventory and digitization of habitat types was completed prior to establishment of sample locations for the three wildlife surveys. Permanent circular plot stations within approach zones enumerated species elevation and direction in relation to localized habitat variables. A General Wildlife Survey included 59 permanent circular plots in 8 habitat types to assess species presence, abundance and habitat preference. An Aquatic Wildlife Survey included 58 sampling

locations to assess species presence, abundance and habitat preference in 9 habitat types. Univariate and multivariate analysis was performed to substantiate relationships of biological data to seasonal and habitat interaction. A total of 143 species of birds, 12 species of mammals and 4 species of amphibians was observed within the 12- month evaluation. The wildlife within the study area are strongly influenced by migratory species using the Pacific flyway. The most abundant migratory species include Canada goose (Branta canadensis), northern pintail (Anas acuta), American wigeon (Anas americana), green-winged teal (Anus crecca), and tundra swan (Cygnus columbianus). Seasonal pattern reflected an increase in abundance from late fall through winter with numbers beginning to decline in March-April period. Highest densities of birds were observed in the bottomlands (3.41 birds/acre), whereas lowest values (0.07 birds/acre) were in the mining ponds. Flight overlap of birds and airplanes within the approach zone was relatively uniform. Flight risk from Canada geese and European starlings (Sturnus vulgaris) was evident. It appears from data that the proposed development would alter localized flight patterns and decrease existing risk within the flight corridor.
Keywords: AERODROME SURVEYS; ATTRACTANTS; BORROW PITS; BSCUSA; NORTH AMERICA

ABBHA Ref. #: 990
Citation: SCANLON, P.F. Use of an Airport Design Project in a Vertebrate Pest Management Course. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: As part of a course entitled "Vertebrate Pest Management" I assigned a project on minimizing potential vertebrate problems through appropriate development of a new airport in a coastal mid-Atlantic area. Students were formed into 4 teams with distinct but somewhat overlapping responsibilities. Topographical maps of the area were supplied. Features such as agricultural use, human activities, and natural forested areas were designated on the maps. Available literature in the university library was placed on reserve. A large number of slides pertinent to airports (grounds and management, water and snow management, building design, ground operations, relationships to physical and vegetative features, etc.) were used in briefing the class. A local general aviation airport, with some problems from vertebrate pests, was visited. Initial briefing of the students was designed to simulate a real-world type request for professional input in minimizing problems by vertebrate pests. Student teams produced outline preliminary reports, oral final reports, expanded written final reports and provided an evaluation of the project. Student evaluations indicated satisfaction with the relevance and value of the project, tolerance of the initial briefing and a high value for the airport visit.
Keywords: AERODROME DESIGN; BSCUSA; FACILITIES

ABBHA Ref. #: 991
Citation: PINOS, A. Efforts By the International Civil Aviation Organization (ICAO) to Minimize Bird Strikes to Aircraft. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: In 1969, the Council of ICAO adopted Amendment 23 to Annex 14, ICAO's

regulatory document concerning airport design and operations which added a requirement to decrease the number of birds on airports. Since that time, ICAO has played an active role in bird hazard reduction through Annex amendments, the development of the Bird Control and Reduction Manual (ICAO Document 9137, Part 3), and the introduction in 1980 of the ICAO Bird Strike Information System (IBIS), a computerized bird strike data collection system. This paper describes in detail, ICAO's efforts to minimize the hazard birds pose to civil aviation.
Keywords: BSCUSA; CIVIL AVIATION; ICAO; LEGAL ISSUES; REGULATIONS; STATISTICS

ABBHA Ref. #: 992
Citation: FRANKENFIELD, D.L.; LEBOEUF, E.; FLOYD, J.; LANGE, W.R.; BAKER, S.P. Animal Ambush At the Airport: Nonbird Wildlife-Related Hazards in U.S. Aviation, 1983-1993. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Wildlife hazards in aviation are a very real but under-recognized problem. Information concerning animal (excluding birds) involvement in U.S. aviation from 1983 to 1993 was obtained from the National Transportation Safety Board, the Federal Aviation Administration, and the U.S. Department of Agriculture, Animal Damage Control. There were 178 events reported during the study period. Twenty injuries (10 serious and 10 minor) were sustained in twelve crashes. Most of the events (55%) happened during the landing phase of flight and 30% during take-off. Reasons for flying included: personal (40% of occurrences), instruction (10%), business (6%), aerial application (3%), scheduled carrier (9%), and non-scheduled taxi (9%). Deer accounted for the majority of cases (65%), followed by cattle (14%), horses (4%), and dogs (3%). Events were reported by large airports serving scheduled carriers as well as those serving general aviation aircraft only. Sixty-three percent of aircraft sustained substantial damage, 20% minor, 4% were destroyed. Fire was a result in 3% of the crashes, causing 2 serious injuries. Suggestions for eliminating animal hazards at airports include installation and maintenance of intact perimeter fencing, use of harassment devices in strategic locations, authorized killing of the animals, and more attention to establishing and enforcing wildlife management plans.
Keywords: BSCUSA; CONTROL METHODS

ABBHA Ref. #: 993
Citation: MERRITT, R.L. United States Air Force Bird Aircraft Strike Hazard (BASH) Summary Report for 1993. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: During 1993, the United States Air Force reported 2,405 bird/wildlife strikes to aircraft worldwide. These strikes resulted in over $15 million in damage. Seventy percent (1,381) of all strikes with known phase of flight occurred in and around airfields. Four hundred and twenty nine bird strikes (22%) were reported during low-level flight operations and 166 (8%) were reported enroute. The fall migratory months of September (12.6%) and October (11.8%) accounted for the greatest number of reported strikes with March (10.1%), April (11.7%), and May (10.1%) showing the expected influence of spring migration. Bird strikes were reported from nearly every Air Force installation with Barksdale AFB LA leading with 162 strikes followed by Little Rock AFB (119), Hurlbert Field (100), Castle

AFB (89), Reese AFB (78), Randolph AFB (74), Kirtland AFB (67), Howard AFB (66), Columbus AFB (59), and Travis AFB (53) completing the top ten. Strikes to all aircraft types were identified with KC-135 aircraft reporting 422 strikes (15.5%), followed by C- 130 with 264 (9.9%) and T-38 with 244 (9.1%). The BASH Team identified approximately 35% of the species involved in bird strikes. Horned larks (Eremophila alpestris) were the most commonly struck bird (120), followed by hawks (66), mourning doves (Zenaidura macroura) (62), meadowlarks (Sturnella spp.) (47), swallows (46) and gulls (Larus spp.) (42). The change in strike trends will be discussed along with details of proposed actions to improve safety on high-risk airfields.
Keywords: BSCUSA; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 994
Citation: ALGE, T.L. Bird Types At Selected Airports Based On Engine Ingestion Events (Experience from 1980 Through 1993). Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: More aggressive corrective measures are needed at domestic and foreign airports to reduce the chances of serious incidents or accidents from bird strikes. Information by airport location as to the most frequently ingested species of birds in GE and CFMI engines during commercial revenue service shows that multiple bird species must be addressed when controlling birds at airports. The intent is to help identify specific bird species at airports to aid biologists, airport authorities, and regulatory agencies who are faced with the challenge of controlling bird threats at and near airports.
Keywords: BSCUSA; CIVIL AVIATION; ENGINEERING; ENGINES

ABBHA Ref. #: 995
Citation: SLIWINSKI, R.P. Bird Strike Documentation At O'Hare International Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: O'Hare International Airport is known as the world's busiest airport with over 800,000 aircraft movements (landings and take-offs) annually. Located between the eastern edge of the Mississippi migratory flyway and Lake Michigan, O'Hare also has considerable bird activity. Seventy bird strikes were documented in 1992 and 139 bird strikes were recorded in 1993. The increase in reported bird strikes in 1993 is probably due to increased awareness of airport personnel, through education, allowing for better documentation and bird carcass retrieval. In addition, various bird strike sources were checked and cross referenced including: Airport Operations, Military, Air Transport Association, Federal Aviation Administration, Smithsonian Institution, and Commercial Airline reports. Wildlife species found as a result of strikes were photo-documented. The most common types of aircraft involved in bird strikes included the B737, B727, and MD80, which are also the most common aircraft types at O'Hare. In approximately 50% of the known bird strike cases, the aircraft type was identified. Of those 50% where the aircraft type was known, 16% sustained damage requiring repair or replacement to parts such as fan blades, radome or wings. Some aircraft needed engine replacement. I estimate that only 0.0013% of the aircraft that arrived or departed from O'Hare during 1993 incurred

damage as a result of a bird strike (0.13 damaging strikes/10,000 movements). Despite this small percentage, the damage caused by these few strikes totaled several million dollars. Of the 139 bird strikes that were recorded at O'Hare in 1993, 60% were not reported to the FAA. The sources presented in this paper should allow biologists to document a far more complete record of bird strikes for any civilian commercial airport in the United States than is available today.
Keywords: BSCUSA; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 996
Citation: RUBIN, D.J. Mobile Bird-Tracking Radar and Radio and Satellite Telemetry to Enhance United States Air Force Bird Avoidance Capabilities. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Since the inception of the United States Air Force (USAF) Bird Avoidance Model (BAM) in 1984, the Bird Aircraft Strike Hazard (BASH) Team has recognized several data gaps that could not be filled from information found in the current literature. The scarcity of data pertaining to the distribution of birds in three dimensional airspace continues to limit the model to rather general categorizations of bird strike hazards by altitude bands. Additionally, few studies have dealt with enigmatic avian species such as turkey vultures (Cathartes aura), which are responsible for approximately 20% of all USAF damaging bird strikes. The BASH Team, with funding provided by the Windshield Development Program (WL/FIVR) at Wright-Patterson AFB and HQ ACC at LANGLEY AFB, Virginia has undertaken two research projects to provide data to enhance the current BAM. The first study will quantify the risk of a bird strike to aircraft operating at Dare County Bombing Range, North Carolina, as well as to investigate the effects of low-level bombing missions on migratory birds. A mobile radar installation has been constructed and is currently in operation on the range. Radio telemetry will be used to monitor individual bird movements on the range. The second project involves the use of radio and satellite transmitters to study the seasonal and altitudinal distribution of turkey vultures in North America. The Argos Data Collection and Location System will be used to gather remote data. Each transmitter, weighing only 84 grams, will be modified to incorporate altimeters to allow absolute altitude calculation for each satellite transmission. Current status and findings of each project are discussed.
Keywords: BIRD POPULATIONS; BSCUSA; DETECTION; ELECTRONIC MEDIA; LOCAL MOVEMENTS; MIGRATION; RADAR; VULTURES

ABBHA Ref. #: 997
Citation: GABREY, S.W. Bird Abundance At Four Types of Waste-Management Facilities in Northeastern Ohio. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Few data exists on bird abundance at waste-management facilities other than traditional putrescible-waste landfills. Because the potential threat to aircraft safety presented by birds using these non-traditional facilities is unknown, the Federal Aviation Administration subjects such facilities to the same siting policies as putrescible-waste landfills. We monitored bird abundance (species and numbers) at 2 yard-waste compost facilities, 1 construction and

demolition landfill, and 2 trash-transfer stations for comparison with a control site (vacant lot) and a putrescible-waste landfill from May 1993 to April 1994 in Cuyahoga County, Ohio. Numbers of birds at 4 of the 5 non-traditional waste-management facilities were equal to or less than at a vacant lot. European starlings (Sturnus vulgaris), ring-billed gulls (Larus delawarensis), and house sparrows (Passer domesticus) comprised 55% of all birds recorded. Less than 2% of all birds observed were feeding on the waste materials. Over 500 times more birds were seen per observation at the putrescible-waste landfill than at the 5 non-traditional waste-management facilities. Bird use of these facilities appears to be influenced much more by the type of habitat or land-use (wetland, landfill) surrounding the facility than by the waste itself. These non-traditional waste- management facilities do not appear to attract birds at higher than background levels and would probably not be a hazard to aircraft if located near airports.
Keywords: ATTRACTANTS; BSCUSA; LANDFILLS

ABBHA Ref. #: 998
Citation: DAVIS, R.A. Landfills, Gull Roosting Behavior and Five Mile Protection Zones Around Airports. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Gulls are attracted to landfills, often in large numbers. This, in itself, does not necessarily create bird hazards to aircraft. Hazards occur when gulls fly through aircraft approach and departure paths en route to and from landfills. Therefore, it is important to know where the gulls concentrate when they are not at the landfill. It is then possible to identify the flight paths and altitudes used by gulls travelling between landfills and areas such as night roosts, pre-roost concentrations, and nesting colonies. It is the locations of these flight paths that determine whether a particular landfill poses a gull threat to aircraft safety. At LGL Limited, we have examined gull flight paths to and from over 40 landfills, in several parts of North America. Several consistent patterns occur and examples from Texas, Colorado, Wisconsin, Illinois, New York, Virginia and Ontario are presented to illustrate these patterns. The examples, involving Ring-billed (Larus delawarensis), Herring (L. argentatus) and California (L. californicus) Gulls, demonstrate that the night roosting behavior of gulls is the most important factor determining whether a landfill creates a bird hazard to aircraft. Because of the behavioral significance of night roosts, gulls can travel long distances to reach them every night. These distances often greatly exceed 5 miles. Thus, present landfill siting criteria in Canada and the U.S. that are based on 5 mile exclusion or notification zones around airports, miss many potentially dangerous bird hazard to aircraft situations and can penalize safe situations within 5 miles of an airport.
Keywords: ATTRACTANTS; BSCUSA; GULLS; LANDFILLS

ABBHA Ref. #: 999
Citation: ALLAN, J.R. The Central Science Laboratory Bird Strike Research Club. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: The MAFF Central Science Laboratory (CSL) has been the leading European research organization in the field of bird strike prevention for over 20 years. In response to requests from

the aviation industry, CSL has established a subscription club designed to spread the costs and share the benefits of research among its members. The initial research program has been set by the club members and at present concentrates on gathering data on the physical properties of bird bodies and on the spatial structure of bird flocks. These data are needed by manufacturers and regulatory authorities to assist in the formulation of standardized and representative testing techniques for aircraft components. Examples of the data obtained so far are presented, and the unique system developed for measuring bird flock structure is demonstrated. The current research program is being carried out in collaboration with the U.S. Department of Agriculture and is endorsed by the U.S. Federal Aviation Administration and the Joint Aviation Authority of the European Union. Current club members are the UK, Civil Aviation Authority, U.S. Air Force Wright Laboratory, Rolls Royce, British Airports Authority and British Aerospace. Participation is invited from U.S. manufacturers, regulatory authorities and other interested organizations.
Keywords: BIRD POPULATIONS; BSCUSA; ENGINEERING; FLOCK DENSITY; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 1000
Citation: PARKER, R.S. Harmonizing Engine Design Rules: United States - Europe. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: This presentation provides an overview of the efforts that have been in process over the past 15 years to improve the standards for engine design certification. An important feature is the cooperation between the United States and Europe to develop, through harmonization, a common set of standards. Having common standards is important so that all engine manufacturers can design to a common level of safety that will be accepted worldwide. The purpose of the presentation is to inform Bird Strike Committee-USA of the efforts from the manufacturing side of the industry. This positive exchange of information is intended to update the committee that effective protection from the bird hazard results from combined efforts throughout the industry.
Keywords: BSCUSA; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 1001
Citation: STEFFEN, R.F. Anti-Bird Collision (ABC) Light System to Prevent Bird Strikes in Aviation (An Airborne System). Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: The prevention of bird strikes in aviation can hardly be described as having been successful in the past. Damage each year in the region of $1-2 billion, caused by approximately 15,000 bird strike incidents involving commercial and military aircraft, speaks for itself. Efforts to keep birds away from airports and their surroundings have proved not very effective as birds adapt quickly to new conditions, especially where there is plenty of space available for their own safety zone, i.e., the distance between bird and source of danger. Bearing this fact in mind, an aircraft-linked system comes into question as a supplementation. Numerous studies have shown that bird strikes can only be avoided when the attention of the birds can be caught. Information

as to the direction and speed (or distance) can be transmitted, and habit effects eliminated. These four factors plus the sun effect are the key towards the prevention of bird strikes. Biologists and ornithologists agree that birds are visual animals (one calls them also flying eyes) with an absolute instinct for an escape route. Because true dimensional sight is missing, with the exception of night hunters such as owls, birds are almost always surprised by fast aircraft. In an emergency, many try to fly a deviation maneuver directly into a bright landing light, which they interpret as being the sun with an obstacle-free escape route. This behavior I call sun effect. In both cases a collision is inevitable. A solution is offered in the form of two stroboscope lamps, horizontally mounted approximately 2-20 meters apart on the fuselage or wings, to deliver direction information. Both these flash-lights begin to blink with increasing frequency during taxiing and take-off, whereby an acceleration is simulated and attention increases up to 200 times. Apart from this, the birds are frightened away by the two penetrating stroboscope lights and the sun-effect is eliminated. After landing, the frequency of the flash is reduced, showing a speed reduction. The habit effect is eliminated by this change of rhythm and a continuous asynchronous flashing of + 100 ms. That theory and practice coincide has been proved by hundreds of take-offs and landings at airports well known for their many birds and in the most adverse conditions. Air safety, economy and ecology are aviation laws according to which the ABC-Light System has been invented.
Keywords: AIRCRAFT APPEARANCE; BSCUSA; ENGINEERING; LIGHTS

ABBHA Ref. #: 1002
Citation: WILDA, D.J. Wildlife Laws and Permits. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: In 1918, the Migratory Bird Treaty Act was enacted between the United States, Mexico, and Great Britain, on behalf of Canada. This act states that it is unlawful to take, hunt, kill, sell, purchase or possess migratory birds except as permitted by regulations adopted by the Secretary of the Interior. Both a state and federal permit are needed to kill, capture, possess, or transport any protected species of bird. This applies not only to the bird itself, but also to its eggs, nests, feathers, and parts. In some cases a state permit may also be required to harass or scare migratory birds. All birds except introduced species such as English sparrows (Passer domesticus), rock doves (Columba livia), European starlings (Sturnus vulgaris), and monk parakeets (Myiopsitta monachus) and some nonmigratory (resident) game birds are protected by the Migratory Bird Treat Act. However, introduced species such as mute swans (Cygnus olor) and nonmigratory (resident) game birds like grouse, pheasant, and quail may be protected by an individual state and not by federal law. The Code of Federal Regulations (CFR) is a codification of the general and permanent rules in the Federal Register. CFR is divided into 50 titles which are then divided into chapters. Each chapter is further subdivided into parts covering specific areas. These chapters and subdivisions, represented by chapter number and subdivision, are found on the federal permit. The permit holder must follow the permit exactly to the letter. The permit states exactly what is authorized. Any deviation from the permit can result in revocation of permit, fine and imprisonment. When used in accordance to its regulations, a Migratory Depredation Permit is an integral part of many Airport Wildlife Hazard Management Plans.

Federal Depredation Permits and further information regarding federal laws are available from regional offices of the U. S. Fish and Wildlife Service (USFWS). Addresses and telephone numbers of USFWS offices are available from USDA/APHIS/ADC State Directors.
Keywords: BSCUSA; LEGAL ISSUES; PERMITS; REGULATIONS; UNITED STATES

ABBHA Ref. #: 1003
Citation: MASER, J.A.; VERAART, N.; BUCKNALL, J. The Environmental Impact Statement Process for the Gull Hazard Reduction Program At JFK International Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Bird strikes at John F. Kennedy International Airport (JFKIA) are a serious problem that has been severely exacerbated by the establishment and rapid growth of a breeding colony of laughing gulls (Larus articilla) on the salt marsh islands in Jamaica Bay located at the southeast end of Runway 22R/4L. In response to this problem, a temporary, on-airport program of shooting gulls entering the airspace was conducted by the Animal Damage Control program of the U.S. Department of Agriculture from 1991 through 1993. The concern for potential cumulative impacts associated with the shooting program led to the preparation of an Environmental Impact Statement. Alternative gull hazard reduction strategies identified through the public scoping process and further research were evaluated. These alternatives include the following: No-Action Alternative; Nonlethal Gull Hazard Reduction Methods; Lethal Gull Hazard Reduction Methods; and an Integrated Management Program. Evaluation of possible alternatives was conducted in a three-tiered manner: 1) elimination of unfeasible and ineffective alternatives; 2) elimination of alternatives with substantial environmental impacts and low effectiveness; and 3) comparison of alternatives and selection of a preferred alternative. No single gull management strategy appears likely to provide the control necessary to reduce the gull hazard on an immediate, permanent basis without resulting in substantial environmental impacts or killing large numbers of birds. Therefore, the Integrated Management Program, which couples a high effectiveness with relatively low environmental impacts and which uses a combination of nonlethal as well as lethal methods, was selected as the preferred alternative.
Keywords: BSCUSA; GULLS; JFK IAP; LEGAL ISSUES; PUBLIC RELATIONS

ABBHA Ref. #: 1004
Citation: DOLBEER, R.A.; BUCKNALL, J.L. Response of Gull Populations to Shooting At John F. Kennedy International Airport, 1991-1993. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Laughing gulls (Larus articilla) comprised 47% of the birds colliding with aircraft from 1988 to 1990, averaging 170 bird strikes per year. This species is present from May to September in association with a 7,600-nest colony (1990) adjacent to the airport. An experimental program to reduce gull collisions with aircraft was undertaken in 1991-1993 in which 2-5 people stationed on airport boundaries used shotguns to shoot gulls flying over the airport from May to August. In 3,401 person- hours of shooting, 35,692 gulls were

killed (14,866 in 1991, 13,466 in 1992, and 7,340 in 1993), comprised of 32,534 laughing gulls and 3,158 other gulls. The number of laughing gulls struck by aircraft during the shooting period (20 May-15 Aug) was reduced by 66% in 1991, 89% in 1992, and 90% in 1993, compared with the mean level of 147 strikes during the same time period for 1988-90. Strikes by the other gull species were reduced by a comparable amount. In spite of the removal of 32,000 laughing gulls in 1991-1993 (over twice the number of adults in the Jamaica Bay colony in 1990), the nesting colony declined by only about 20% from 1990 to 1993. Thus, although shooting is an effective means of reducing the incidence of bird strikes, the program has not significantly reduced the nearby nesting colony. Our recommended long-term solution is to relocate the nesting colony away from JFKIA. A seasonal shooting program should continue to minimize the number of gull-aircraft collisions until this relocation is achieved.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; GULLS; JFK IAP; SHOOTING

ABBHA Ref. #: 1005
Citation: MONTONEY, A.J. White-Tailed Deer Management Program At O'Hare International Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: O'Hare International Airport (ORD), owned and operated by the City of Chicago, is located 16 miles west of downtown Chicago, Illinois. ORD is the busiest airport in the world with up to 2,400 flights per day for an average of 65 million passengers per year. The 7,700-acre airport contains 2,000 acres of grassland and 500 acres of woodland. A 1984 Environmental Impact Statement for ORD identified white-tailed deer (Odocoileus virginianus) as a potential hazard to air-traffic and public safety. The Illinois Department of Conservation (IDOC) conducted aerial deer surveys of ORD from 1984 to 1988 and noticed that deer densities were increasing. Since 1982 there have been approximately 5 deer/aircraft collisions, the most recent in July 1993, and several reported near misses. Aerial deer surveys conducted by the U.S. Department of Agriculture's Animal Damage Control program (ADC) at ORD in 1992 and 1993 revealed 31 and 58 white-tailed deer, respectively. In 1993, an Environmental Assessment was completed by ADC which evaluated possible management techniques for wildlife hazard management at ORD. Past deer management techniques included raising the perimeter fence to 12 feet to prevent deer from moving freely onto the airport. Wildlife patrols were increased throughout the year to harass deer and prevent them from crossing runways and taxiways. A permanent exclusion fence could not be erected adjacent to runways due to radar interference. Therefore, a temporary, bright orange snow fence was constructed to deter deer from approaching active runways and taxiways. All these options proved ineffective at long term deer hazard reduction at ORD. ADC began deer removal operations in December 1993 following the issuance of a deer removal permit to ORD by IDOC. As a condition of the permit, sharp-shooters were certified by IDOC and all venison was donated to charitable organizations. Sharpshooters were positioned over baited stations and used spotlights during night operations. Deer density at ORD was reduced by 95% prior to fawning season as a result of this operation. A 100% reduction of deer strikes and a decrease in deer observations suggest aviation hazards have

been significantly reduced.
Keywords: BIRD CONTROL TEAM; BSCUSA; CONTROL METHODS; FENCES; HAZARD MANAGEMENT; O'HARE IAP

ABBHA Ref. #: 1006
Citation: HOUNSELL, R.G. Effectiveness of the Phoenix Wailer As a Bird Deterrent At a Small Transport Canada Airport. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: The Phoenix Wailer (PW), a bird deterrent device which emits several dozen electronically generated noises, has been successfully used during the past 2-3 years to reduce bird damage in a variety of agriculture operations. During autumn 1993, with Transport Canada funding, I assessed the effectiveness of the PW in reducing bird numbers on and along runways and runway areas at Yarmouth Airport, Nova Scotia. The airport was divided into 14 sectors and a Mark II PW was installed in one of these sectors. Bird inventories were conducted twice daily in all sectors during a 10-day period before initial start-up of the PW and during four 10-day periods thereafter. Significantly fewer birds (on average, 66%-93% fewer per inventory) were recorded in the PW coverage area during periods when the PW was in operation than were recorded during periods when the PW was not in operation.
Keywords: BSCUSA; CONTROL METHODS; SOUND

ABBHA Ref. #: 1007
Citation: FORBES, J.E. Habitat Modification At New York Airport Results in Multiple Aircraft Strikes By Doves Attracted to Witch Grass. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: An airport in upstate New York, which had a history of few bird strikes, suddenly developed a large number of strikes during the summer of 1992. Almost all of the struck birds recovered were mourning doves (Zenaidura macroura). Site survey observations, conducted by wildlife biologists from the New York Animal Damage Control office, revealed large numbers of doves congregating at specific runway locations. A check of these locations indicated that the dove attraction was witch grass (Panicum capillara) growing in narrow (2-3 feet wide, 25-100 feet long) strips at the edges of runways. Positive identification of this plant was made by the Systematic Botany and Mycology Laboratory of the USDA Beltsville Agricultural Research Center, Beltsville, Maryland. Examination of the dove crops confirmed doves were eating witch grass seed. Witch grass was growing in bare strips, possibly where a snow plow blade had removed the sod. A recommendation was made to treat the witch grass with a herbicide and replace the sod.
Keywords: BSCUSA; CONTROL METHODS; DOVES; HABITAT MODIFICATION

ABBHA Ref. #: 1008
Citation: COOPER, J.A. Canada Goose Management At the Minneapolis-St. Paul International Airport. Bird Strike Committee USA, 1994. (Abstract only.)

Abstract: This paper describes the effectiveness of efforts to reduce the Canada goose (Branta canadensis) population at the St. Paul-Minneapolis International Airport in Minnesota. Introduced to the area in the 1950s, geese began using the wetlands and grass adjacent the runways in 1973. From 1980 to 1984, four goose strikes were recorded and goose flights through the operations airspace were common from September to November. Population control experiments began in June, 1984 when flightless goose concentrations within 16 km of the airport were captured and the adults neckbanded. Marker observations and counts at the airport that fall indicated a minimum of 300 birds from 7 of 11 banding locations were using the airport. Geese at these locations were drive-trapped and shipped to distant locations from 1985 to 1994. Capture efficacy ranged from 82 to 99%. The number of geese observed from the air traffic control tower during September-November was 48%, 67%, and 88% below the 1984 level in 1985-1987, respectively. One goose strike occurred in 1985 and none since, while the goose population in unmanaged locations grew more than 50% during this period. The results of this study indicate that reducing breeding populations of Canada geese that use an airport can significantly reduce aircraft strikes.
Keywords: BIRD POPULATIONS; BSCUSA; CONTROL METHODS; DEPREDATION; GEESE

ABBHA Ref. #: 1009
Citation: DOSCH, J.J.; BENETT, K.; REED, L.M.; DELAY, L.; CACCAMISE, D.F. Management of Bird Strike Hazards At Airports: a Habitat Approach. Bird Strike Committee USA, 1994. (Abstract only.)
Abstract: Management of bird strike hazards is costly and time consuming, yet effectiveness is limited to special circumstances and short intervals. The best opportunities for developing robust approaches for management must be built on a careful integration of the needs of air operations with the biological factors regulating the interaction of bird populations and the airport environment. This project examined bird associations at an airport typical of northeastern USA (Atlantic City Airport - ACY). Our goals were to: 1) identify bird strike hazards, 2) understand their biological basis, and 3) develop management approaches specific to ACY while holding the potential for application at a regional level. ACY provides unique and attractive habitats that supported a diverse avian community of at least 127 bird species. Breeding laughing gulls (Larus atricilla) caused the greatest bird strike hazard because their high numbers occurred over the short interval when they provisioned young in colonies 18 k away. Gulls at ACY foraged for insects (60-80% of diet), mainly Japanese beetles (Popillia japonica). Foraging opportunities provided mainly by abundant Japanese beetles were the primary attractant for laughing gulls at ACY. This occurred because emergence of Japanese beetles coincided with the period of peak food demand by nestlings. We are developing a management approach for laughing gulls based on reducing the foods (i.e., Japanese beetles) that attract the gulls to ACY. Our approach modifies habitats to reduce availability of plant species required by Japanese beetles for growth and reproduction.
Keywords: BSCUSA; CONTROL METHODS; FOOD; HABITAT MODIFICATION;

ABBHA Ref. #: 1010
Citation: LEBOEUF, E. U.S. Air Force Bird Strike Update. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: The United States Air Force averaged 2,666 bird/wildlife strikes to aircraft annually over the last 10 years. During 1994, 2,203 strikes were recorded including two class A strikes, six class B strikes and 68 class C strikes. The remaining 2,126 strikes were considered non-damaging or resulted in damages not exceeding $10,000. Class A mishaps include incidents exceeding $1,000,000 in damages, total loss of an aircraft, or loss of life. Class B mishaps include incidents with damages between $200,000 and $1,000,000. Class C mishaps include those incidents with damages between $10,000 and $200,000. The total cost of all strikes exceeded $15 million in 1994. Seventy three percent (1,160) of all strikes with known phase of flight occurred on or near the airfield. Three hundred and nine strikes (19%) occurred during low level flights and 127 (8%) strikes were tallied while aircraft were enroute. Autumn migratory months accounted for the greatest number of strikes with 248 and 282 strikes reported for September and October, respectively. All Air Force installations reported at least one strike with Little Rock AFB reporting the greatest number (106) followed by Barksdale (101), Luke AFB (90), Kirtland (76), Hurlburt (75), Randolph AFB (74), Castle AFB (67), Incirlik AFB (63), Reese (56), and McConnell (52). The three most frequently struck aircraft were the KC-135 with 316 (14.3%) strikes followed by the C-130 with 263 (11.9%) and the F-16 with 210 (9.5%). The most frequently struck birds were hawks (65), followed by sparrows (48), horned larks (Eremophila alpestris) (39), gulls (Larus spp.) (38) and European starlings (Sturnus vulgaris) (26). These trends and other recent changes in the BASH Team will be discussed.
Keywords: BSCUSA; MILITARY AVIATION; NORTH AMERICA; STATISTICS; UNITED STATES

ABBHA Ref. #: 1011
Citation: TIANHAO, W. Bird Strike Prevention in China. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Bird strike statistics and some accidents from bird strikes in China are described. The First Symposium on Aircraft Bird Strike of China (1 SABSC) was held 25-28 October 1994 in Kunming. Thirty-two delegates from 20 organizations of civil aviation, military, aircraft industry companies and institutes of China Academy, and universities and colleges attended. Meanwhile, Bird Strike Research Group, Ornithology Branch, China Zoology Society/Bird Strike Prevention Committee, Yunnan Zoology Society (BSRG/BS&PC) were established simultaneously. A project on feasibility of bird strike prevention was signed with Civil Aviation Administration of China at Chongquing Airport, Sichuan Province and shall be initiated this September. Emphasis of the project is a fundamental ecological investigation in or near airports.
Keywords: AERODROME SURVEYS; ASIA AND MIDDLE EAST; BSCUSA; CHINA; STATISTICS

ABBHA Ref. #: 1012
Citation: KELLY, T.A.; ZAKRAJSEK, E.; SMITH, A. BASH TEAM RADAR STUDY AND BIRD AVOIDANCE MODEL DEVELOPMENT AT DARE COUNTY BOMBING RANGE, North Carolina. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: This paper contains a summary of the project at Dare County Bombing Range to quantify the effects of military aircraft on endangered species and the risk of bird strikes. An outline is given of the radar equipment used. The data collected to date is used to illustrate the Bird Avoidance Model proposed to reduce both bird strikes and any potential disturbance to threatened and endangered species in the area.
Keywords: AVOIDANCE; BSCUSA; DETECTION; MAPS; RADAR

ABBHA Ref. #: 1013
Citation: RUBIN, D.J. Using Satellite Telemetry to Describe Daily and Seasonal Movements, and Altitudes of Flight for Two Species Presenting a Significant Hazard to Military Low-Level Aircraft Operations; Turkey Vultures and Tundra Swans. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Over the past 10 years the U.S. Air Force (USAF) alone has suffered more than $3 million a year in damage as a result of aircraft collisions with turkey vultures (Cathartes aura). This single species has accounted for 20% of all USAF damaging bird strikes over this period. Tundra swans (Cygnus columbianus), although not commonly struck by aircraft, can represent a significant hazard where they concentrate during migration. Satellite Telemetry has been employed to investigate the activity regimes of these birds and to calculate associated flight altitudes. From September 1994 to February 1995 nine satellite transmitters were attached to three different groups of turkey vultures in the vicinity of the Dare County Air Force Bombing Range in North Carolina, and a single transmitter was placed on a tundra swan at Pungo National Wildlife Refuge, North Carolina. Each 84-gram backpack transmitter contains a pressure sensor that provides data that, combined with the local barometric pressure at the time of the location, can be used to calculate the absolute altitude of the bird. Point Analyses, obtained from HQ Air Mobility Command at Scott AFB IL provide a model of meteorological conditions estimated for the exact time and location of each satellite fix. These data will be used not only to determine the altitude distribution of these birds, but also to attempt to explain the influence of specific weather conditions on these flight altitudes. Data collection will continue through January 1996. Funding and labor for this project has been provided by the Windshield Development Program at Wright-Patterson Air Force Base (AFB), Ohio and the USAF BASH Team at Kirtland AFB, New Mexico. Methods, findings to date, and the timeline for data analyses will be discussed.
Keywords: BIRD POPULATIONS; BSCUSA; MARKING/BANDING; MIGRATION; SWANS; VULTURES

ABBHA Ref. #: 1014
Citation: KELLEY, M.E. Aircraft Bird Strike Prevention Using Infrasound and Modulated Radar. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Aircraft bird strikes are a serious and costly problem for both military and civilian aircraft. Bird strikes cost the USAF $50-80 million per year on average, and cost world- wide aviation an estimated $1-2 billion per year. The birds struck do not fare well either, which is especially important if the birds are protected species. A Small Business Innovative Research (SBIR) effort sponsored by Wright Laboratory is investigating the effects of low frequency sound (infrasound) and modulated radar on bird behavior. The phase I effort is completed and Phase II will begin later in 1995. Results to date show birds react to infrasound. Their reaction is "alert!" and they try to locate the sound source. If the aircraft is the source, the bird will see the aircraft sooner, and will be better able to avoid the aircraft. We have also learned that people, animals, and birds can "hear" modulated radar at energy levels that do not cause injury. Various studies by researchers have repeatedly demonstrated that radar modulated with a frequency corresponding to an audible sound frequency can be "heard" by people and animals. People can understand words, and animals trained to perform tricks when they hear specific sounds perform the same tricks when radar modulated with those sounds is used. Bird tests have been less detailed and structured. Birds will avoid the end of a large cage when radar is used there, and birds in the wild have been observed diving/dodging out of the beam of some radars. Birds have similar hearing physiology to people and animals, so it is expected that birds will also be able to hear and understand simple signals/warnings in modulated radar. Latest research results will be given in the presentation.
Keywords: BSCUSA; CONTROL METHODS; MICROWAVES; SOUND

ABBHA Ref. #: 1015
Citation: KREITHEN, M.L.; DAVIS, E. Development of a Pulsed Microwave Warning System to Reduce Avian Collisions With Obstacles. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Twenty homing pigeons were tested in the laboratory for their ability to detect pulsed microwave signals broadcast through a horn antenna into a test chamber. All 20 birds were able to detect the pulsed RF signals on the first day of testing at 1.25 gHz and 2.45 gHz at average incident power densities below 1 mw/cm2 and peak incident power densities in the range of 1-10 watt/cm2. The method used to establish the behavioral response was cardiac conditioning, a testing method routinely used by the principal investigator to demonstrate the sensitivity of birds to light, to sounds and vibrations, and a variety of unusual signals such as barometric pressure, ultraviolet light, polarized light, and atmospheric infrasounds. All 20 birds detected the signals on the first day of testing. This suggests that naive birds encountering such signals in the environment will not require extensive learning to respond to the signals. For a total of 707 trials, the birds responded to 84.3% of the pulsed microwave (experimental) signals (n=426). Responses to control trials, which establish the background rate of spontaneous cardiac accelerations during an interval without RF signals, were 17.1% (n=281). These results were numerically and behaviorally comparable to previous tests with well-known stimuli such as light

and sound, and clearly indicate that the birds are able to detect pulsed microwave signals. This experimental step establishes the feasibility of constructing a collision warning system which uses pulsed microwave signals to inform birds of the presence of hazardous obstacles. Pulsed microwave signals, unlike sounds, travel at the speed of light, unlike light, can penetrate fog and clouds, work in daylight or darkness, and the microwave signals do not require that the bird be looking toward the object to detect the warning signal. We routinely mark human hazards with conspicuous signals. It seems reasonable to provide birds with similar information, appropriate to their biological natures, to be used in locations with a history of bird collisions with objects.
Keywords: BEHAVIOR; BIRD POPULATIONS; BSCUSA; CONTROL METHODS; MICROWAVES

ABBHA Ref. #: 1016
Citation: CURTIS, T. Bird Strike Damage Rates for Commercial Jet Aircraft. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Since the inception of jet travel, there have been thousands of bird strikes that have damaged large commercial jet aircraft. This survey of bird damage to selected Boeing aircraft gives a detailed accounting of damage or other safety related problems caused to selected Boeing aircraft during the period January 1, 1982 to June 30, 1993. These are all damage events that required some type of repair to physical damage before the aircraft could return to regular service. It includes bird strike incidents involving the 737- 300/400/500 series and all 747, 757, and 767 aircraft. Damage rates by aircraft and area of the aircraft are given, as are rates for significant bird damage events.
Keywords: AIRCRAFT SYSTEM; BSCUSA; CIVIL AVIATION; ENGINEERING; STATISTICS

ABBHA Ref. #: 1017
Citation: SHORT, J.J.; SEAMANS, T.W. Using Computerized Axial Tomography and Magnetic Resonance Imaging to Develop Bird Density Models to Aid in Testing Aircraft Components. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: The development and certification of aircraft engines that can withstand bird strikes is costly and time-consuming, especially if components must undergo full-scale testing. Recent developments in computational modeling make possible the use of "computer- simulated birds" during the initial engine design process. However, for this computational modeling to be accurate, the internal densities of bird species must be known. This study used empirical measurements, magnetic resonance imaging (MRI) and computer-aided tomography (CAT) measurements to determine the variability of internal tissue densities of birds. Empirical measurements using water displacement indicated that the densities of 18 body pats from 14 species varied from 1.201 (+ 0.231) g/cm3 for the coracoid (bone connecting keel to shoulder) to 0.657 (+ 0.223) g/cm3 for the trachea. Initial results of relative tissue density collected by computer-aided tomography show good correlation with empirical measurements of the tissues.

These preliminary results indicate radiological assessments should be an efficient and accurate means of providing bird density data ready for input into complex engineering design models. This study is a collaboration with the United States Air Force Wright Laboratories, the U.S. Department of Agriculture, and Ministry of Agriculture Central Science Laboratory of the United Kingdom.
Keywords: BIRD POPULATIONS; BODY DENSITY/WEIGHT; BSCUSA; ENGINEERING

ABBHA Ref. #: 1018
Citation: GARBER, S. Factors Affecting Relocating a Laughing Gull Colony Near JFK International Airport. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Presently, the only laughing gull nesting colony in New York state is adjacent to John F. Kennedy International Airport (JFKIA). Establishing a new laughing gull colony in New York State away from JFKIA is in the planning phase. While monitoring laughing gull movements, nest-site selection, feeding behavior, habitat preferences, and relative abundance throughout the region, measures are being taken to reduce bird attractants both on and off JFKIA. Laughing gulls attempting to fly over JFKIA have been shot for the past 5 summers (1991-1995), reducing strikes by about 90% compared to 1988-1990. To break out of this politically and environmentally complicated situation, the Port Authority of New York and New Jersey is committed to solving the safety issues in a manner that makes the most biological, political, and long-term sense from a policy perspective. We are working with the federal, state and local regulatory agencies to find the best solution to a problem that has been growing in complexity on an annual basis for almost two decades. Although JFKIA has maintained the safest environment for its passengers during each of these years, it has been at a high cost to several involved publics. We wish to find the best possible location for a new laughing gull colony, attract laughing gulls to nest there by methods that will be explained, and then move the rest of the colony to a new location by a combination of means that have been attempted to varying degrees in other locations for a suite of other reasons. All plans will be discussed and feedback will be requested so the final plan will have input from experts who have been solicited worldwide.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; GULLS; SHOOTING

ABBHA Ref. #: 1019
Citation: SEAMANS, T.W.; BELANT, J.L.; DWYER, C.P. Propane Exploders and Cattle Guards As White-Tailed Deer Deterrents. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Increasing deer populations in urban and suburban areas has led to an encroachment of deer onto airport facilities. Deer residing at airports pose a major threat to aviation safety, comprising 65% of aircraft-mammal strikes. Frightening agents and exclusion devices are needed to keep deer from runways, even if used temporarily until a permanent resolution can be achieved. Propane exploders are used at airports to repel deer; however, few data exist on the duration and degree of effectiveness. We conducted 3 trials in a 2,200-ha fenced facility in northern Ohio containing about 2,000 white-tailed deer (Odocoileus virginianus) using

systematic and deer-activated propane exploders. Systematic exploders fired once at 8-minute intervals, whereas deer-activated exploders fired 8 times for each intrusion. Systematic exploders repelled deer for up to 2 weeks, whereas deer-activated exploders repelled deer for up to 6 weeks. Deer habituated less rapidly to deer-activated exploders; however, rate of habituation varied seasonally. Many airports have installed fencing to exclude deer; however, deer may continue to enter these facilities through gates that remain open for emergency or service vehicles. We conducted 3 trials at this same facility to determine the effectiveness of cattle guards as a deer exclusion device at openings in fences. The number of deer crossings through 3 openings spaced 0.6-km apart along a 2.44-m high chain-link fence was evaluated before and after installation of cattle guards. During pretreatment, the number of crossings averaged 9.7 deer/day. After installation of the cattle guards, the number of crossings averaged 0.4 deer/day, a decrease of 96%. Cattle guards are effective in reducing deer movements through openings in fences.
Keywords: BSCUSA; CONTROL METHODS; EXCLUSION; FENCES

ABBHA Ref. #: 1020
Citation: MACKINNON, B.T.; FAIRBAIRN, D. Transport Canada 1994-95 Bird Strike Awareness and Training Programs. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Transport Canada Airports feels that awareness of bird strike issues within the aviation community deserves high profile. It was determined that the bird strike reporting system in Canada required improvement, that pilots should be more aware of the ongoing importance of and procedures for reporting bird strike incidents, and that airport operators could be made aware of the role that they play in mitigating bird strike problems. An intensive awareness campaign was initiated in 1994, that included Canada-wide distribution of new bird strike reporting forms, pilot brochures, wildlife bulletins, videos, posters, and updated aeronautical information publications. In order to enhance awareness among airport operators, the Wildlife Control Procedures Manual was updated, and distributed to most Canadian airports. the traditional 5-day Airport Wildlife Control Training course was revised into a 2- day 'canned' seminar that can be delivered to individual airports, thereby reducing the costs to the airport operator and significantly increasing the number of students who can be taught in a year. Also, the new course is more readily available to the airport staff who have the 'hands on' responsibility for wildlife control, and it is linked to the updated procedures manual that each wildlife control officer has access to. The course is designed to be tailored to each airport's unique circumstances, and will lead to the development of an airport wildlife control management plan. Interest in the awareness initiative is encouraging, and early indications are that the training seminar will improve the quality of airport wildlife control programs.
Keywords: BSCUSA; GUIDANCE; HAZARD MANAGEMENT; TRAINING

ABBHA Ref. #: 1021
Citation: DOLBEER, R.A.; LEBOEUF, E. Preliminary Bird Strike Analysis for Civil Aircraft in

the USA, 1994. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: In the United States, bird and other wildlife strikes annually cause many millions of dollars in damage to civilian and military aircraft and the occasional loss of human life. However, the extent and nature of the bird strike problem for civilian aircraft in the United States is largely unquantified. Bird strikes have been reported voluntarily to the Federal Aviation Administration (FAA) since 1968 (presently on Form 5200-7) by pilots and airport personnel but little analysis of these data has been done. The United States lags behind almost all other industrialized countries in the analysis and publishing of bird strike data. The U.S. Department of Agriculture, through an Interagency Agreement with the FAA, initiated a program in April 1995 to organize, manage, edit, analyze and report on the FAA Bird Strike Database. Since April, all reported strikes for 1994 (n = 2,285) have been edited and entered into the database. Gulls (28% of total), waterfowl (24%), and birds of prey (17%) were the 3 bird groups most frequently reported struck. Deer were involved in 57 reported strikes of which 17% were from Pennsylvania. September had the highest number of reported strikes for birds whereas November had the highest total for deer. In all, 488 incidences of damage to aircraft were reported, including 126 engines damaged. About 25% of the reported gull strikes caused damage whereas 50% of reported waterfowl strikes caused damage. A comparison of the 1994 reported strikes with those known to occur on a major U.S. airport where detailed records were maintained indicates <25% of all strikes are reported to the FAA. The reporting of bird and other wildlife strikes is critical to determining the economic costs, the magnitude of the safety issues, and most importantly, the nature of the problems (e.g., bird species, aircraft and engine types, airports, seasonality) so that corrective actions can be justified and taken. The current plan to implement careful editing and data entry of reported strikes and to produce a timely, annual publication on strike results should help in promoting the reporting of strikes by the aviation community.
Keywords: BSCUSA; CIVIL AVIATION; NORTH AMERICA; STATISTICS; UNITED STATES

ABBHA Ref. #: 1022
Citation: HUPF, T.H.; FLOYD, J.K. Federal Aviation Administration Technical Center--1995 Managed Grass and Shrub Mowing Plan. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Long grass management has been implemented with varying success at Atlantic City International Airport (ACY), New Jersey since 1990. While greater bird deterrence has been generally observed, attainment of the actual long grass heights of 10-14 inches has been sporadic and inconsistent. In 1993 and 1994, mowing caused mortality to nesting and young upland sandpipers (Bartamia longicauda), a state endangered species, resulting in state notices of noncompliance. In 1995, we designed, implemented and rigorously coordinated a highly managed mowing plant to: 1) efficiently and safely operate ACY; 2) deter laughing gulls (Larus atricilla), Canada geese (Branta canadensis), and European starlings (Sturnus vulgaris); 3) eliminate mowing mortality to upland sandpipers; 4) protect habitats of grassland endangered, threatened, and candidate species of birds, moths and plants; and, 5) enhance black-legged tick control efforts. ACY and the Center were divided into five grass management zones using

combinations of three grass heights: short grass (3- 5 inches), long grass, and tall grass (>14 inches), mowing bans, mowing timings and mower controls within each zone. Tall grass was used to deter birds and heights averaged 22 to 24 inches. Preliminary results and observations suggest high levels of deterrence were achieved for laughing gulls, Canada geese and starlings. Resident Canada geese were largely restricted to mowed strips and low density tall grass stands. Upland sandpiper reproduction and populations increased without any apparent increase as aviation hazards. Management of tall grass on airports may present a successful approach to bird deterrence, compatible with airport operations and endangered grassland species.
Keywords: BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 1023
Citation: SLIWINSKI, R.P. Turf Management At O'Hare International Airport to Reduce Bird Strikes. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: The U.S. Department of Agriculture's Animal Damage Control program has provided assistance to U.S. airports having bird/wildlife problems through recommendations presented in Wildlife Hazard Management Plans. Typically, increasing grass height from 4 inches to 6-10 inches has been recommended as a non-lethal means of reducing bird numbers on airports. It is assumed that birds such as gulls, geese, and starlings do not prefer longer grass because of the difficulty of walking and visual obstruction. However, there have been no clear guidelines on which grass heights are the most effective. In addition, there are problems with determining appropriate grass heights because of obstructions, fire hazards, and the creation of habitats that may attract a different set of wildlife species (e.g., raptors hunting rodents in tall grass) which could pose hazards to aircraft. To determine the effectiveness of tall grass management in reducing bird strikes, an experiment has been designed to evaluate 4 grass heights (treatments), each replicated 4 times, in 16 30-to 50-acre plots at O'Hare International Airport, Chicago, Illinois. Initiated in 1995, the experiment will run for 4 years. Bird, small mammal, and insect use of the plots is being determined through regular surveys. The goal of this study is to determine which grass heights are most effective in reducing hazardous bird numbers, while not attracting other species that may create new hazards. This presentation presents the complexities of organizing a turf management plan at an airport, the details of turf height in relation to FAA installations, and includes preliminary data on bird use and turf composition.
Keywords: BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 1024
Citation: SHORT, J.J. Availability of an Annotated Bibliography of Bird Hazards to Aircraft (ABBHA). Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: An annotated bibliography of bird hazards to aircraft, termed ABBHA, was developed in cooperation with the U.S. Air Force Armstrong Laboratory's Technical Information Center, at Tyndall AFB, Florida. The ABBHA can stimulate and facilitate additional research into bird hazards to aircraft. The ABBHA currently brings together over 500 citations pertaining to bird

strike avoidance, bird management and control, and bird remains identification; more references are added periodically. The ABBHA is available electronically and can be used with a variety of word processing or bibliographic software. Computerization of the ABBHA helps users locate references, reduces distribution costs and allows for frequent updates. Citations included in ABBHA include working papers published in the proceedings of Bird Strike Committee Europe, Canada and the United States, studies published in scientific journals, and information contained in institutional databases such as the National Technical Information Service.
Keywords: BIBLIOGRAPHIC; BSCUSA; LITERATURE SURVEY

ABBHA Ref. #: 1025
Citation: SEUBERT, J.L. Assessing the Implementation of Wildlife Hazard Management Programs At Civil Airports. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: This talk describes a proposed system for assessing the implementation of wildlife hazard management programs at civil airports. Important management functions and control techniques for controlling wildlife hazards are listed: and habitats, land uses, and food sources are identified that are attractive to wildlife on or in the vicinity of airports.
Keywords: BSCUSA; HAZARD MANAGEMENT; ORGANIZATION; SURVEYS

ABBHA Ref. #: 1026
Citation: BARDEN, M.; SLATE, D. Designing a Practical Bird Hazard Survey: What We Learned At Pease International Tradeport, New Hampshire. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Bird hazard surveys vary in scope and require flexibility in their design. Nevertheless, we feel that some standardized procedures are needed that can be easily incorporated into surveys to meet specific study objectives at a wide variety of sites. Our experience in developing and conducting a bird hazard survey for Pease International Tradeport (formerly Pease Air Force Base), New Hampshire will be used to discuss how the current version of the ADC Airport Safety Manual, airport history, objectives, funding and data needs influenced our design. We discuss how permanent sampling blocks of a uniform size, a 1- minute bird sampling regime with replication, a streamlined data collection sheet and corresponding computerized database, and personnel and equipment are being used to conduct the survey at Pease. Our experiences at Pease may be helpful in developing some standardized procedures that could be used in future bird hazard surveys for airports.
Keywords: BSCUSA; HAZARD MANAGEMENT; ORGANIZATION; SURVEYS

ABBHA Ref. #: 1027
Citation: DEWEY, J.; LOWNEY, M. Status Report On the Wildlife Hazard Assessment At Washington Dulles International Airport. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Wildlife has been recognized as a potential hazard to human safety and aircraft

operations at Washington Dulles International Airport. USDA/APHIS/Animal Damage Control (ADC) was requested to conduct a wildlife assessment to generate site-specific management recommendations to reduce wildlife-human conflicts. ADC initiated four ecological studies: a bird survey, a pond survey, a small mammal survey, and a deer management study. Historic data were analyzed. The bird survey consists of recording bird species, abundance, and activities weekly from 24 observation points spaced equi- distant within the Aircraft Operations Area (AOA). The pond survey records wildlife use of beaver and man-made ponds monthly. The small mammal survey involves trapping small mammals in different habitat types within the AOA and analysis of fox scat to determine the percentage of small mammals in the diet. The deer management study collects data from three sources: an existing game control program (deer hunting), a semi- annual deer herd health check, and spotlight surveys twice each month. Preliminary results indicate populations of American crows, Canada geese, ring-billed gulls, and various raptors present in the AOA. Beaver ponds attract few wildlife species in abundance. Small mammal distribution suggests that short grass habitat management in the AOA has the fewest small mammals and would be expected to attract the fewest avian and mammalian predators. The estimated deer density is higher than desirable with an estimated pre-hunt population of 70 deer/square mile. The game control program appears effective in maintaining herd size and a young age structure (deer < 3 years of age), but further study is necessary to determine methods to increase the proportion of does harvested and result in a reduction in herd size. The existing five-strand electric fence is ineffective at excluding deer and should be replaced with conventional fencing.
Keywords: BSCUSA; CONTROL METHODS; EXCLUSION; FENCES

ABBHA Ref. #: 1028
Citation: DOLBEER, R.A.; LEBOEUF, E.; ARRINGTON, D.P.; ATKINS, C. Can Aircraft and Albatrosses Coexist At Midway Island? Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: The nesting population of albatrosses on Sand Island, Midway Atoll, has increased from <50,000 adults in 1939 to about 400,000 adults in 1995. Consequently, bird strikes are an increasingly serious problem for aircraft landing at the Naval Air Facility (NAF) on Sand Island. In 1993, strikes were reported for 57 (12%) of the 459 aircraft movements at the NAF. In April 1995, we monitored movements of albatrosses and other birds across the 8,000-ft runway by time of day. Bird activity was extremely high during all daylight hours with a mean of 363 birds (85% Laysan albatrosses, 3% black-footed albatrosses, 12% other species) recorded crossing the runway per minute. There were no periods of bird inactivity during daylight hours. Runway crossings ranged from about 250 birds/minute during midday (1100-1400 hr) to 525/minute during early morning (0700-1000 hr). In contrast, runway crossings at night averaged only 6 birds (mainly Bonin petrels)/minute. Albatross crossings/minute averaged <0.5 at night. To minimize the probability of strikes, non-emergency aircraft movements at Midway should be restricted to hours of darkness during the albatross nesting season (November-July). Presently, the NAF on Midway is scheduled to be closed by 1997 when the island will be administered by the U.S. Fish and Wildlife Service (USFWS) as a Wildlife Refuge. The USFWS is considering

allowing private companies to develop an eco-tourism industry for the island to defray the high costs of maintaining the airfield and support facilities. However, the extreme bird strike hazard resulting from the high concentration of birds on the island may be a limiting factor in the development of an eco-tourism industry.
Keywords: AERODROME SURVEYS; ALBATROSSES; BIRD POPULATIONS; BSCUSA; LOCAL MOVEMENTS; MIDWAY ATOLL; MILITARY AVIATION; OTHER

ABBHA Ref. #: 1029
Citation: FORBES, J.E. Potential Bird Strike Hazard from Irrigating Agricultural Areas On Airports With Wastewater Effluent. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: Recently there has been an increased interest in using airports as locations to dispose of sewage sludge and wastewater effluent in states such as New York and California. The author was asked to comment on possible bird hazard to aircraft at the Arcata-Eureka Airport in McKinleyville, California from a proposed wastewater effluent irrigation plan. Treated effluent would be pumped through a 14-inch diameter pipe to the airport where it would be discharged at two different rates called type 1 and type 2 irrigation. Type 1 would discharge 3 inches per month for a total of 13.5 inches per season. Type 2 irrigation would result in 15 inches per month and 67.5 inches per season. The current airport habitat, described as brush, would be cleared and planted to two species of grass which would be cut for hay two to three times each year. This paper discusses the predicted effect of the proposed action, including the existing deer problems and the increased attraction to birds from: adding water, adding nutrients, habitat change, short grass, tall grass and mowing. Very little research has been conducted on wastewater effluence disposal on airports. More research is needed. However, this research should not be conducted at active airports.
Keywords: ATTRACTANTS; BSCUSA; SEWAGE; WATER/RESERVOIRS

ABBHA Ref. #: 1030
Citation: DAVIS, R.A.; DAVIS, T.J. Successful Gull Control At a Colorado Landfill. Bird Strike Committee USA, 1995.
Abstract: The building of the new Denver International Airport near the existing Tower Landfill, northeast of Denver, created a potential gull hazard to aircraft safety. BFI of Colorado Inc. commissioned LGL Limited to conduct a baseline study, design a gull control program, and train BFI employees to implement it. The baseline study lasted from May 1992 to August 1993. Up to 4,000 to 5,000 California and Ring-billed Gulls were present during the spring and fall migrations. Smaller numbers of breeding California Gulls were present in summer and about 1,000 Ring-billed and Herring gulls were present in winter. A gull control program designed to account for gull behavior and based only on habitat management and pyrotechnics was begun in late August 1993. During the first nine months of control, including the fall and spring migrations, the numbers of gulls using the landfill were reduced by 94.4% and 97.7%. It was hypothesized that control would be even more effective in the second year of control, after the

migrating gulls had learned that food was no longer available at Tower Landfill. The numbers of gulls present in the 1 January - 15 May period declined in the second year (1995) by a further 80% compared to the first year of control (1994). Gull control and monitoring continue at the site.
Keywords: ATTRACTANTS; BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; LANDFILLS; PYROTECHNICS

ABBHA Ref. #: 1031
Citation: PARKER, R. Update On Jumbo Jet Flock Encounter. Bird Strike Committee USA, 1995. (Abstract only.)
Abstract: In September 1994, a foreign-operated B747 encountered a flock of birds during takeoff roll. The encounter resulted in the transverse fracture of fan blades and the release of the engine inlet cowl. This event stresses the continuing need for airport bird control. A short segment of a video tape on an 8-pound bird ingestion test will be shown.
Keywords: B-747; BSCUSA; ENGINEERING; ENGINES

ABBHA Ref. #: 1137
Citation: SEUBERT, J.L. Do Populations of North American Canada Geese Pose an Increasing Hazard to Aviation. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Trends in North American Canada goose populations are illustrated with color slides for the period 1970-1995. Emphasis is on the increases in the non-migratory residential Canada goose populations that cause hazards to aircraft as well as nuisance, agricultural, and health problems. These large geese are the "giant" (Branta canadensis maxima) and the "western" (B.c. moffitti) subspecies. Mid-winter surveys have indicated that the North American population of these large geese almost tripled during the 1985-1995 period from 600,000 to 1.7 million birds. Total Canada goose populations increased by 66% during this period. Information is given about the numbers of these geese in the Atlantic, Mississippi, Central and Pacific flyways for both resident geese and the total flyway population. Jet aircraft numbers also have increased during the 1985-1995 period, 52% for the U.S., 38% for Canada, and 68% worldwide. Departures by U.S. airlines increased 29% during the same period. Canada goose strikes to jet aircraft probably have increased, but data are not complete. I conclude that Canada geese are a serious hazard to aircraft, and that concerned parties should take appropriate measures to obviate this threat. The U.S. Fish and Wildlife Service is considering a modification in the system of issuing depredations permits that would authorize states and/or the Animal and Plant Health Inspection Service, U.S. Department of Agriculture to control safety and other problems at airports, caused by resident Canada goose populations.
Keywords: BIRD POPULATIONS; BSCUSA; GEESE

ABBHA Ref. #: 1138
Citation: ANONYMOUS. Video of Anchorage Television News Report of U.S. Air Force AWACS Crash, 22 September 1995. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: On 22 September 1995, a USAF AWACS (modified Boeing 707) crashed approximately 0.8 nm NE of Elmendorf AFB, Alaska. The aircraft impacted a wooded hill resulting in total destruction and 24 fatalities. The cause of the accident was engine ingestion of Canada geese (Branta canadensis). This video of local news coverage in the aftermath covers the airport and crash scenes, eyewitness interviews, discussions with an Air Force accident investigator, and the impact of the crash on the local Air Force community.
Keywords: BIBLIOGRAPHIC; BSCUSA; FILM/VIDEO; LEGAL ISSUES; MILITARY AVIATION; UNITED STATES

ABBHA Ref. #: 1139
Citation: CLEARY, E.C.; WRIGHT, S.E.; DOLBEER, R.A. Wildlife Strikes to Civil Aircraft in the United States, 1993-1995. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: About 2,200 wildlife strikes involving civil aircraft were reported to the Federal Aviation Administration (FAA) annually, 1993-1995. This reporting rate is probably <20% of the actual number. Reports were received from all 50 states and most U.S. territories. About 97% of the reported strikes involved birds and 3% involved mammals. Gulls (14%) and waterfowl (6%) were the most commonly struck birds; deer (2%) and coyotes (<1%) were the most commonly struck mammals. About 15% of bird strikes (979) and 40% of mammal strikes (71) reported damage to the aircraft or some other related cost. Of the 1,050 strike reports indicating aircraft damage, only 530 reports provided an estimate of the aircraft down time (265 reports totaling 67,000 hours, x = 253 hours/report) or monetary losses (265 reports totaling $27.6 million, x = $104,000/report). Because only 25% of the reports that indicated damage provided an estimate of the aircraft down time or monetary loss, coupled with the estimate that <20% of all strikes were reported, these figures likely severely underestimate the actual cost of wildlife strikes to the civil aviation industry. The actual losses attributable to wildlife strikes are likely closer to 278,000 hours/year in aircraft down time and $144 million/year in direct aircraft damage and related losses. Aircraft most frequently reported in wildlife strikes were: Boeing 737 (18%), MD80 and DC-9 (18%), and Boeing 727 (7%). Aircraft components most frequently damaged by birds were engines (29%), wings (21%), radomes (15%) and windshields (9%). For mammals, the most frequent damage was to landing gears (23%), propellers (14%), wings (11%) and fuselages (9%). About 21% of bird and 76% of mammal reports indicated the strike had a negative effect on the flight: aborted take-off (3%), engine shut down (1%), precautionary landing (5%) and other (14%). Most bird strikes occurred during the day (66%), in late summer-early fall (51%), when the aircraft was on approach (37%) or during take-off (33%) and below 2,300 feet AGL (90%). Most mammal strikes occurred at night (68%) and during fall-early winter (57%). Airport wildlife management programs have traditionally focused on gulls, the most frequently struck wildlife species. Our data indicate that emphasis needs to be expanded to

include other birds - especially waterfowl, raptors, and waders, as well as deer.
Keywords: BSCUSA; CIVIL AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 1140
Citation: ALLAN, J.R. Bird Strike Statistics Can Be Meaningful: the CSL Analysis. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: This paper presents the results of the first long-term analysis of bird strike records of every major civil airport in a country. Data from the UK Civil Aviation Authority's bird strike database for 1976-1990 were analyzed and presented as an aerodrome digest showing trends in performance for each airport. The objective was not to produce a table of risky airports, but rather to provide airport managers and bird controllers with means to assess their own performance and to trigger appropriate action to remedy problems before they become serious. Simply counting the number of bird strikes per year at an airport and correcting for movement rate is clearly an unsatisfactory measure of the strike risk. Strikes with large birds and especially those involving flocks are more likely to result in damage. Strikes with species known to be controllable indicate a possible failure in bird control procedures. A series of new measures have therefore been developed to make greater use of information contained in the records.
Keywords: BSCUSA; REPORTING; STATISTICS; UNITED KINGDOM

ABBHA Ref. #: 1141
Citation: CURTIS, T. Assessment of Bird Strike Accident Risk Using Sequence Analysis. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Accident reports from five bird-strike related accidents involving large jet transports were analyzed in order to develop an event-sequence-analysis-based assessment of the risk of a hull loss due to bird strikes. The five accidents all had birds ingested into one or more engines during takeoff and in two of the accidents crew actions were directly involved in the sequence of events that led to the accident. From those five accidents, two groups of events were identified that should be part of a bird strike risk assessment. The first group included twelve events that were directly involved in past accidents. The second group included four events that were not directly involved in those accidents but could be directly involved in future accidents. The paper also includes a brief overview of the event sequence analysis method and a discussion of ways to expand upon the results of the study.
Keywords: AIRCRAFT SYSTEM; BSCUSA; CIVIL AVIATION; ENGINEERING; ENGINES; STATISTICS

ABBHA Ref. #: 1142
Citation: VOGT, P.F. Control of Feeding, Roosting and Loafing Birds on Airports and Other Large Areas with ReJeX-o-FoG. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Birds frequent airport environments for many reasons and not all are there looking for food. But all birds at an airport are a potential hazard to aircraft movements. ReJeX-iT FG-40 in the form of a mist, smoke or fog acts as an irritant to birds, mainly through contact in eyes. If exposed to the material, birds leave the area. If the application is repeated several times, birds tend to leave the general area for a more friendly habitat. Several large-scale experiments have

been successful in removing nuisance bird populations from downtown areas.
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS

ABBHA Ref. #: 1143
Citation: ESCHENFELDER, P.F., Jr. Pilot Techniques in the Avoidance of Animal Hazards. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Much effort goes into identifying animal hazards, law is written regarding the proper manner to mitigate animal hazards, and warnings to pilots from a variety of sources such as airport operators, air traffic facilities and federal managers are required. This paper discusses the available actions pilots may take based on the provided information, the required federal statutes and company guidelines to pilots for major air carriers. Specific examples will be cited in relation to other major aviation hazards such as wind shear, thunderstorms, and icing.
Keywords: AVOIDANCE; BSCUSA; ENROUTE MANUEVERING

ABBHA Ref. #: 1144
Citation: ESCHENFELDER, P.F., Jr. Conflict at KATY - the Construction of a Modern Jetport in the Middle of a Major Wintering Ground for Waterfowl. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The City of Houston, Texas, has purchased property on its far west side for the construction of a modern airport equipped for all weather operations. The KATY-Hockley prairie, as the area is known, is primarily used for rice farming with little other development. Due to the abundance of water and grain crops, and because it is located on the central flyway, the area is historically known for large flocks of waterfowl in winter. One local community bills itself as the "Goose Hunting Capital of the World". The City of Houston's consultant first hired to review the bird situation resigned when he realized the scope of the problem. The U. S. Air Force BASH Team submitted an unfavorable model calculated on the consultant's work. The City of Houston has asked FAA to reinitiate an EIS as the City would like to go forward with the project. A review of the airport plans, bird census, and controversy will be made.
Keywords: AERODROME DESIGN; BSCUSA; LAND USE; LEGAL ISSUES; SITING

ABBHA Ref. #: 1145
Citation: SLIWINSKI, R.P. Preliminary Evaluation of 4 Grass Heights to Reduce Bird Hazards at O'Hare International Airport. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Long-grass management has been recommended to reduce bird numbers at airports. However, there has been little research to determine the effects of different grass heights on birds in North America and there are no guidelines for grass heights as a wildlife management technique for airports. To determine appropriate habitat modification recommendations to reduce bird numbers at Midwestern airports in the USA, a 4-year turf management experiment (1995-1998) was designed to evaluate bird and small mammal use of 4 grass lengths (10, 20, 30, and >30-cm) in 16, 12-20 ha plots on 240 ha of grasslands at O'Hare International Airport, Chicago, Illinois. This presentation reflects initial data collected from June-September 1995 (summer) and

January-March 1996 (winter). During summer, mean bird use was 3 times greater in 10-cm grass plots (x = 13.1 birds/6 minutes/6 ha) than in >30-cm plots (x = 4.0). Intermediate numbers were observed in 20-cm grass (x = 8.6). However, these differences in bird use among treatments for summer were not significant (P > 0.05). Small mammals trapped in September 1995 were 4 times more abundant in >30-cm and 30-cm grass plots compared to 10-cm grass plots; 20-cm grass plots had intermediate numbers. Results suggest that during the summer, 30-cm grass may be the minimum height necessary to provide optimal cover for small mammal populations to prosper. During winter, mean bird use was 3 times greater in 10-cm grass (x = 3.7) than in 20-cm grass (x = 1.3). Intermediate numbers were observed in 30-cm grass and mowed (cut to 30 cm in October 1995) fallow grass. However, these differences in bird use among treatments were not significant (P > 0.05). Small mammals trapped in mid-April 1996 were 2 times more abundant in 10-cm grass (x = 4.7) than mowed fallow grass (x = 2.2). The 20-cm and 30-cm plots had intermediate numbers. However, there were no significant differences in small mammal abundance for spring data. Small mammals declined over winter by 14 times in mowed fallow grass, but only 1.5 times in 10-cm grass. These first-year data suggest that overall bird use is greater in short (10-cm) grass than in taller (>20 cm) grass. Surprisingly, the higher small mammal populations measured in tall (>30 cm) grass in late summer compared to short (10 cm) grass were not sustained in winter. Data collected in 1996-1998 will provide more definitive conclusions and turf management recommendations regarding the response of bird and small mammal populations to the 4 grass heights.
Keywords: BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 1146
Citation: DEWEY, J.; LOWNEY, M. Small Mammal Abundance in Five Habitat Types at Washington Dulles International Airport. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Small mammals (mice, voles, shrews, etc.) have been identified as a potential attractant to both mammalian and avian predators at Washington Dulles International Airport (Dulles Airport) in northern Virginia. A study was conducted within the Aircraft Operating Area (AOA) at Dulles Airport to determine the habitats in which small mammals were most abundant. Seventeen snap traps and eight live traps were set in 30 m x 30 m grids in five habitat types: short grass (<10"), long grass (>14"), shrubs, ditches, and woodlands. Traps were set for five consecutive nights on four occasions: in October 1994, March 1995, October 1995, and March 1996. Thirty-eight percent of the total catch was in shrub habitat and 30% was in ditch habitat. In contrast, only 4% of the total catch was in short grass habitat and 11% in long grass habitat. Similar results were observed in a comparable study in 1992 at Atlantic City International Airport, New Jersey. The minimal small mammal abundance in the shorter grass habitat suggests that the implementation of a grass management regime maintaining a grass height < 14" would decrease the small mammal abundance in the area. Such a grass management regime could be implemented within the AOA at airports to decrease attractiveness to avian and mammalian predators.
Keywords: BSCUSA; CONTROL METHODS; HABITAT MODIFICATION; LONG GRASS

ABBHA Ref. #: 1147
Citation: BARDEN, M.; SLATE, D.; BRULEIGH, R. Bird Hazard Survey Design and First Year Findings at Pease International Tradeport, New Hampshire. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: In April 1996, we completed the first year of a bird hazard survey at Pease International Tradeport, Newington, New Hampshire. Replicate 1-minute samples of bird activity were obtained from permanent sampling blocks 1 day per week for 1 year. Each block included an equal portion of runway such that runway violations by birds could be used as an index to air traffic hazards. A total of 4,275 birds involving 43 species was observed. Seven species accounted for 87% of the birds observed: snow bunting (1,450, 34%), American crow (855, 20%), European starling (712, 17%), mourning dove (239, 6%), killdeer (223, 5%), horned lark (138, 3%) and red-winged blackbird (101, 2%). There was a pronounced increase in birds during fall, peaking in October. There were 247 runway violations involving 27 species. Crows crossed the runway most frequently (110, 45%), followed by mourning doves (30, 12%), killdeer (15, 6%), grackles (12, 5%) and red-winged blackbirds (10, 4%). Eighteen bird strikes were reported during the 12 months: doves (7), killdeer (4), snow buntings (3), gulls (2), pigeons (1) and unknown (1). In spite of the presence of crows on the airport throughout the year and the number of runway violations they committed, crows were not involved in strikes and probably did not present a serious hazard at Pease. The frequency of mourning dove strikes may have been related to freshly hydroseeded areas along the runway. Snow buntings were involved in 3 strikes at Pease. Although a small bird, they occurred in such dense flocks in hydroseeded areas that their presence was considered a hazard. Pease represents an anomaly for a coastal airport near a National Wildlife Refuge in that gulls and waterfowl use the airport infrequently. We meet regularly with U.S. Fish and Wildlife Service personnel to discuss refuge management activities likely to increase waterfowl or other bird activity at Pease. Also, we are examining on and off-site landfill management activities that could influence gull use of Pease. In this paper, we also discuss the complexities of making effective wildlife hazard management recommendations in the presence of the only breeding population of upland sandpipers in New Hampshire, a state endangered species. We also discuss the utility of our survey design and how our findings will be integrated into the existing wildlife hazard management plan at Pease.
Keywords: ATTRACTANTS; BSCUSA; FOOD; HAZARD MANAGEMENT; PLANS; VEGETATIVE

ABBHA Ref. #: 1148
Citation: GAUTHREAUX, S.A., Jr.; BELSE, C.G. The National WSR-88D Weather Radar Network and Real Time Warnings of Dense Bird Movements. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Most attempts to warn pilots of dense movements of birds in the atmosphere have relied on predictive models instead of real time warnings as is the custom for weather briefings.

With the advent of new Doppler weather radar technology in the 1980s and the establishment of a national network of 150 of these radars (WSR-88D) in the 1990s, it is now possible to have real time access to information on the density, ground speed and flight direction of the birds in movements over most of the United States. This has been accomplished by calibrating the intensity of bird echo patterns on base reflectivity images from the WSR-88D in terms of the actual number of birds aloft in a given sample area. By using the unfiltered 4 km x 4 km national mosaic of composite reflectivity produced by Paramax Systems Corporation and the bird density calibration curve, it is now possible to monitor the density of large-scale bird movements in real time over most of the nation. With relatively minor modifications, it soon should be possible for military and commercial pilots to access this information as easily as they can access weather information.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCUSA; DETECTION; MIGRATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 1149
Citation: BRUDER, J.; O'HERN, B.; WICKS, M. Detection of Bird Hazards with Airport Surveillance Radar. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The existence of birds in the vicinity of airport runways and flight paths present a serious hazard to air traffic, particularly during take-off and landing when loss of one or more engines can jeopardize the safety of the aircraft. Airport surveillance radars, such as the ASR-9 can potentially detect bird activity in the vicinity of airports, but the detections are intentionally rejected as unwanted clutter. Following a serious bird strike incident involving a C5A aircraft in 1983, Rome Laboratory performed a study "Project Bird Watch at Dover AFB" involving radar detections of bird activity in the vicinity of Dover Air Force Base. The study investigated the use of four types of radars, including AN/GPN-21 airport surveillance radar. The AN/GPN-21 with increased sensitivity demonstrated the ability to detect bird activity in the vicinity of the airport and the take-off and landing zones. As a result of the study, recommendations were made for the radar monitoring of bird activity in the vicinity of Dover AFB to alert air traffic controllers to potential bird hazards. Rome laboratory also developed, with the help of a contractor, software for optimizing the site selection for airport surveillance radars. Modern airport surveillance radars provide the capability of detecting bird activity, and with the addition of an additional receiver channel and processing, can provide for detection and monitoring of bird activity without interfering with the normal operations of the surveillance radar. The presentation (and the associated paper) will describe the results of Project Bird Watch at Dover AFB, illustrate the radar siting software, and outline practical means for utilizing airport surveillance radars for monitoring of bird activity in the vicinity of airport and take-off and landing zones.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCUSA; DETECTION; LOCAL MOVEMENTS; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 1150
Citation: LAWRENCE, R.J.; ALLAN, J.R. United Kingdom (RAF) Bird Avoidance Model - Geographic Information System (BAM-GIS). Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Over 70% of serious RAF bird strikes in the United Kingdom occur to aircraft operating at low level. A reduction in bird strikes could be possible if pilots had access to information on bird activity that would allow them to decide whether to avoid known bird hazard areas. The Royal Air Force Inspectorate of Flight Safety (IFS) has sponsored 2 projects to determine bird activity levels in the UK, a trial using radar to provide aircrew with real-time warnings of bird intensity and a statistical based planning/prediction tool, based on data of known bird activity. The difficulty of providing adequate low level radar coverage to detect birds across the whole country; the ability to disseminate the radar-derived information to aircraft operators in real-time; and the prohibitive cost (in excess of $23 million) to implement the system, means that at least at a national level, the project is unlikely to proceed further. On the other hand, the UK (RAF) Bird Avoidance Model - Geographic Information System (BAM-GIS) developed in collaboration with the UK Central Science Laboratory (CSL) shows more promise. Briefly, the CSL produced software integrating a database of known and predicted bird activity/concentrations in the UK lower airspace with a digitized UK military low flying chart; the whole program running on a Pentium PC. Operators enter details of their flight (route, operating height, date and time) and the program then maps the flight and highlights bird hazard areas graphically, thus allowing pilots to avoid these by adjusting their flight profiles as necessary. Trials with a front-line RAF squadron are due to start shortly.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCUSA; DETECTION; MAPS; MIGRATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 1151
Citation: KREITHEN, M.L.; SPRINGSTEEN, A. Development of an Optical Painted Pattern Designed to Reduce Avian Collisions with Obstacles. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The Kenetech/Windpower Avian Task Force developed and tested a two-color pattern to paint on wind turbine blades to enhance their visibility to birds. The pattern consisted of alternating dark and light stripes of decreasing width from the root to the tip of the blades. Dark and light colors were selected to maximize contrast and visibility under all lighting conditions. The color combination was an improvement over the traditional red and white patterns used by the aircraft industry. Since this pattern was developed for birds rather than for people, both the pattern size and the pattern colors had to be optimized for avian vision. The pattern spacing was tailored for bird visual acuity, determined by laboratory testing. The colors were specified to match the spectral sensitivity of bird eyes, which was shown to be substantially different from human vision. Laboratory measurements established that 51% of avian brightness perception lies in the solar ultraviolet wavelengths between 305-400 nm, wavelengths not visible to the human eye. The paints needed to match all of the wavelengths used by bird vision, rather than the more

limited wavelengths of human vision. Obtaining an acceptable paint turned out to be a difficult task, since exhaustive measurements showed that there were no commercially available paint formulations that have adequate reflectance for the wavelength perceived by birds. Therefore, considerable effort was directed to develop, from scratch, an acceptable and practical paint to be used to make the pattern visible to birds under the greatest variety of lighting conditions. A limited production run of the paint was manufactured and the pattern was painted on 21 KVS-33 meter wind turbine blades selected for bird flight testing. Pre- and post-modification test flights with red-tailed hawks were performed during the 1995 wind season to evaluate the effectiveness of the pattern.
Keywords: BIRD POPULATIONS; BSCUSA; SENSORY; VISUAL

ABBHA Ref. #: 1152
Citation: KELLEY, M.E. Bird Strike Reduction Projects at Wright Laboratory. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Aircraft bird strikes cause expensive damage, injuries, and fatalities every year with both military and civilian aircraft. Wright Laboratory in the Air Force Material Command has several ongoing research efforts to reduce these losses. Different efforts will reduce the number of bird strikes, lower the costs of bird strikes that occur, and reduce the costs involved with designing and testing new aircraft components. Areas being pursued or planned include infrasound, modulated radar (ground-based and airborne), aircraft radar, IR sensors, Virtual (computerized) and artificial birds, and detailed analyses of existing data bases to detect and explain "non-randomness" in bird strikes. Some of the more interesting results from the ongoing efforts will be given.
Keywords: AIRCRAFT APPEARANCE; BSCUSA; CONTROL METHODS; ENGINEERING; MICROWAVES

ABBHA Ref. #: 1153
Citation: DOOLING, R.J. Hearing in Birds: Absolute Thresholds, Sound Localization, and the Perception of Complex Sounds. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Hearing in over 25 species of birds will be reviewed. Behavioral audibility curves are available for a range of species covering seven different orders: Anseriformes, Columbifornes, Falconiformes, Galliformes, Passeriformes, Psittaciformes, and Strigiformes. From these data, we can construct an average bird audiogram. This audiogram shows that birds hear best at 2.5 kHz with thresholds in the most sensitive region of hearing between about 1-5 kHz approaching levels of human sensitivity of 1-5 dB Sound Pressure Level (SPL). Sensitivity declines about 15 dB/octave for frequencies below 2 kHz and about 45 dB/octave for frequencies above 2 kHz. Compared to mammals, birds do not hear well at frequencies above 10 kHz or below several hundred hertz. Within their range of hearing, birds can discriminate among complex sounds quite well and they can localize a sound source surprisingly well given their small head and closely-spaced ears. New techniques for measuring the perception and the salience of complex sounds

including vocalizations and the relevance of these approaches for bird control will be discussed.
Keywords: AUDITORY; BIRD POPULATIONS; BSCUSA; SENSORY

ABBHA Ref. #: 1154
Citation: LAYBOURNE, R.C. Feather Identification Methods Developed at Smithsonian. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Disciplines that require feather identification and techniques used for feather identification are noted. The various methods for identifying feathers or feather material and the advantages and use of each method are discussed as well as the reasons that the Smithsonian became involved in bird strike remains identification and how the institution faced the challenge.
Keywords: BSCUSA; FEATHERS; IDENTIFICATION; MICROSCOPIC

ABBHA Ref. #: 1155
Citation: DOVE, C.J. Dynamics of Bird Strike Identification. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Identifying species of birds from feather fragments involves both comparison of macroscopic and microscopic feather characters and consideration of circumstantial evidence pertaining to the sample (e.g., locality, date, time). This technique has proven useful in a variety of disciplines: archaeology and anthropology; ecological studies of prey remains; forensics; wildlife law enforcement, and in identification of unknown bird strike samples. Bird strike remains that have been identified at the Smithsonian Institution are now being entered into a database which allows analysis of the changes in identification over time. This database also serves as a reference source to query species lists from localities where bird strikes have occurred in the past. Thus far, over 1,200 records have been entered covering 8 years (1982-1987; 1993-1994). More than 200 species of birds have been identified in bird strikes during this time. Bird strike remains were divided into three categories depending on the amount of material used to identify the species: 1) microscopic only, 2) microscopic and whole feathers, and 3) whole feathers only. Preliminary results show that 60.6% of the cases were identified using whole feathers whereas 21.5% were done using a combination of whole and microscopic feather samples. Only 9.3% of the samples were identified from microscopic evidence alone. These microscopic samples consisted of horned larks (32%), swallows (15%), and swifts (13%), which are unique in their microscopic structures. An additional 40% came from miscellaneous species. This evidence strongly supports the need for this type of work to be done in a museum collection with proper comparative material. The amount of material submitted sharply increased in the "whole feather" category beginning in 1986 and is attributed to increased effort by field personnel to collect as much of the remains as possible.
Keywords: BSCUSA; FEATHERS; IDENTIFICATION; MACROSCOPIC; MICROSCOPIC

ABBHA Ref. #: 1156
Citation: LAROSE, M. Control of Earthworms (Lumbricus Terrestris) at 8 Wing Trenton, Ontario, Canada. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Because of environmental and regulatory concerns, 8 Wing Trenton did not maintain a spraying program for worm control for many years. Coincidentally, there was a significant increase in the earthworm population - a major attraction to gulls. In 1995, Trenton maintained a rate of 3.452 bird strikes per 10,000 movements. The Canadian Air Force rate was 0.868 bird strikes per 10,000 movements. A review of the problem was done by Dr. Al Tomlin, Rhizosphere Ecologist for Agriculture and Agrofood Canada (AAFC), in September 1995. Through the use of Dr. Tomlin's earthworm monitoring technique, priority areas were defined and a spraying program, using Benomyl, was developed. The initial results of the spraying program will be discussed.
Keywords: ATTRACTANTS; BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS; FOOD; INVERTEBRATES

ABBHA Ref. #: 1157
Citation: JENSEN, M.A. Overview of Methods Used to Reduce Gull, Geese, Raptor, and Deer Hazards to Aircraft to O'Hare International Airport. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Gulls, geese, raptors, and deer have been determined to be the most hazardous wildlife species at O'Hare. The U.S. Department of Agriculture's Animal Damage Control (ADC) Program developed methods to reduce wildlife hazards to aircraft focusing on species specific hazard reduction. Effective and ineffective methods are discussed. An integrated wildlife management approach was used to reduce hazards for gulls, geese and birds of prey. Methods include harassment, habitat modification (exclusion via wire grids and Nixalite), nest removal, garbage reduction, lethal removal, open water reduction, and grass management. O'Hare maintains a zero tolerance for gulls and geese on the airport operations area (AOA). The deer hazard reduction program continues to be improved. Methods including fencing, creek barriers, culvert barriers, and lethal removal. Education and awareness have increased wildlife sightings reported to ADC biologists. O'Hare also maintains a zero tolerance for deer on the AOA. Success of the ADC program at O'Hare is revealed through the analysis of the wildlife strike database record. Gull strikes have been reduced 70% since 1993. Goose strikes have been reduced 80% since 1994. Deer struck by aircraft have been reduced 100% since 1993. However, raptor strikes have increased 68% since 1993. A raptor trapping and relocation project was initiated in 1996 to reduce this hazard.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; EXCLUSION; HABITAT MODIFICATION

ABBHA Ref. #: 1158
Citation: DAVIS, R.A.; SEARING, G.F. A Bird Control Strategy for Vancouver International Airport. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Vancouver International Airport (YVR) is located on Sea Island in the Fraser River delta along the coast of British Columbia. The delta supports Canada's largest wintering populations of waterfowl, shorebirds, and raptors. Thus, the airport supports large bird populations, particularly in winter. To accommodate increasing air traffic, YVR is constructing a third runway parallel to its existing main runway. The Parallel Runway project was approved after an EIS review process that resulted in a 350-acre parcel of land immediately north of the airport being set aside as a Conservation Area to mitigate against wildlife habitat lost to the new runway. Concerns about the presence of the Conservation Area, an increasing number of bird strikes despite a full-time bird control program, and major changes to the airport related to the Parallel Runway have prompted YVR Airport Authority to retain LGL Limited to reassess the bird control program at the airport. The existing program is based primarily on active dispersal techniques. These techniques will become problematic with the Parallel Runway to the north, the Crosswind runway to the west, a float plane approach/departure route on the south, and urban areas to the east. The recommended control program involves ranking threats posed by each bird species, managing airport habitat to exclude the highest threat species, managing the Conservation Area to promote non-threatening species, adapting control methods to allow for the behavior of the birds (e.g., territoriality), using a greater diversity of control methods, actively controlling birds at night during the winter rainy season, removing specific problem situations at the airport, and extending control to problem areas away from the airport (e.g., offshore gull roosts). This study, funded by the Vancouver International Airport Authority, is based on data from a series of studies conducted by LGL Limited for Transport Canada.
Keywords: ATTRACTANTS; BSCUSA; CONTROL METHODS

ABBHA Ref. #: 1159
Citation: SUPROCK, T.G. Effectiveness of High Strength, Low Visibility Fencing in Control of Canada Geese. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: While fencing has long been considered a viable method of controlling Canada goose populations along waterways, there have been several drawbacks to conventional fencing techniques. These drawbacks are generally those associated with initial costs (acquisition and installation), maintenance costs (repair and replacement), and those problems associated with visibility (visual intrusion, aesthetics and blocking). GridTech tested 29 different fencing materials and has developed a high strength fence, 30" high that prohibits Canada geese from traversing from water to ground, effectively rendering the area unsuitable for goose habitation, while being virtually invisible from a distance of 30 feet. The fence is inexpensive, lightweight, UV resistant, and very strong. Installations have been effective in eliminating Canada goose populations from certain areas in a nonlethal manner. In virtually any instance where the issue of Canada geese control relates to a body of water, the GridTech fencing, G-Grid, has been effective to either a high degree or completely effective. Golf courses with multiple ponds have

been virtually cleared of geese within hours of installation. Industrial facilities with cooling water ponds have had their resident flock reduced from thousands of birds to 50 birds in a period of two days. This fence is easily erected and retrieved if necessary, and storage requirements are minimal.
Keywords: BSCUSA; CONTROL METHODS; EXCLUSION; GEESE; NETS/WIRES; WATER

ABBHA Ref. #: 1160
Citation: HALL, T.C. Blackbird Roost Control at Airports with DRC-1339. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Sacramento International Airport has had a winter roost of up to 30,000 blackbirds and starlings for the past several years. Flightlines to and from the roost crossed airspace and, therefore, presented an bird-strike hazard. In addition, bird fecal deposits at the roost sites damaged property. From 1988-1993, Airport Management attempted to haze the birds from the premises with no success and also contracted with companies that used Avitrol, Rid-A-Bird perches, and starlicide with minimal to no success. In 1995-1996, the USDA, Animal Damage Control Program in California used DRC-1339 on cracked corn under an experimental-use permit to determine if the proposed staging-area label would reduce damage associated with roosts at airports. Trials were conducted in February of both years to determine the efficacy of treatments and public relation problems that poisoning could pose. Baits were placed on top of terminals where the birds staged prior to roosting. The 6,000-bird roost in 1995 contained about 75% brown-headed cowbirds (Molothrus ater) and 25% Brewer's blackbirds (Euphagus cyanocephalus). The 2,500-bird roost in 1996 contained about 92% cowbirds and 8% blackbirds. Starlings (Sturnus vulgaris) comprised <1% of the roost during both treatments. In 1995, about 12,000 starlings roosted at the airport prior to treatment. In 1996, a roost of 7,000 starlings roosted away from the terminal in palm trees at the airport. The blackbird roost was reduced by up to 80% in 1995 and 86% in 1996. The treatments were effective at reducing the problems associated with the roost. The trials were discussed in the local press, but public opinion favorable to the baiting program prevailed.
Keywords: BLACKBIRDS; BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS

ABBHA Ref. #: 1161
Citation: RODRIGUEZ, A.; CONSTANTIN, B.U. Controlling Bird Problems in Hangars. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Birds that roost and nest in open hangars and other buildings that service aircraft cause serious problems. Manure and debris result in property damage to aircraft and equipment and unsanitary working conditions for personnel. This is especially serious where personnel are exposed daily to heavy accumulations of bird feces and where turbine engines and sensitive mechanical and electrical equipment are exposed when being serviced. Also, bird manure, due to high acidic content, tends to corrode the

body and canopy of airplanes. We conducted bird control activities in hangars and other buildings at the Florida Air National Guard Base (FANG) in Jacksonville and the Puerto Rico Air National Guard Base (PRANG) in San Juan. At the PRANG Base, where 210 greater Antillean grackles (Quiscalus niger) and 69 zenaida doves (Zenaida aurita) roosted and nested, an automatic triggering sound system was installed in one hangar to disperse a grackle roost. The roost was effectively dispersed; however, the electrical device had to be removed because of safety regulations. Subsequently, 45 grackles and 36 doves were trapped and removed. The remaining birds became trap shy so an air rifle was used to remove 137 grackles and 8 zenaida doves. The remaining birds left the hangars and problems ceased. At the FANG Base, starlings (Sturnus vulgaris), house sparrows (Passer domesticus) and pigeons (Columba livia) used hangars and other buildings for nesting and roosting. The ceiling of one hangar was netted by a contracting company to prevent birds from roosting and nesting in the girders; however, the netting was improperly installed and birds gained access. Some became trapped above the netting and died. On several occasions an American kestrel became trapped above the netting and part of the netting had to be let down to allow the kestrel to escape. Also, sparrows persisted in nesting below the netting. An integrated plan was devised to eliminate these birds from the Base. Roosting and nesting areas were excluded whenever possible. Shrubs that provided roosting areas for house sparrows were removed. House sparrows were removed by trapping, mist netting and shooting. Pigeons were removed by trapping and shooting. Starlings were shot. Nests of all three species were destroyed whenever possible.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; EGGS/NESTS; HABITAT MODIFICATION; SHOOTING; TRAPPING; TREES/SHRUBS

ABBHA Ref. #: 1162
Citation: CACCAMISE, D.F.; REED, L.M.; ROMANOWSKI, J. Bird Strike Hazards and Waste Management Facilities in Urban Landscapes. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Airports are best located near surface transportation networks, yet away from concentrations of human activity. They also must be reasonably close to the urban centers that require air service. Unfortunately these same characteristics apply equally well to the siting requirements for waste management facilities. Putrescible materials associated with many types of waste facilities can attract large numbers of birds, particularly gulls. Here we assessed avian use of 4 types of waste management facilities. Our goal was to characterize the avian communities attracted to these facilities providing information that can be used to assess the actual risks to air operations posed by the waste facilities. Our most revealing observations indicated considerable variation in attractiveness to birds among both the types of waste management facilities and among the individual facilities within types. These differences were based on factors including: (1) volume of waste material processed, (2) physical characteristics of the facilities, (3) cleanliness of the operation, and (4) nature of the avian

community near the facilities. With many factors affecting the size of bird populations attracted to waste facilities, generalizations concerning potential interference of these facilities do attract birds, some considerable numbers. Nonetheless, many factors can influence the impact of waste management facilities on local bird populations, and these must be considered in any evaluation of bird strike hazards.
Keywords: ATTRACTANTS; BSCUSA; LANDFILLS; STRUCTURES

ABBHA Ref. #: 1163
Citation: HENZE, L.E.; FORBES, J.E. Bird Use at Trash Transfer Stations in Massachusetts. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Little documentation is available on bird activity at trash transfer stations. The need for this information is becoming increasingly more important as landfills are replaced with transfer stations and sightings are proposed near airports. Massachusetts USDA/Animal Damage Control conducted preliminary surveys of bird activity at transfer stations at the request of the Massachusetts Department of Environmental Protection. This was to resolve disagreement between FAA and the Martha's Vineyard Commission about the proposed construction of a regional transfer station 4,000 feet from the end of the Martha's Vineyard Airport runway. Ten Massachusetts transfer stations were surveyed between 15 November 1995 and 1 March 1996. These preliminary surveys show that birds are attracted to trash transfer stations for the purpose of feeding. The primary factors that affected whether birds were attracted are surrounding habitat type, distance from the ocean, and tons of refuge accepted/day. Other factors that affected bird presence were the presence of bird exclusion devices and clean facility management. This was a preliminary study as the result of an emergency need for information. More thorough research is necessary to satisfy the needs of agencies involved in making decisions about the construction of trash transfer stations.
Keywords: ATTRACTANTS; BSCUSA; LANDFILLS

ABBHA Ref. #: 1164
Citation: PREUSSER, K.J.; FORBES, J.E. A Gull and Starling Control Program at the Colonie Landfill, Cohoes, New York. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: A program to control starlings and 3 species of gulls was conducted in 1995-1996 on a 5-acre working face at a 160-acre landfill adjacent to the Mohawk River, approximately 5 miles from the Albany County Airport, New York. The program was requested by the landfill operator to meet standards of the new York State Department of Environmental Conservation for permit compliance. A bird management plan was developed that included 9 proposed bird control techniques. Three of the techniques were actually implemented and 2 were found to be useful: pyrotechnics and shotgun shooting to kill. Over a 1 month period, bird numbers were reduced from the original population of 5,400 gulls and 6,000 starlings to 400 gulls and 300 starlings. Gulls were found to be more difficult to control in the current study than in other studies reported in the literature because of high turnover rates with transient population, more aggressive gull species and an increased competition for food resulting from other landfill closings. Persons contemplating similar gull control projects at landfills in the northeastern

United States should be aware of associated hidden costs such as: 1) increased vehicle maintenance costs resulting from operating in a landfill environment; 2) unusually high amounts of pyrotechnics required; and 3) additional manpower to control starlings which leave the landfill and relocate in neighboring residences.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; GULLS; SHOOTING; STARLINGS

ABBHA Ref. #: 1165
Citation: CONSTANTIN, B.U. How to Keep 298,926 Birds from Using a Landfill. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The Florida USDA, Animal Damage Control (ADC) Office conducts bird control activities at Medley Landfill in Miami, Florida between 15 October-15 April to reduce the potential for bird strikes by aircraft using Miami International Airport. Medley Landfill, only 4.5 miles from the airport, is the only landfill in Dade County that accepts food. This type of operation attracts numerous birds year round, but numbers are especially high in winter when migrants are present. Medley Landfill requested assistance from ADC to control gulls, vultures, white ibises, cattle egrets, and other birds that daily congregated at the landfill to feed and loaf (gulls were present in far greater numbers than any of the other species). The soaring pattern of all species (except cattle egrets) brought them into flight lanes of aircraft using Miami International Airport. Bird numbers from May-October were fairly low (an aggregation of approximately 4,500 birds). However, migrants increased the numbers to around 300,000 during winter. Medley Landfill requested that ADC conduct bird control during winter when bird numbers were higher, and train Medley personnel to control birds during summer when bird numbers were lower. Following the NEPA process, ADC employed the integrated pest management approach using the APHIS, ADC Decision Model found in the ADC, EIS (April 1994). Pyrotechnics, propane cannons and electronic bioacoustics were tried, but the overwhelming number of birds made this approach alone ineffective. Avitrol was then used as part of the harassment process. Two Avitrol treatments, during each of which 20 birds were given Avitrol-treated bread bait, were conducted. Immediately after the gulls responded to the Avitrol, pyrotechnics were used and all birds left the area. When the gulls tried to return, several were shot with a 12 gauge shotgun, and pyrotechnics, propane cannons and electronic distress calls were used to disperse the remainder. We found that cannons and electronic calls had little effect on the birds, but shooting and pyrotechnics were very effective, so we continued to use shooting and pyrotechnics as the control method. Within 2 weeks, the number of birds attempting to land at the landfill was reduced to less than 10,000. These birds attempted to come in early in the morning, during lunch breaks, and at other times when the ADC biologist was not present. Only intense harassment from sunup to sundown kept the birds completely off the landfill. Even so, if harassment stopped for several days, bird numbers steadily increased and it wasn't long before thousands of birds were back using the landfill. Continuous harassment was needed to keep the landfill bird-free. Once the birds were dispersed from the landfill for about 10 consecutive days, equipment operators could effectively keep most birds from using the landfill on weekends by using only pyrotechnics. After 3-4 days, however, pyrotechnics alone were

ineffective, and unless the shooting/harassment resumed, bird numbers quickly increased.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; PYROTECHNICS; SHOOTING

ABBHA Ref. #: 1166
Citation: JOSHI, C.; SHARMA, P.; SHARMA, R.K. Use of Airgun as a Scaring Device for Pigeons. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The blue rock pigeon (Columbia livia) has adapted to a wide range of habitats and has a high level of resistance to varying climatic conditions. Throughout the world, efforts are being made to control and prevent damage caused by this bird. In airfields, pigeons not only cause a serious safety problem to aircraft but spoil structures where they roost and nest. This paper describes a solution to the problem caused by pigeons. An airgun was used as a scaring device causing continuous harassment and fear of life. A simple airgun (New Diana Model 65) was used as a scaring device. The activity of pigeons was observed with the help of field binoculars. The ceiling of a large dome of a college auditorium, the permanent roosting site for pigeons for several years, was chosen as the experimental site. Two field scientists (one with the airgun and the other with binoculars) counted the number of pigeons and made a blind shot aiming at the pigeons. The shot was repeated daily at the same time for 15 consecutive days. We observed that initially 25 pigeons were roosting, but after regular use of the airgun for 10 days, this figure touched the zero mark. We also noted that it took more than a month for the pigeons to discard the fear and to return back after the gun shots were discontinued. It was evident that even after 15 days, when the first pigeon returned to the roosting site, the number of pigeons returned back was less than half the original number. We concluded that an airgun can be used in airport hangars to scare away the pigeons. The gun should be used every day in the beginning and weekly thereafter. Deploying one airgun for firing the blank shots in each hangar should make hangars free from pigeons.
Keywords: BSCUSA; CONTROL METHODS; DEPREDATION; PIGEONS; SHOOTING

ABBHA Ref. #: 1167
Citation: WINDLER, P.R. U.S. Air Force Bird Strike Update. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: The United States Air Force (USAF) averaged 2,588 bird/wildlife strikes to aircraft annually, 1984-1994. From January-October 1995, 1,829 bird strikes to USAF aircraft were recorded including one class A strike, three class B strikes and 28 class C strikes. The remaining bird strikes were considered non-damaging or resulted in damages that did not exceed $10,000. Class A mishaps include incidents exceeding $1 million in damages, total loss of an aircraft, or loss of life. Class B mishaps include incidents with damages between $200,000 and $1,000,000. Class C mishaps include incidents with damages between $10,000 and $200,000. The total cost of all strikes exceeded $81 million. Of the strikes with known phase of flight, 78% (1,047)

occurred on or near the airfield and 19% (255) occurred during low level flights. The fall migratory months accounted for the greatest number of strikes with 322 and 329 strikes reported for August and September, respectively. Air Force bases (AFB) with the most strikes reported by October 1995 include Altus AFB, OK (113), Hurlburt Field, FL (104), Randolph AFB, TX (73), McConnell AFB, KS (72), Travis AFB, CA (69), and Columbus AFB, MS (65). The most frequently struck aircraft were the C-130 with 239 strikes (13%), followed by the KC-135 with 210 (11.5%), the C-141 with 85 (4.6%), and the F-16 with 78 (4.3%). The most frequently struck birds identified by remains were rock doves (24), horned larks (23), western meadowlarks (16), and turkey vultures (13). These trends and other recent changes in the BASH Team will be discussed.
Keywords: BSCUSA; MILITARY AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 1168
Citation: WRIGHT, S.E. Things That Go Bump in the Flight: Managing the FAA Wildlife Strike Database. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Bird and other wildlife strikes to aircraft are a serious problem. To better define wildlife problems at and around airports in the United States, the FAA has collected bird and other wildlife strike reports since 1968. In 1995 the U.S. Department of Agriculture, Animal Damage Control (ADC) Program, through an Interagency Agreement with the FAA, took over management of the database. As of July 1996, over 9,500 records from 1992 to the present have been organized by date, checked for accuracy, edited and entered into a computerized database. Approximately 85% of the strikes were reported on the FAA 5200-7 form, with the remainder coming from various sources including individual airport reports, FAA Preliminary Aircraft Incident Reports and NASA's Aviation Safety Reporting System. Many strike reports contained incomplete or conflicting information. Additional facts on these reports have been obtained by contacting biologists, pilots, and other aviation personnel and by referencing aviation industry databases. The first annual report summarizing bird and other wildlife strikes to civilian aircraft in the United States was completed for 1994. The International Civil Aviation Organization is now receiving copies of the FAA database for entry into their world-wide bird strike database. The compilation and analysis of this information is critical in determining the scope of wildlife strikes so that corrective measures can be taken to ensure safe and economic air transport. Database reports are already being used to justify wildlife management actions at airports that otherwise might have been considered too controversial to undertake. Recommendations to improve FAA Form 5200-7 include; changing the date to read month, day, year; changing take-off to take-off roll; broadening the damage cost information to include more than engines; deleting ($US thousands) in the estimated cost section and adding a way to contact the person reporting the strike for updated information. Presently, less than half of all strikes are being reported. Suggestions for improving the form and promoting the reporting of strikes are welcome.
Keywords: BSCUSA; CIVIL AVIATION; GENERAL AVIATION; STATISTICS; UNITED STATES

ABBHA Ref. #: 1169
Citation: PRAST, W.; SHAMOUN, J.; BIERHUIZEN, B.; ROSELAAR, C.S.; SCHALK, P.H.; WATTEL, J.; LOS, W.; LESHEM, Y.; YOM TOV, Y.; BUURMA, L.S. BRIS: A Computer-based Bird Remains Identification System. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: A user-friendly computer information and identification system for bird remains (BRIS) is being developed by the European Centre for the Identification of Bird Remains (Zoological Museum; University of Amsterdam), the Expert Center for Taxonomic Identification (ETI) and the Tel Aviv University. The BRIS, based on ETI's Linnaeus II software, consists of various parts. A multimedia database stores detailed textual and pictorial information on feather structures. An innovative computer-guided identification system assists the user to recognize the identification characters and to identify the taxa. An interactive geographic information system allows for quick geographic searches through the data. Also general information on bird species, such as descriptions, diagnostics, color pictures and distribution maps, is included. BRIS now covers 200 European species and will be released on CD-ROM in 1996. International cooperation is sought to expand the system with more species and further information. We actively solicit comments, suggestions and input from ornithologists and others who are working on the identification of bird remains. We propose an international network of specialists to expand the BRIS. In this paper the methods of identification and the implementation of the geographic information system are discussed.
Keywords: BIBLIOGRAPHIC; BSCUSA; COMPUTERIZED MEDIA; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 1170
Citation: BELANT, J.L.; SEAMANS, T.W.; TYSON, L.A. Electronic Frightening Devices and Predator Urines Do Not Deter White-tailed Deer. Bird Strike Committee USA; Phoenix, Arizona, 1996.
Abstract: Deer use of airport facilities has increased concurrent to increasing urban and suburban deer populations. Deer are involved in 3% of aircraft-wildlife collisions and 81% of aircraft-mammal collisions. Effective frightening devices are needed to keep deer from runways and taxiways, even if used temporarily until a permanent solution can be achieved. We evaluated the effectiveness of three acoustic frightening devices and two predator urines as white-tailed deer (Odocoileus virginianus) deterrents. Three 4-week experiments evaluating the motion-activated YardGard, motion-activated Usonic Sentry (both ultrasonic), Electronic Guard (sonic), and coyote and bobcat urine at established deer feeding stations were conducted in a 2,200-ha fenced facility in northern Ohio with high deer densities (about 38/km2). At this same facility we also conducted a 4-week experiment to determine if coyote urine could be used to reduce deer use of trails. There was no difference in the number of deer entering feeding stations among

pretreatment, treatment, and posttreatment periods for any of the devices or urines evaluated. The amount of food consumed at feeding stations also did not differ among periods. Similarly, coyote urine did not reduce deer use of trails. We conclude that the electronic frightening devices and predator urines tested were ineffective in deterring high concentrations of white-tailed deer from preferred food sources and trails. Research to develop effective frightening devices for white-tailed deer will continue. Additional research will include evaluations of exclusion devices (e.g., fences) and feeding repellents.
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS; SOUND; ULTRASONICS; WHITE-TAILED DEER

ABBHA Ref. #: 1171
Citation: THORPE, J. Fatalities and Destroyed Civil Aircraft Due to Bird Strikes: 1912-1995. Bird Strike Committee Europe 23, Working Paper 1; London, May 13-17, 1996: 17-32.
Abstract: Following a short introduction, the paper contains brief details of all known accidents involving either fatality or the destruction of civil aircraft as a result of bird strikes. The paper is divided into three sections, transport aircraft, general aviation aircraft and helicopters. There have been over 50 aircraft written off and 190 people killed due to bird strikes. (This paper is the work of an individual author and may not reflect the full and final views of the Civil Aviation Authority)
Keywords: BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 1172
Citation: RICHARDSON, W.J. Serious Birdstrike-related Accidents to Military Aircraft of Europe and Israel: List and Analysis of Circumstances. Bird Strike Committee Europe 23, Working Paper 2; London, 13-17 May 1996: 33-56.
Abstract: This paper lists and summarizes the circumstances of 168 accidents in which military aircraft were destroyed or damaged beyond repair as a result of encounters with birds. At least 34 aircrew and 3 civilians on the ground were killed in these accidents. The analysis includes data from 21 countries: 14 in western and central Europe, 4 in eastern Europe, Israel, and Canadian and U.S. forces in Europe. Data were available for 15-46 years within the 1950-95 period, depending on the country. This paper excludes additional known accidents and fatalities in countries for which only fragmentary data were available. Of the 168 accidents considered, 45 were in the U.K. and Ireland, 18 in Scandinavia, 57 in western and central Europe, 11 in southern Europe (no data for Spanish forces), 21 in eastern Europe (data very incomplete), and 7 in Israel. At least nine European military aircraft were lost to birdstrikes outside Europe and Israel. Most aircraft lost were jet fighter and attack aircraft (88 before 1980; 55 from 1980 to date), single-engined trainers (12), or twin-engined bombers (7). Two 4-engine aircraft, a Victor tanker and Nimrod patrol aircraft, were lost in the U.K. The largest numbers of accidents (45 before 1980; 33 more recent) were during low-level (<1000 feet AGL) cruise flight, mainly at high speeds. The second most common category involved aircraft at or near aerodromes (34

before 1980; 24 more recent), mainly at low altitude and low speed. Most losses involved engine ingestions and/or windscreen penetrations. Gulls, followed distantly by buzzards (hawks), ducks, pigeons and corvids, were the birds most commonly identified as being responsible for the accidents, with some notable regional differences. Additional accident data from other years and other countries are sought to provide a basis for a more comprehensive and representative list and analysis at a future date.
Keywords: BSCE; EUROPE; ISRAEL; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 1173
Citation: PINOS, A. Fifteen Years of Data Collection by the ICAO Bird Strike Information System (IBIS). Bird Strike Committee Europe 23, Working Paper 3; London, 13 - 17 May 1996: 57-64.
Abstract: This paper discusses the IBIS reporting form, the change from a mainframe computer to a PC-based system and the reporting and processing of bird strikes. Also presented are some IBIS statistics, taken from the more than 62 000 bird strikes which have been reported to ICAO during the fifteen years that IBIS has been in operation.
Keywords: BSCE; CIVIL AVIATION; GENERAL AVIATION; ICAO; REPORTING; STATISTICS

ABBHA Ref. #: 1174
Citation: PAPP, A. Bird-related Accidents in Hungarian Military Aviation: 1960-1995. Bird Strike Committee Europe 23, Working Paper 4; London, 13-17 May 1996: 65-70.
Abstract: In the last 35 years of Hungarian military aviation there has been 67 accidents, caused unambiguously by bird strike. This is 10.2% of all the known accidents of Hungarian military aircrafts. There was one victim of the bird strike accidents, a pilot died. One fighter and 40 engines were written off.
Keywords: BSCE; EUROPE; HUNGARY; MILITARY AVIATION; MISHAP INVESTIGATION; STATISTICS

ABBHA Ref. #: 1175
Citation: AAS, C.K. Some Characteristics of Bird Strikes to Military Aircraft in Norway: 1985-1995. Bird Strike Committee Europe 23, Working Paper 5; London, 13-17 May 1996: 71-80.
Abstract: For an eleven year period, the occurrence of bird strikes to Norwegian military aircraft are analyzed in the paper. From 1985 to 1995, the RNAF experienced 345 collisions with birds, one of which resulted in the loss of an F-16. Two strikes caused major damage to the aircraft whereas 29 caused minor damage. No pilots or other air crew personnel were killed during these years. Annual fluctuations and seasonal peak(s) in bird strike frequency are presented. The distribution of strikes by phase of flight and by altitude are also shown, as well as the types of aircraft that were involved. Of strikes in which the bird species or bird group was identified, gulls accounted for the greatest number (43 %), and they were also responsible for a

disproportionately high frequency of the strikes resulting in damage. Gulls thus confirm their position as the most troublesome birds to aircraft in Norway.
Keywords: BSCE; GULLS; MILITARY AVIATION; MISHAP INVESTIGATION; NORWAY; STATISTICS

ABBHA Ref. #: 1176
Citation: BUURMA, L.S.; DEKKER, A. EURBASE: Potential Lessons from Military Bird Strike Statistics. Bird Strike Committee Europe 23; Working Paper 6 London, 13-17 May, 1996: 81-89.
Abstract: Per April 1996 the European Military Bird Strike Database (EURBASE) contains 27.754 bird strike reports of 12 west and east European airforces. The growth now seems to be stable, but the progress tables also indicate that some air forces stay behind. The status of EURBASE has strengthened since the 22th BSCE meeting in Vienna. The European Bird Strike Form was adopted by the Military Agency for Standardization in Bruxelles as annex to Standard NATO Agreement 3879 FS. Furthermore, progress reporting by custodian RNLAF became a fixed agenda item for the Air Forces Flight Safety Committee (Europe). Delivering data implies that contributing air forces consider BSCE, and in particular her Low Level WG, as their specialist group. As the database contains non-aggregated data the possibility exists to discern reporting biases by comparison. This, in turn, facilitates proper sampling which ultimately leads to improved separation of facts and feelings. Recent openness also favored the exchange of formerly classified information, e.g. flying hours enabling the calculation of ratios. As some examples may show, best professional judgement of the database already works. Scientific substructuring will follow, which hopefully will contribute to the standardization and certification of bird strike prevention measures.
Keywords: BSCE; EUROPE; MILITARY AVIATION; MISHAP INVESTIGATION; STATISTICS

ABBHA Ref. #: 1177
Citation: HORTON, N.; MILSOM, T. Bird Strike Statistics can be meaningful: The CSL Analysis. Bird Strike Committee Europe, 23 Working Paper 7; London, 13-17 May 1996: 91-92.
Abstract: This analysis of UK civil bird strike data from 1976 to 1990 was first reported to BSCE in Helsinki and received a mixed response. This was possibly because the paper had not been seen before its presentation in the Plenary Session. The work is complete and the finished book is available at this meeting. The findings of this work present a more useful interpretation of the bird strike problem on an aerodrome than does the simple collation of an annual total presented as a rate per 10,000 movements. Although comparisons will naturally be made between aerodromes, the analyses have been designed to give airport management a better indication of their own problem and control effectiveness. In Helsinki, the new analyses were demonstrated using data from two real airports labeled A and B. The same airports are used here

but with a further five year's data. In addition, an example is given which reveals a correlation between bird control effort applied at anaerodrome and a reduction in high risk bird strikes. This is one of the most important findings of this work and can possibly give financial justification for aerodrome bird control. Ibis has always been a problem for aerodrome management as aerodrome bird control is an attempt to prevent a situation which cannot be proved will occur if no action is taken. In addition, it cannot be proved that using all the mitigation measures that are available will prevent the next bird strike. The use of a single statistic can give very misleading information about an aerodrome's bird problem and the standard of bird control. The examples for the two aerodromes above give amore informed impression but, still only represent one aspect in the control of the bird problem to aircraft and, should be regarded together with other measures available to management. These include regular monitoring of the airfield bird population, routine examination of the control measures; exacting such items as quality management, staff training levels, staff and management motivation, etc.
Keywords: AIRPORT; BSCE; CIVIL AVIATION; CONTROL METHODS; REPORTING; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 1178
Citation: BECKER, J. How to Get Reliable Information on the Bird Strike Risk? Bird Strike Committee Europe 23, Working Paper 8; London, 13-17 May 1996: 93-100.
Abstract: The paper shows that knowledge about the spatial and temporal distribution of bird species dangerous to aircraft is mostly incomplete. The requirements for coverage, assessment and actuality of the data describing the bird strike risk can be best achieved combining geographical, biological, weather and radar data.
Keywords: BIRD POPULATIONS; BSCE; FLOCK DENSITY; MIGRATION; RADAR; RISK ASSESSMENT; STATISTICS; WARNING SYSTEMS

ABBHA Ref. #: 1179
Citation: LEHMKUHL, H. An Aviation Insurer's View of the Situation of Bird Strike Prevention in Germany. Bird Strike Committee Europe 23, Working Paper 9; London, 13-17 May 1996: 101-124.
Abstract: Following an introduction regarding the background of the author, the paper contains brief details regarding German aviation law applicable to the bird strike problem and possible consequences arising from civil law. The next chapter deals with the Lufthansa reporting and statistical system to comply with legal requirements regarding bird strikes. Developments of the bird strike situation in Germany - also taking into account the cost of damages - are explained by extracts from statistics. Description of changes that were achieved by a major German airport by changing its bird strike prevention activities. Conclusions and recommendations based on our experience.(This paper is the work of an individual author and may not reflect the full and final views of Delvag Luftfahrtversicherungs AG)
Keywords: BSCE; CIVIL AVIATION; GERMANY; INSURANCE; LIABILITY; REGULATIONS; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 1180
Citation: LESHEM, Y. Evaluating the Cost of Bird-related Damage to Civilian and Military Flights as a Vital Tool to Increase Flight Safety. Bird Strike Committee Europe 23, Working Paper 10; London, 13-17 May 1996: 125-134.
Abstract: This paper attempts to evaluate the global cost of bird-related damage to civilian and military flights. We believe that the global yearly direct and indirect damage reaches several billion dollars. We suggest that the BSCE initiate the establishment of a global database for bird strikes as a tool for decision makers to invest money to increase flight safety.
Keywords: BSCE; CIVIL AVIATION; LEGAL ISSUES; LIABILITY; MILITARY AVIATION; RISK ASSESSMENT

ABBHA Ref. #: 1181
Citation: VASSILAKIS, K. Bird Strikes in Greece. Bird Strike Committee Europe 23, Working Paper 12; London, 13-17 May 1996: 139-160.
Abstract: This paper presents the results of bird strike statistical analysis for the period 1975-1992 in Greece (number of bird strikes, bird species involved, strike seasons, risk per airport, altitudes, phase of flight, points of strike, influence on the mission). Finally this paper presents the methods coping with the problem in Greece.
Keywords: ATTRACTANTS; BSCE; CIVIL AVIATION; GREECE; MILITARY AVIATION; MISHAP INVESTIGATION; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 1182
Citation: CURTIS, T. Assessment of Bird Strike Accident Risk Using Event Sequence Analysis. Bird Strike Committee Europe 23, Working Paper 13; London, 13-17 May 1996: 161-174.
Abstract: Reports from five bird strike related hull loss accidents involving large jet transports were analyzed in order to develop an event sequence analysis based assessment of the risk of a hull loss due to bird strikes. The five accidents all had birds ingested into one or more engines during takeoff and in two of the accidents crew actions were directly involved in the sequence of events that led to the accident. From those five accidents, two groups of events were identified that should be part of a bird strike risk assessment. The first group included twelve events that were directly involved in past accidents. The second group included four events that were not directly involved in those accidents but could be directly involved in future accidents. The paper also includes a brief overview of the event sequence analysis method and a discussion of ways to expand upon the results of this study.
Keywords: BSCE; CIVIL AVIATION; MISHAP INVESTIGATION; RISK ASSESSMENT; STATISTICS

ABBHA Ref. #: 1183
Citation: SHORT, J.J. Availability of an Annotated Bibliography of Bird Hazards to Aircraft (ABBHA). Bird Strike Committee Europe 23, Working Paper 14; London, 13-17 May 1996: 175-177.
Abstract: Wright Laboratory has produced an annotated bibliography of bird hazards to aircraft, termed ABBHA. The ABBHA currently brings together over 900 hundred citations on a wide range of topics such as birdstrike tolerance engineering, bird hazard management and control, birdstrike avoidance, and bird remains identification. Citations included in ABBHA include books on bird hazards, working papers published in the proceedings of the Bird Strike Committees of Europe, Canada and the United States, studies published in scientific journals, and research reports found in reference collected such as those maintained by the National Technical Information Service, the National Aeronautics and Space Administration and the Defense Technical Information Center. The ABBHA is available electronically and can be used with a variety of word processing or bibliographic software. Computerization of the ABBHA reduces distribution costs, allows for frequent updates, and helps users locate references on topics of interest through the use of keyword "searches". An extensive list of key words has been devised which will facilitate retrieval of citations from ABBHA on a variety of topics. Copies of ABBHA can be obtained without charge and may eventually be hosted on the INTERNET. The ABBHA was proposed at BSCE 21 and demonstrated at BSCE 22. A revised list of keywords are presented for annotation of BSCE papers.
Keywords: BIBLIOGRAPHIC; BSCE; LITERATURE SURVEY

ABBHA Ref. #: 1184
Citation: RYJOV, S.K. Data on Statistical Studies of Bird Strikes with Russian Aircraft for the Period 1988 to 1990. Bird Strike Committee Europe 23, Working Paper 15; London, 13-17 May 1996: 179-186.
Abstract: Changes in the system of bird strike registration have influenced the dynamics of the registered strikes by altitude, phase of flight, bird groups, part of aircraft, effect on flight two times less.
Keywords: BSCE; CIVIL AVIATION; RUSSIA; STATISTICS

ABBHA Ref. #: 1185
Citation: SHAMOUN, J.; YOM TOV, Y. Five Years of Feather Identification for the Israeli Air Force. Bird Strike Committee Europe 23, Working Paper 17; London, 13-17 May 1996: 189-195.
Abstract: We report birdstrike statistics to military aircraft in Israel during 1991-95. Feather remains were identified by examining the microstructure of downy barbules and macroscopically comparing feathers to bird skins. Although most birds involved in birdstrikes were passerines (36%) and other small birds (Charadriiformes 17%, Columbiformes 10%, Apodiformes 9%), most strikes with considerable damage were caused by heavy soaring birds, mainly raptors and

storks (involved in 42% of the strikes with damage) or high flying, but lighter birds, such as swifts (16%). Most nocturnal birdstrikes were apparently due to migrating passerines (41%) and ground birds (Charadriiformes 38% and Galliformes 9%) which hit the aircraft generally during takeoff and landing.
Keywords: BSCE; FEATHERS; IDENTIFICATION; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 1186
Citation: HERMANS, J.; BUURMA, L.S.; WATTEL, J. Identification of Bird Remains after Bird-airplane Collisions, Based on DNA Sequence Analysis. Bird Strike Committee Europe 23, Working Paper 19; London, May 13-17 1996: 203-207.
Abstract: In order to establish a method for the identification of bird remains after bird-airplane collisions, a technique was developed to isolate DNA from minute tissue samples, blood smears or feather fragments. PCR amplification of part of the mitochondrial cytochrome-b gene and sequence determination of the product allows identification of the origin of the sample to the species-level. Since no data of cytochrome-b sequences of the bird species most frequently encountered in bird-airplane collisions were available from the GenBank database, the cytochrome-b gene of twenty species was partially sequenced and deposited into the database. For this purpose DNA was isolated from tissue of frozen specimens, feathers and blood samples, as well as from bird skins in the collection of the Zoological Museum Amsterdam.
Keywords: BSCE; DNA ANALYSIS; IDENTIFICATION

ABBHA Ref. #: 1187
Citation: PINOS, A. ICAO's Efforts to Minimize Bird Strikes to Aircraft. Bird Strike Committee Europe 23, Working Paper 20; London, 13-17 May 1996: 217-220.
Abstract: This paper gives an overview of ICAO's continuing efforts to reduce the hazards which birds pose to civil aviation. Outlined are ICAO's attempts to increase awareness of the birdstrike threat through ICAO, Annex 14, volume I: The Airport Services Manual, Part 3 - Bird Control and Reduction; the ICAO Bird strike Information System (IBIS) and ICAO's Regional Bird Hazard Workshops.
Keywords: BIBLIOGRAPHIC; BSCE; CONTROL METHODS; ICAO; REGULATIONS; REPORTING

ABBHA Ref. #: 1188
Citation: SATHEESAN, S.M. Importance of Reassessment of Bird Menace to Aircraft at Airports after a Period of Time Especially When Bird Aircraft Strikes Are on the Rise. Bird Strike Committee Europe 23, Working Paper 21; London, 13-17 May 1996: 221-225.
Abstract: This paper points out the importance of reassessment of bird menace at airports after a period of time, especially when bird aircraft strikes are on the rise. The field studies carried out by the author at Trivandrum International Airport in 1994 and Bangalore Airport of Hindustan

Aeronautics Limited (H.A.L.) in 1995 reveal the status of implementation of the recommendations given in 1989 to contain bird menace by the Bombay Natural History Society (BNHS). This also elaborates new findings and provides fresh recommendations to combat bird hazards.
Keywords: AERODROME SURVEYS; ASIA AND MIDDLE EAST; BANGALORE IAP; BSCE; CONTROL METHODS; INDIA; TRIVANDUM IAP

ABBHA Ref. #: 1189
Citation: KELLY, T.C.; MURPHY, J.; BOLGER, R. Quantitative Methods in Bird Hazard Control: Preliminary Results. Bird Strike Committee Europe 23, Working Paper 22; London, 13-17 May 1996: 227-233.
Abstract: This study presents a preliminary report on the development of quantitative methods in assessing the effectiveness of bird hazard control at Dublin Airport. Yearly totals of bird strikes since the base year 1978 are indexed using the recently developed Underhill method. The numbers of birds involved in individual incidents are analyzed using the variance to mean ratio of a frequency distribution. It will be shown that while there has been an increase in the annual index of bird strikes since 1990, the variance of the numbers of birds being struck has remained less than the mean. The results are discussed in the general context of monitoring bird hazard control.
Keywords: AERODROME SURVEYS; BSCE; IRELAND; STATISTICS

ABBHA Ref. #: 1190
Citation: SEUBERT, J.L. North American Canada Goose Populations an Increasing Hazard to Aviation? Bird Strike Committee Europe 23, Working Paper 23; London, 13-17 May 1996: 235.
Abstract: The presentation uses color slides to illustrate trends in North American Canada goose populations for the period 1970-95. Emphasis is on the increases in residential goose populations that are causing nuisance, agricultural, health, and safety problems. These large geese are the "giant" (Branta canadensis maxima) and the western (B.c. moffitti) sub-species. Information is given about goose numbers in the Atlantic, Mississippi, Central, and Pacific flyways for both resident geese and total flyway populations. The U.S. Fish and Wildlife Service is considering a modification in the system of issuing depredations permits that would authorize states and/or the Animal Plant Health and Inspection Service, U.S. Department of Agriculture to control problems caused by residential Canada goose populations.
Keywords: BIRD POPULATIONS; BSCE; GEESE; MIGRATION; PERMITS; RESIDENT

ABBHA Ref. #: 1191
Citation: MACKINNON, B. The Role and Value of Awareness Programs in Reducing Bird Hazards to Aircraft. Bird Strike Committee Europe 23, Working Paper 24; London, 13-17 May 1996: 237-246.

Abstract: Decision makers in Canada, as in other parts of the world, often approve or promote land use activities near airports that seem to be incompatible with the goal of reducing bird hazards to aircraft. It seemed clear to managers in Transport Canada that a sense of awareness about bird hazards to aircraft was lacking among decision makers, and that an aggressive awareness program might encourage these decision makers to consider bird issues more carefully when planning land use near airports. Also, it was felt that an extended awareness program might lead to better reporting of bird strikes, and improvements in the quality of airport wildlife control programs.
Keywords: AGRICULTURE; ATTRACTANTS; BIBLIOGRAPHIC; BOOKS/MANUALS; BSCE; CANADA; FILM/VIDEO; PUBLIC RELATIONS; REGULATIONS

ABBHA Ref. #: 1192
Citation: CACCAMISE, D.F.; REED, L.M. Bird Strike Hazards and Waste Management Facilities in Urban Landscapes. Bird Strike Committee Europe 23, Working Paper 25; London, 13-17 May 1996: 247-266.
Abstract: Airports and waste management facilities have similar siting requirements resulting in a tendency to place waste facilities near airports. Putrescible materials associated with many types of waste facilities can attract large numbers of birds, particularly gulls. Here we assessed avian use of 4 types of waste management facilities. Our goal was to characterize the avian communities attracted to these facilities providing information that can be used to assess the actual risks to air operations posed by the waste facilities. Our most revealing observations were the considerable variation we found in attractiveness to birds among the types of waste management facilities and among the individual facilities within types. These differences were based on factors including: (1) volume of waste material processed, (2) physical characteristics of the facilities, (3) cleanliness of the operation, and (4) nature of the avian community near the facilities. With many factors affecting the size of bird populations attracted to waste facilities, generalizations concerning potential interference of these facilities with safe air operations are difficult. It is clear that most facilities do attract birds, some considerable numbers. Nonetheless, other factors, including how the facility is operated can influence the impact on local bird populations and must be considered in an evaluation of bird strike hazards.
Keywords: ATTRACTANTS; BIRD POPULATIONS; BSCE; GARBAGE

ABBHA Ref. #: 1193
Citation: SATHEESAN, S.M. Evaluation of Weed Control Efficacy of KLASS 80 WP (Diuron) in Juhu Airport, Bombay India. Bird Strike Committee Europe 23, Working Paper 27; London, 13-17 May 1996: 277-280.
Abstract: This paper summarizes the results of the field trial of Klass 80 wettable powder (wp) the first Diuron-based herbicide manufactured in India by Hoechst, Schering and AgrEvo, Limited. KLASS 80 WP (Diuron) is found to be useful in controlling weeds which attract birds hazardous to aircraft safety because of the plant food and animals preyed upon by these birds as

well as the roosting, resting and nesting facilities provided by this vegetation cover on airport grounds.
Keywords: ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; HABITAT MODIFICATION; INDIA; VEGETATIVE

ABBHA Ref. #: 1194
Citation: PILO, B.; KUMAR, B.A.; OOMMEN, S.; VINOD, K.R.; KUMAR, G.P. Controlling Vegetation on Indian Aerodromes Using Weedicide: A Preliminary Appraisal. Bird Strike Committee Europe 23, Working Paper 28; London, 13-17 May 1996: 281-286.
Abstract: An assessment on the effect of weedicide KLASS-80 W. P. was tested on selected test plots on aerodrome area at different concentrations (20 and 30 kg/ha) and monitored over a period of 12 months. The weedicide (30 kg/ha) effectively controlled the vegetation in the test plots while some of the plant species showed resistance to low dosage of weedicide application. The efficacy of the weedicide lasted up to ten months with higher dosage.
Keywords: ATTRACTANTS; BSCE; CHEMICAL/REPELLENT; HABITAT MODIFICATION; INDIA; VEGETATIVE

ABBHA Ref. #: 1195
Citation: DEKKER, A.; VAN DER ZEE, F.F. Birds and Grassland on Airports. Bird Strike Committee Europe 23, Working Paper 30; London, 13-17 May 1996: 291-305.
Abstract: The long grass regime has been a wide spread and successful tool in the prevention of on-airfield bird strikes. The RNLAF has carried out experiments with an alternative grassland management. This so-called poor grass regime is aimed at reduction of biomass production. Food will not only be inaccessible (as in the long grass approach) but also less available. Experiments showed that poor grass is at least as unattractive to birds as long grass. Benefits of poor grass over long grass all relate to the better development of the vegetation and include a better resistance to drought and erosion. The lower vole density in poor grassland implies a lower density of its associated predators. Poor grass leads to a more diverse vegetation including rarer species. Flight safety and the development of natural values both profit from a poor grass regime.
Keywords: BSCE; HABITAT MODIFICATION; LONG GRASS; NETHERLANDS

ABBHA Ref. #: 1196
Citation: ROCHARD, B. Airfield Bird Control - Setting the Standards. Bird Strike Committee Europe 23 Working Paper 32; London, 13-17 May 1996: 311-318.
Abstract: The UK Civil Aviation Authority has introduced an Aerodrome Safety Management Initiative which significantly changes the way in which it regulates aerodromes, and requires operators to take prime responsibility for safety management. Bird hazard control is an important part of safety management culture and must be fully described in aerodromes' operations

manuals. The CM's safety audits are now based on assessment of the promulgated organization and procedures. To ensure that the best and most recent information is available to managers tasked with providing bird hazard control systems, the CM commissioned a review of 30 years' experience and development of bird scaring methods and recent relevant research in bird behavior. The study concluded that only man-operated scaring systems remain effective in the long term and meet the exacting requirements of the aerodrome environment. It set standards of performance for the most effective systems and identified the best operational procedures. The results are being used to update and expand the CAA's aerodrome bird control manual which will be published in a new format, with particular emphasis on organization and management. In less than a year's operation, the new system is creating a more positive approach to bird hazard control.
Keywords: ARM-WAVING; BIOACOUSTICS; BOOKS/MANUALS; BSCE; CONTROL METHODS; FALCONRY; GAS CANNONS; GUIDANCE; HAZARD MANAGEMENT; PYROTECHNICS; SHOOTING

ABBHA Ref. #: 1197
Citation: DEACON, N. Airfield Bird Control - Applying the Principles. Bird Strike Committee Europe 23 Working Paper 33; London, 13-17 May 1996: 319-325.
Abstract: In the mid-1980s, after a variety of attempts to use service personnel for the task, the Royal Air Force began a program of “contractorising” its Bird Control Units (BCUs). These contracts, which have now run for seven to eleven years, have shown that a bird control system which combines careful habitat management, sufficient dedicated manpower, adequate equipment, and effective management can produce a worthwhile and sustained reduction in the birdstrike hazard while remaining comparatively inexpensive. Birdstrike rates are consistently lower than non-military UK aerodromes, and multiple impact birdstrikes and birdstrikes causing damage have become a rarity. Long-term reductions in aerodrome populations of some of the larger, more hazardous species have been achieved, and the frequency of their involvement in birdstrikes has consequently fallen. Since "contractorisation" was completed, no RAF aircraft has been lost as a result of an airfield birdstrike when a contract BCU was on duty, but a twin-engined jet fighter was lost when a BCU was off duty.
Keywords: BIRD CONTROL TEAM; BIRD POPULATIONS; BSCE; HABITAT MODIFICATION; HAZARD MANAGEMENT; ORGANIZATION; STATISTICS

ABBHA Ref. #: 1198
Citation: DOLBEER, R.A.; ARRINGTON, D.P.; LEBOEUF, E.; ATKINS, C. Can Albatrosses and Aircraft Coexist on Midway Atoll? Bird Strike Committee Europe 23, Working Paper 34; London, 13-17 May 1996: 327-335.
Abstract: Aircraft collisions with birds (bird strikes), especially Laysan Albatrosses (Diomedea immutabilis), have been a problem at Midway Naval Air Facility since at least the 1950s. The U.S. Navy in 1993 reported 57 strikes during 459 aircraft movements. We visited Midway from

15-21 April 1995 to determine the species composition and diurnal pattern of bird flights over Runway 6-24 so that recommendations could be made regarding timing of aircraft movements to minimize strikes. Midway Atoll in 1994-1995 had an estimated 450,000 nesting pairs of albatrosses (900,000 adults), a mean density of 725 nests/ha. We recorded a mean of 363 birds (89% Laysan albatrosses) crossing the runway/minute during daylight hours. At night (2230-2300), we estimated only 5.7 birds/minute (89% Bonin petrels (Pterodroma hypoleuca) flying over the runway, a 98.5% reduction over mean numbers during daylight. As Midway Atoll goes through the transition from military base to wildlife refuge, nonemergency aircraft movements should be restricted to night from November - mid July. Furthermore, any plans to develop "ecotourism" or other activities for the Atoll will need to factor in this constraint for aircraft movements. Under present conditions, daytime aircraft movements for commercial or private carriers would raise serious safety and liability issues.
Keywords: AERODROME SURVEYS; ALBATROSSES; BIRD POPULATIONS; BSCE; LOCAL MOVEMENTS; MIDWAY ATOLL; RESIDENT

ABBHA Ref. #: 1199
Citation: JACOBI, V. Study of Bird Behavior to Bird Strike Prevention. Bird Strike Committee Europe 23 Working Paper 35, London, 13-17 May 1996: 337-343.
Abstract: There is a need to study some biological aspects -- 1. Bird behavior concerning aircraft; 2.Control of bird behavior at airports; 3. Prediction of migratory behavior of birds -- to solve bird strike problem. Aircraft is indifferent factor for birds, but become a repellent at short distance. Probabilities of bird strike increase in some cases: -- birds run into aircraft for the first time (migrants and juveniles); -- low noise of landing plane; -- birds take off facing into wind; -- curved flight of aircraft relatively birds; -- condition decreasing distance of acoustic and visual detection. Scaring and ecological control methods are the most efficient to prevent birds from visiting airport area. Scaring methods (bioacoustical, pyrotechnic and so on) at airdromes have some shortcomings viz. Short distance of action, necessity of bird detection on runway, getting use to frighten factors, conformation of these factors. Their main merits are in their good scaring effect to migrants and juveniles. Ecological methods prevent birds from landing on the ground but do not stop their flying over airport. One of them is frighten for some birds but attractive for the others. Both landing and flash lights are imperceptible for birds at daytime. Probability of strike increase at night when birds could not see aircraft silhouette but see landing lights that attract them. Radar and visual observations of migrating birds allow to predict time, altitude and way off light in connection with weather and use this data in other countries through BIRDTAM. To prevent such collisions in the future, practice of detailed analysis of circumstances all of bird strikes, search and utilization of new methods are the most effective. This is concern with such strikes for which now impossible to recommend some of definite method. It is appeared to be the possibility to create original on-plane radar system to discover, recognize and avoid birds in flight.
Keywords: AIRCRAFT APPEARANCE; ATTRACTANTS; BIRD POPULATIONS; BSCE; CONTROL METHODS; DETECTION; LIGHTING; LOCAL MOVEMENTS; MIGRATION;

RADAR

ABBHA Ref. #: 1200
Citation: BRIOT, J.L. Last French Experiments with Lasers to Frighten the Birds. Bird Strike Committee Europe 23 Working Paper 36; London, 13-17 May 1996: 345.
Abstract: Abstract of the video presented Some experiments with four different types of lasers are firstly presented: - Continuous laser guns (helium neon; P = 5 to 10 mW) - Impulse laser (lambda = 530 nm, P = 150 microJ/cm2) - Thermic laser: CO2 (p = 1W/cm2) - Diode pumped Nd: Yag lasers (lambda = 532 nm, P = 200 to 400 mW) The most important results are: 1) To scare away the bird, it is not useful to aim the eye or to dazzle it. The color don't seem important (blue, green, red). The birds take off when they see the laser beam pointing toward them like a long stick. 2) Working below the ocular security (25 W/m2) with continuous lasers and appropriate optical equipments in order to get 10 W/m2 at 1000 m, most of the birds species take off when the sunlight is below 13 000 lux. (a sunny day is around 30 000 lux). Over this limit there is no contrast and the birds cannot see the laser beam. 3) an experiment on a rookery show that there in no habituation when the laser beam is in movement. A prototype of equipment is today realized and will be fixed along a runway to evaluate the possible disturbances on the pilots (reflections problems, test in IMC conditions etc.). The correlations with the meteorological conditions and the results on other kinds of birds will be also studied.
Keywords: BSCE; CONTROL METHODS; LASERS

ABBHA Ref. #: 1201
Citation: ROBINSON, M.

TI: The Potential for Significant Financial Loss Resulting from Bird Strikes in or Around an Airport. Bird Strike Committee Europe 23, Working Paper 38; London 13-17 May, 1996: 353-367.
Abstract: Following a brief introduction, this paper contains a brief study outlining some arguments concerning the perceived need for maintaining an adequate "airport and/or air traffic control legal liability" insurance program. It includes reference to known loses caused by bird strikes and an analysis suggesting that in an increasingly litigious world, bird dispersal measures must be vigilantly maintained.
Keywords: BSCE; INSURANCE; LIABILITY; RISK ASSESSMENT

ABBHA Ref. #: 1202
Citation: JARMAN, P. Proposal for an Association of Airfield Bird Controllers. Bird Strike Committee Europe 23, Working Paper 38; London 13-17 May, 1996: 369-375.
Abstract: The paper details a proposal for an association of airfield bird controllers, as distinct from the members of BSCE. This could provide a number of advantages for BSCE and other

organizations involved in reduction of bird strikes, including two-way dissemination of information between BSCE (and similar organizations) and the personnel actively involved inbird control, a large number of dispersed information gatherers for the scientists and early warning of trends which may not be apparent from bird strike statistics alone. The paper is divided into three sections - possible advantages, possible disadvantages, and suggested organization and costs.
Keywords: BIRD CONTROL TEAM; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 1203
Citation: HENZE, T. Operational Methods for Birdstrike Prevention. Bird Strike Committee Europe 23, Working Paper 40; London 13-17 May, 1996: 377-379.
Abstract: Following this summary, the paper contains some operational decisions pilots will make in case of high bird concentrations. The possibility to avoid collisions with birds by pure avoiding maneuvers is virtually nil. A number of operational methods however, will help to reduce the severity in case of a bird strike or even prevent it. The most effective prevention lies in the biological management on airports.
Keywords: AVOIDANCE; BSCE; CIVIL AVIATION; CONTROL METHODS; HAZARD MANAGEMENT; NOISE; STATISTICS

ABBHA Ref. #: 1204
Citation: SHORT, J.J.; KELLEY, M.E.; MCKEEMAN, J. Recent Research into Reducing Birdstrike Hazards. Bird Strike Committee Europe 23, Working Paper 41; London 13-17 May, 1996: 381-407.
Abstract: In the aftermath of the 1995 AWACS birdstrike tragedy, Wright Laboratory is accelerating its search for technologies to prevent serious birdstrikes. These studies represent a cooperative effort between the U.S. Air Force, the U.S. Department of Agriculture, members of the aerospace industry, and academia. The research focuses on the active projection of sound to disperse birds from the flight path. This includes infrasound, modulated radar, and discrete bands of noise normally associated with aircraft engines. Early results indicate that birds appear to respond to these sounds. Additional study is needed to determine if these sounds, used separately or in combination with other stimuli, convey a biological meaning to the birds sufficient to result in birdstrike reduction. Passive infrared sensors systems are undergoing evaluation for possible application in locating bird targets that may threaten safe flying operations. Recent research suggests that the long-wave infrared systems may provide the needed sensitivity and range to discriminate bird targets in an airfield environment, and possibly, during flight. Further research is underway to develop and optimize this capability.
Keywords: ARTIFICIAL BIRDS; BIRD POPULATIONS; BODY DENSITY/WEIGHT; BSCE; CONTROL METHODS; DETECTION; ENGINEERING; ENGINES; INFRARED; INFRASOUND; SOUND; TESTING

ABBHA Ref. #: 1205
Citation: CHAMORRO, M.; CLAVERO, J. Birdstrike Motivation Program for Pilots: The Spanish Air Force Results. Bird Strike Committee Europe 23, Working Paper 42; London 13-17 May, 1996: 409-414.
Abstract: Following a short introduction, the paper contains brief details of the Bird Strike prevention plan and statistics showing the increase on the number of pilot birdstrike reports during 1985-1995 period.
Keywords: BSCE; MILITARY AVIATION; PUBLIC RELATIONS; REPORTING; STATISTICS

ABBHA Ref. #: 1206
Citation: LESHEM, Y.; GAUTHREAUX, S.A., Jr. Proposal to Develop a Global Network to Predict Bird Movements on a Real Time and Daily Scale by Using Radars. Bird Strike Committee Europe 23, Working Paper 50; London 13-17 May, 1996: 415-416.
Abstract: Civilian air traffic as well as military flights have increased significantly during the last decades. Military aircraft now fly at low altitudes and high velocities during day and night, using fire zones in several countries. The cost of commercial and military aircraft has increased two fold during the last decades. Due to these reasons, the potential for damage caused by birds has increased dramatically. We propose to develop a global network of radar to predict bird movement on a realtime and daily scale through the use of a network of regional radar systems. A network of regional radar systems should be developed in the Middle East, around the Mediterranean Sea, in Western, Northern, and Eastern Europe, in Asia, and in Africa which will provide together a global network as currently in place in the USA for weather prediction by NEXRAD radar. It should be proposed by BSCE to the European Market, leading insurance companies, and others to develop the system which can significantly reduce the number of air collisions in order to save lives and billions of dollars.
Keywords: BIRD POPULATIONS; BSCE; CIVIL AVIATION; DETECTION; LIABILITY; MIGRATION; MILITARY AVIATION; RADAR; WARNING SYSTEMS

ABBHA Ref. #: 1207
Citation: SEEGAR, W.S.; FULLER, M.R.; HOWEY, P.W.; LESHEM, Y. Satellite Telemetry, A Tool for Tracking and Monitoring Bird Movements from a Local to Global Scale. Bird Strike Committee Europe 23, Working Paper 51; London 13-17 May, 1996: 433-462.
Abstract: Bird strikes to aircraft can result in damage that is expensive to repair and as lost revenue due to equipment down-time. Bird strikes also poses a safety risk to commercial, private and military aviation because it has resulted in serious human injury and death. Biotelemetry has been used effectively to examine the behavior, range, and biology of avian species since the early 1960s (Samuel and Fuller 1984). Conventional biotelemetry has been used to support basic

research on birds as well as the conservation of avifauna throughout the world. However, biotelemetry has limitations that do not easily allow for the continuous tracking and monitoring of bird species over long distances for long periods. We report here on the development of bird-borne Platform Transmitter Terminals (PTT) and some of the past and present applications of satellite tracking to study avian species. The use of satellite tracking to locate and forecast bird movements and migration to aid in the bird strike problem has been proposed. A satellite tracking system used with other emerging technologies and capabilities to address the birdstrike problem is discussed.
Keywords: BIRD POPULATIONS; BSCE; MARKING/BANDING; MIGRATION; TELEMETRY

ABBHA Ref. #: 1208
Citation: DEFUSCO, R.P. Using Geographic Information Systems to Model Bird Distributions and Populations on a Continental Scale. Bird Strike Committee Europe 23, Working Paper 52; London 13-17 May, 1996: 463-501.
Abstract: The objectives of this study were to use physiographic, geographic and climatic correlates to describe the breeding and wintering distribution and abundance patterns of Turkey Vultures (Cathartes aura) in the continental United States and model the hazards posed to aircraft by these birds. Thirty years of data were correlated with remotely sensed and ground-sampled environmental data in a raster-based geographic information system (GIS). Environmental factors evaluated include elevation, hydrography, thermal reflectance, temperature, precipitation, snow cover, number of frost free days, vegetation types and ecoregions, for each square kilometer block of the continental United States. A GIS overlay process was used to determine statistical relationships between environmental factors and sampled vulture data. Vulture numbers were most strongly correlated with geophysical factors throughout their range and between seasons. Breeding vultures were more strongly positively correlated with heterogeneous and more open physiographic habitats. Wintering vultures were more strongly correlated with forested areas, presumably for thermal roosting cover. These techniques have helped better determine Turkey Vulture habitat requirements on a scale never before attempted, and can be used for other species in the future. Modeling techniques can be used to identify specific areas where birds pose potential hazards to aviation.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCE; ELECTRONIC MEDIA; LOCAL MOVEMENTS; MIGRATION; RADAR; UNITED STATES

ABBHA Ref. #: 1209
Citation: LESHEM, Y. Establishment of an International Center for the Study of Bird Migration and Flight Safety at Latrun, Israel, as a Model for Regional Activity. Bird Strike Committee Europe 23, Working Paper 51; London 13-17 May, 1996: 503-514.
Abstract: In 1995 the Society for the Protection of Nature in Israel (SPNI) and Tel Aviv

University initiated the establishment of the International Center for the Study of Bird Migration located at the Armored Corps Memorial in Latrun. The sight is in the heart of Israel midway between Tel Aviv and Jerusalem. The site will house a field study center and hostel, an auditorium, a radar for monitoring birds and weather, and a museum on bird migration with an emphasis on flight safety. An inter university center for migratory research concerned with practical aspects of flight safety will also be established. Finally, a network of bird and weather radars will be developed in Israel and the Middle East. The database will be centered at Latrun and real-time information will be transferred to the air force and civil aviation of participant countries. We believe that this multi-disciplinary project proposed here combining scientific subjects with flight safety, education, eco-tourism and nature conservation -- goals common to many Middle East countries -- can help promote the peace process in this region and will be used as a model for other areas around the world.
Keywords: AIRCRAFT; ASIA AND MIDDLE EAST; BSCE; CIVIL AVIATION; CONSERVATION; ISRAEL; LEGAL ISSUES; MIGRATION; MILITARY AVIATION; RADAR

ABBHA Ref. #: 1210
Citation: ZALAKEVICIUS, M. Basic Bird Migration Characteristics in Lithuania: Towards Long-term Forecast in the Bird Strike Problem. Bird Strike Committee Europe 23, Working Paper 54; London 13-17 May, 1996: 517-525.
Abstract: The paper contains an overview of the work carried out in south-east part of the Baltic region characterized by large-scale migratory movements of birds. The use of radar and complex methods of observation allowed to get a number of new characteristics of bird migration in the Baltic region, seasonal and circadian activities of birds, to determine migratory routes, flight directions and bights, to create model for forecasting large-scale migratory passages, to model migratory behavior of birds. The results obtained can be used for long-term forecasting both in Lithuania and the entire region of the Baltic states.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCE; MIGRATION

ABBHA Ref. #: 1211
Citation: RUHE, W.; ENGELBART, D. Bird Migration Observation in the Berlin Area Using Atc-radar and Wind-profiler. Bird Strike Committee Europe 23, Working Paper 55; London 13-17 May, 1996: 527-538.
Abstract: Air traffic around Bedin is continuously growing, whereas Berlin is located in an environment with a high bird population. An additional bird strike risk arises in periods of bird migration. Observations have been made recently by video-digitizing of an air traffic control (ATC) radar located at Berlin-Tegel Airport and simultaneously by a wind profiler located at the Meteorological Observatory in Lindenberg, 65 km southeast of Tegel. Both methods are described. An analysis of a selected dataset is presented in respect of heavy bird migration and heights. A coincidence of several bird strike events with observed high bird migration densities could be detected.

Keywords: BIRD POPULATIONS; BSCE; ELECTRONIC MEDIA; FORECASTING; MIGRATION, RADAR

ABBHA Ref. #: 1212
Citation: KELLY, T.A.; ZAKRAJSEK, E.; SMITH, A. Bird Avoidance Modeling at Dare County Bombing Range, North Carolina and Moody Air Force Base/Grand Bay Weapons Range, Georgia. Bird Strike Committee Europe 23, Working Paper 56; London 13-17 May, 1996: 539-542.
Abstract: This paper contains a brief abstract of the recently completed project at Dare County Bombing Range, North Carolina and the current project at Moody Air Force Base/Grand Bay Weapons Range complex, Georgia. The objectives at Dare Range were to quantify the effects of military aircraft on endangered species and the risk of bird strikes to military aircraft Radar, radio telemetry, satellite telemetry and acoustics were used to remotely monitor all bird movements across the bombing range. The objective at Moody Air Force Base/Grand Bay Weapons Range is to quantify the risk of bird strikes to military aircraft. A thermal imaging camera has been added to these technologies to provide better species identification. The data generated is used to quantify the bird strike risk and to monitor the effects of low-level flying on wild bird populations. This risk analysis is distributed to aircrews and mission schedulers through the Bird Avoidance Model software: a multi-media computer model used to schedule flights around high-risk areas, altitudes and times. An outline is given of the radar and telemetry equipment used.
Keywords: AVOIDANCE; BOMBING RANGE; BSCE; LOCAL MOVEMENTS; MAPS; RADAR; RISK ASSESSMENT; TELEMETRY

ABBHA Ref. #: 1213
Citation: BUURMA, L.S. Bird Movements Around Airports: a Critical Issue in the Specification of Avoidance Systems. Bird Strike Committee Europe 23, Working Paper 57; London 13-17 May, 1996: 543-554.
Abstract: Quantifying, qualifying and predicting low level bird movements is the key issue hampering the certification of bird strike prevention measures in the control zone of airports as well as "en route". Bird control at the runway itself is already successful at many airports. Less widespread, and limited to military aviation, but technically speaking ripe for improvement, are large scale warning systems indicating mass bird migration. However, the 'bottom-up' and 'top-down' approach together do by far not solve all bird strike problems. A geographical comparison of the (low level) altitude distribution of military bird strikes from EURBASE indicates a missing link, just outside visual range but also below the coverage of most radars. This risk is posed by local bird flights over up to some tens of kilometers especially in coastal and wetland areas. Integrated radar and visual observations in The Netherlands show that also a significant part of long distance migratory flights may occur at low level, even at night. Local and migratory flights may accumulate along topographical barriers or leading lines at locations

considered for airport construction. This presentation is a plea for the classification of these complex problems. This should happen in such a manner that existing ornithological knowledge will help to develop rules of thumb to be used in integrated bird avoidance systems. There are fundamental, psychological as well as political reasons why operational bird prediction models should be backed up by bird detection devices. Problems with wild geese wintering in The Netherlands may serve as an example.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; MIGRATION; RADAR; VISUAL

ABBHA Ref. #: 1214
Citation: NEBABIN, V. An On-board Bird Recognition Device for the Prevention of Birdstrikes. Bird Strike Committee Europe 23, Working Paper 58; London 13-17 May, 1996: 555-560.
Abstract: The paper details an onboard device for recognition and avoidance of birds, using radar cross section values of birds, the spectral structure of radar returns and their Doppler frequency.
Keywords: AVOIDANCE; BSCE; DETECTION; RADAR

ABBHA Ref. #: 1215
Citation: ALGE, T.L. Commercial Transport Engine Geographic Bird Threats and Trends. Bird Strike Committee Europe 23, Working Paper 60; London 13-17 May, 1996: 567-581.
Abstract: This paper provides statistics on the relative bird threat for selected geographic regions compared to that in North America, using recorded "damaging" bird ingestion events on CF6 engines. Statistics on trends, as well as threat level, are provided. The data shows that certain regions and countries have achieved a marked improvement in level of bird threat since 1980, whereas other countries with a high bird threat appear to have done little or nothing to reduce the threat. Although new engines will have increased birdstrike capability, the older engines will remain in service for many years. It will always be necessary for airport operators and regulatory authorities to ensure that extreme ingestion encounters are avoided. Effective airport bird hazard controls are needed now and must be maintained in the future.
Keywords: BSCE; CONTROL METHODS; ENGINEERING; ENGINES

ABBHA Ref. #: 1216
Citation: MARTINDALE, I. Bird Ingestion and Rolls - Royce Aero Engines. Bird Strike Committee Europe 23, Working Paper 61; London 13-17 May, 1996: 583-593.
Abstract: This paper is intended to give non-engineers an insight into the problems encountered when designing a civil aero-engine to meet the bird ingestion threat. It gives a brief introduction to the principles of the jet engine and to the components which are most vulnerable to damage, outlines the certification regulations which must be satisfied and describes the design methods and testing involved. It concludes that, while great steps have been made in improving the mechanical integrity of engines to make them capable of ingesting birds of increasingly higher

weight, there is a law of diminishing returns in operation which shows that it may be unrealistic to expect further improvements in air safety in this field to be achieved by engineering alone. The problem must be recognized as a common one for engine manufacturers, engine operators and airport managers to combat together.
Keywords: BSCE; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 1217
Citation: SHORR, B.F. Some Problems on the Valuation of the Bird Strike Turboprop Resistance. Bird Strike Committee Europe 23, Working Paper 62; London 13-17 May, 1996: 595.
Abstract: Under turboprop certification some specific problems on the valuation of the bird strike resistance were to be considered, for example: How to conduct the engine test - with a synchronization of bird shots with screw rotation speed to avoid bird collisions with screw blades or without it? How to determine the active engine inlet area (for the turboprop inlet configuration? As a screw cuts a large bird into some fragments penetrating into the air canal of the engine and having a total mass greater than a summary mass of little birds flock, is it a necessity of additional testing of engine to confirm its resistance against little birds? These problems are discussed referred to one of the certificated turboprop.
Keywords: BIRD IMPACT; BSCE; CERTIFICATION STANDARDS; ENGINEERING; TESTING

ABBHA Ref. #: 1218
Citation: THORPE, J. Bird Strikes to Airliner Turbine Engines. Bird Strike Committee Europe 23, Working Paper 63; London 13-17 May, 1996: 597-609.
Abstract: Bird strikes reported during the years 1990 to 1994 world-wide to the engines of UK registered turbine-powered airlines have been analyzed. Birds of weight below 100g, such as the many single swift/swallow/martin reports have been excluded. Aircraft movement data has been used to obtain rates for 1462 aircraft strikes and the 367 engine strikes (25% of incidents affects the engine), together with damage rates. The term "damaged" has only been used where repair or replacement was necessary. The airports where the 94 cases of damage occurred and weight of bird species involved have been detailed. The results show that rear mounted engines are 4 to 5 times less likely to suffer a strike or damage than wing-mounted engines. The engine strike rate does not appear to correlate with engine fan area. There is some evidence that the noisier engines have lower strike rates. The in-service abilities of engines to cope with birds shows considerable variation. More information from wider sources and research on engine forward noise/frequency spectrum may be useful.
Keywords: BSCE; ENGINEERING; ENGINES; STATISTICS

ABBHA Ref. #: 1219

Citation: ALLAN, J.R. Towards Standardized Birdstrike Resistance Testing: The Work of the International Birdstrike Research Group. Bird Strike Committee Europe 23, Working Paper 64; London 13-17 May, 1996: 611-616.
Abstract: The formation of the Central Science Laboratory Birdstrike Research Club was described at the Vienna meeting of BSCE. The group has changed its name to the International Birdstrike Research Group to better reflect its constituent parts and research objectives. The main thrust of the work continues to be the gathering of data to establish representative, world-wide standards for birdstrike resistance testing. To this end, work has continued on the measurement of whole body density and biometrics of species hazardous to aircraft. Data on the internal organ density and development of 3-d computer reconstructions has also been accomplished. Stereo imaging of flocks to determine individual bird separations is also in progress. These data are being used for computer modeling of birdstrike events in order to calculate the probability of particular numbers of a given species being hit. The group has also produced guidelines for airport developers and planners for the reduction of the attractive features to birds in airport designs.
Keywords: ARTIFICIAL BIRDS; BSCE; CERTIFICATION STANDARDS; CIVIL AVIATION; ENGINEERING; ENGINES; FLOCK DENSITY; TESTING

ABBHA Ref. #: 1220
Citation: SHORT, J.J.; SEAMANS, T.W. Tissue Density Determination in Intact Birds. Bird Strike Committee Europe 23, Working Paper 65; London 13-17 May, 1996: 617-626.
Abstract: Bird "slice" density data of intact birds was acquired using medical diagnostic equipment at the Wright-Patterson Air Force Base, Ohio, hospital. Intemal tissue configuration data was collected on twelve species of birds using magnetic resonance imaging (MRI) and two species of birds using computerized tomography (CT). MRI provides detailed information on the location and orientation of internal body tissues and structures without dissection. CT data provides greater detail and the image intensity represents relative density information of the tissue. These techniques, especially CT, could eventually replace the dissection method of determining density and could lead to the development of an improved "virtual bird" for computer modeling of impact forces and an "artificial bird" for use in aircraft component certification testing.
Keywords: ARTIFICIAL BIRDS; BSCE; ENGINEERING; MATHEMATICAL MODELS; TESTING

ABBHA Ref. #: 1221
Citation: RAMACHANDRA, K.; MADHUSOODANAN, R.V.; CHANDRASEKARAN, M.; RAMACHANDRA, S.; JAIN, R. Evaluation of Transient Engine-bearing-loads Due to Bird Strikes YR: 1996 AU: Ramachandra-K; Jain-R; Chandrasekaran-M CS: Bird Strike Committee Europe 23, Working Paper 67; London 13-17 May, 1996: 627-658. AB: Importance of bearing-load in aeroengines and its prediction in the event of "Bird-Strike" is dealt with in this paper. A

short Abstract of analytical results obtained for a critical flight condition is presented to highlight the utility of Impact Software in relation to engine bearing design. DE: Engineering; Engines TI: "Aircraft-specific" Fod Certification: Need for a Relook at Mil-standard Requirements For Aeroengines. Bird Strike Committee Europe 23, Working Paper 68; London 13-17 May, 1996: 659-673.
Abstract: This paper addresses the issue of severity of impact damage due to Bird-Strike under the present provisions of Milstandard 5007 D/E. The need for reviewing the standards with reference to failure modes in Aircraft-Fuselage-mounted aeroengines has been explained. Influence of strike on air intake on bird shape parameters is discussed.
Keywords: AIRFRAME; BSCE; CERTIFICATION STANDARDS; ENGINEERING; ENGINES

ABBHA Ref. #: 1222
Citation: TIANHAO, W. Bird Strike Prevention in China. Bird Strike Committee Europe 23, Working Paper 11; London, 13-17 May, 1996: 135-138.
Abstract: The statistic and some accidents of bird strike in China were described. In the Air force, there were 50 accidents posed by birds during 1957-1982. Then, in September, 1994 there were 5 accidents at an Airforce Training Base, one of which was a serious event, and a new pilot was killed. However, in Civil Aviation, there were 34 accidents, during of 1982-1995, one of which was happened at Changing Airport, Sichuan Province, when two flocks of Gray Heron collided with a Boeing 757 at the time of taxing before taking off in February 1995. First Symposium on Bird Strike to Aircraft of China (lst SBSAC) was held 25-28 October 1994 in Kunming. 32 delegates fran 20 organizations of civil aviation, military, aircraft industry companies and biological institutes of China Academy of Science, universities and colleges attended. Meanwhile, Bird Strike Research Group, Ornithology Branch, China Zoology Society / Bird Strike Prevention Committee, Yunnan Zoology Society(BSRG/BS&PC) were established simultaneously.
Keywords: BSCE; CHINA; CIVIL AVIATION; MILITARY AVIATION; STATISTICS; SYMPOSIA

ABBHA Ref. #: 1223
Citation: YASHON, J. Land Management and Allocation of Resources: Short Term Costs with Long Term Results. Bird Strike Committee Europe 23, Working Paper 43; London 13-17 May, 1996: 415-416.
Abstract: Proper ground maintenance near operational areas is of great importance in the effort to diminish conditions conducive to bird activity. If preventative measures are not enforced, then unregulated vegetation will spread and become a focus for bird activity. Efforts to contain the problem may initially cause undesirable consequences, but over the longer term will contribute to a more stable and secure environment with a concomitant attenuation in bird strikes.
Keywords: BSCE; CONTROL METHODS; FOOD; LANDSCAPING

ABBHA Ref. #: 1224
Citation: SPEELMAN, R.J.; KELLY, M.E.; MCCARTY, R.E.; SHORT, J.J.; TERRY, J.L. Establishing and Validating Aircraft Birdstrike Resistance Requirements. Bird Strike Committee Europe 23, Working Paper 66; London 13-17 May, 1996: 627-637.
Abstract: Aircraft repeatedly prove that birds and aircraft cannot occupy the same airspace at the same time; over 3000 birdstrikes per year cause 50-80 million US dollars in damage to USAF aircraft. To the world-wide fleet this problem is estimated to cost more than one billion US dollars per year. Factors for consideration in establishing birdstrike resistance requirements, and in validating compliance with these requirements are presented. Also presented are some emerging technologies that show promise in combining aeroscience and big-science for reducing the frequency of birdstrikes.
Keywords: ARTIFICIAL BIRDS; AVOIDANCE; BIRD IMPACT; BSCE; CONTROL METHODS; ENGINEERING; ENGINES; INFRASOUND; MICROWAVES; TESTING; TRANSPARENCIES; ULTRASONICS

ABBHA Ref. #: 1225
Citation: MUNTZE, T. The Bird Strike Situation at the Frankfurt Rhein/Main Airport. Bird Strike Committee Europe 23, Working Paper 44; London 13-17 May, 1996: 417-423.
Abstract: The paper briefly describes the current bird strike situation at Frankfort Rhein/Main Airport representing the total number of bird strikes from 1990-1994, the monthly distribution from 1974-1994 and the bird species which are mainly involved. Our present primary objectives are (1) Preparation of a new biotope expertise; (2) Continually extension of the long-grass areas, (3) Initiating of a formal application to obtain a permission to shoot birds - when danger is imminent - even protected birds.
Keywords: BSCE; CONTROL METHODS; DEPREDATION; GERMANY; HABITAT MODIFICATION; SHOOTING

ABBHA Ref. #: 1226
Citation: DAHL, H. Experiments on and the use of chemical agents as bird repellents on aerodromes. Bird Strike Committee Europe 15, WP 7; 4-8 May, 1981; Brussels, Belgium.
Abstract: Responses were collected from member states on chemical repellents for birds
Keywords: BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; EUROPE

ABBHA Ref. #: 1227
Citation: SU-ARETZ, S.; AGAT, I. Summary of sprayings with "RETA" repellent at Ben-Gurion Airport, 1974-79. Bird Strike Committee Europe 15, WP 7a; 4-8 May, 1981; Brussels, Belgium.

Abstract: Israel has experimented extensively with the use of a chemical repellent called "RETA" with negative results. The main aim was to remove birds from the Ben Gurion airport areas.
Keywords: BSCE; CHEMICAL/REPELLENT; CONTROL METHODS; ISRAEL

ABBHA Ref. #: 1228
Citation: SPEELMAN, R.J.; WALKER, R.H.; MCKENNY, L. Enhancement of Aircraft Subsystem birdstrike resistance. Bird Strike Committee Europe 15, WP 8; 4-8 May, 1981; Brussels, Belgium.
Abstract: Aircraft subsystem birdstrike resistance technology is being developed and applied by the USAF Wright Aeronautical Laboratories. Technology development investigations are underway in the transparency and engine subsystems areas. Advanced state-of-the-art transparency system technology is being utilized to develop improved birdstrike resistant windshield systems for several aircraft. Transparency subsystem technology investigations include development of: computer-aided procedures for birdstrike structural analysis; birdstrike hazard risk prediction techniques; design procedures for integration of birdstrike protection and high visibility into high temperature transparencies. Engine subsystems technology investigations and design analysis methods are also discussed in general terms as well as the rationale behind these efforts, the manner in which the technology development and application efforts are interrelated, and some technical voids in designing for and integration of, birdstrike resistance.
Keywords: AIRCRAFT SYSTEM; BSCE; ENGINEERING; ENGINES; MATHEMATICAL MODELS; TRANSPARENCIES

ABBHA Ref. #: 1229
Citation: JACOBI, V.E.; BEKLOVA, M. Can the pilot of an aircraft prevent a collision with birds? Bird Strike Committee Europe 15, WP 10; 4-8 May, 1981; Brussels, Belgium.
Abstract: This paper investigates whether a pilot is able to perceive birds and, by taking immediate evasive action, prevent a collision. An analysis was made of more than 2000 collisions between aircraft and birds in the Soviet Union and in Czechoslovakia. The analysis indicated that the bird generally has a better chance to avoid the aircraft than the pilot has at avoiding an individual bird.
Keywords: AVOIDANCE; BSCE; CZECHOSLOVAKIA; ENROUTE MANUEVERING; STATISTICS; USSR

ABBHA Ref. #: 1230
Citation: SMITH, T.; IWANYCKY, D. Study of Bird Strikes at Canadian Airports-1979 Summary Report. Bird Strike Committee Europe 15, WP 11; 4-8 May, 1981; Brussels, Belgium.
Abstract: A two year project undertaken to control and reduce birdstrikes on aircraft at Canadian airports is summarized. Birdstrike records and cost data are collected through visits to 14 Canadian airports and interviews with the personnel of Canadian carriers and various aviation

organizations. The total cost of birdstrikes on aircraft at Canadian airports and the individual cost at each of 14 airports are estimated. A methodology is then developed to estimate the costs and benefits of various strike reduction measures. The findings of statistical and risk analyses of birdstrikes are also presented. The report recommends more precise and comprehensive birdstrike reporting procedures, the establishment of birdstrike control committees, and the appointment of full-time coordinators, periodic surveys of airports by wildlife experts, and evaluation and research and development of bird dispersal techniques and equipment.
Keywords: BSCE; CANADA; HAZARD MANAGEMENT; LIABILITY; ORGANIZATION; REPORTING

ABBHA Ref. #: 1231
Citation: LIETH, H. Proposal for a joint project about global bird strike analysis between members of the Bird Strike Committee Europe and members of the International Society of Biometerology. Bird Strike Committee Europe 15, WP 12; 4-8 May, 1981; Brussels, Belgium.
Abstract: Proposes standardization of birdstrike statistical analysis in terms of parameters that lend to the development of predictive models.
Keywords: BSCE; REPORTING; STATISTICS

ABBHA Ref. #: 1232
Citation: DELOR, B.; BESSE, J. New Bird impact tests performed at CEAT. Bird Strike Committee Europe 15, WP 13; 4-8 May, 1981; Brussels, Belgium.
Abstract: This report presents the test results on airframe carried out in France at CEAT since 1978.
Keywords: BIRD IMPACT; BSCE; ENGINEERING; FRANCE; TESTING

ABBHA Ref. #: 1233
Citation: ROOSELEER, G. A "Know your Birds" Poster. Bird Strike Committee Europe 15, WP 14; 4-8 May, 1981; Brussels, Belgium.
Abstract: A poster was produced to enhance awareness of birds typically involved in birdstrikes on Belgium aerodromes. The posters will be distributed to Wing and Air staff.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BSCE; HAZARD MANAGEMENT; TRAINING

ABBHA Ref. #: 1234
Citation: ROOSELEER, G. A check-list for birdstrike prevention on airfields. Bird Strike Committee Europe 15, WP 15; 4-8 May, 1981; Brussels, Belgium.
Abstract: This paper presents a detailed protocol for evaluating birdstrike prevention efforts
Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION; SURVEYS

ABBHA Ref. #: 1235
Citation: ROOSELEER, G. Daily movements of Black-headed Gulls (Larus ridibundus L.) in the region of Brussels Airport. Bird Strike Committee Europe 15, WP 16; 4-8 May, 1981; Brussels, Belgium.
Abstract: Regular field work and stomach-analysis of Gulls shot at the airfield, proved that the feeding-flights over and the presence of the gulls are mainly caused by the presence of a garbage dump at the south side of the airfield.
Keywords: ATTRACTANTS; BELGIUM; BSCE; FOOD; GARBAGE; GULLS; LOCAL MOVEMENTS

ABBHA Ref. #: 1236
Citation: SHORT, J.J. Handbook on Bird Management and Control. Bird Strike Committee Europe 15, WP 17; 4-8 May, 1981; Brussels, Belgium.
Abstract: The handbook is a technical guide for pest managers involved in controlling hazardous and pest birds. It describes a systematic approach to bird management by showing how to analyze a bird problem and then selecting the simplest, most effective method(s) of control. For each method described, the handbook lists its applicability, materials and procedures for its use, advantages, disadvantages and restrictions on its use. There are also chapters on bird biology and behavior, identification, health, damage and economic aspects of hazardous and pest birds, public relations and legal aspects of bird management.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BSCE; CONTROL METHODS; SLIDE-TAPE; TRAINING

ABBHA Ref. #: 1237
Citation: SHORT, J.J. Development of a Predictive Bird Avoidance Model for Low-level Operations. Bird Strike Committee Europe 15, WP 18; 4-8 May, 1981; Brussels, Belgium.
Abstract: Avoiding bird concentrations or movements offers the most feasible method of reducing bird strikes. A predictive bird avoidance model is based on historical evidence of bird movements while a system based on radar provides a real time warning of bird hazards. Risk maps can help flight schedulers and planners avoid bird hazards, while radar advisories can identify significant bird concentrations for aircrews. The advantage of a predictive model are that flights scheduled several months in advance can consider expected bird hazards. Using a predictive model, new low-level training routes or ranges can be planned which will avoid seasonal bird hazards.
Keywords: AVOIDANCE; BIRD POPULATIONS; BSCE; FORECASTING; MAPS; MIGRATION

ABBHA Ref. #: 1238

Citation: VAN CAMP, M. Some proposals for alternative ground-covering vegetation on airfields. Bird Strike Committee Europe 15, WP 19; 4-8 May, 1981; Brussels, Belgium.
Abstract: The occurrence of birds on airfields is an increasing flight-safety problem. A partial solution of this vegetation can be found on an ecological base by environmental management. In the grassland areas of the airfield, long grass is recommended but usually requires trade-offs with other factors such as durability, cost, dominance or attractiveness to birds. This paper examines different ground covers for application on airfields.
Keywords: AERODROME DESIGN; BSCE; CONTROL METHODS; HABITAT MODIFICATION; LANDSCAPING; LONG GRASS

ABBHA Ref. #: 1239
Citation: TURESSON, Lars-O. Code of practice of BSCE. Bird Strike Committee Europe 15, WP 20; 4-8 May, 1981; Brussels, Belgium.
Abstract: At BSCE 14 (WP 5), a proposal for the content of BSCE Code of Practice was presented. This working paper is a trial to frame a document with two main sections: a history and achievements and a second section with appendices with specific information.
Keywords: BSCE; ORGANIZATION

ABBHA Ref. #: 1240
Citation: DAHL, H. BSCE 15 Aerodrome Working Group Code of Procedure. Bird Strike Committee Europe 15, WP 21; 4-8 May, 1981; Brussels, Belgium.
Abstract: Participants provided information on the procedures used to scare away birds from airfields; the ecological survey of the environs; and, patrolling of the airfield.
Keywords: BIRD CONTROL TEAM; BSCE; CONTROL METHODS; ORGANIZATION; SURVEYS

ABBHA Ref. #: 1241
Citation: DALLO, E. The international organization of the BSCE. Bird Strike Committee Europe 15, WP 24; 4-8 May, 1981; Brussels, Belgium.
Abstract: This paper discusses the connections with the BSCE and other organizations such as the International Civil Aviation Organization, the European Civil Aviation Conference and the European Economic Community.
Keywords: BSCE; ICAO; ORGANIZATION

ABBHA Ref. #: 1242
Citation: SOPER, W.P.C. Design Manual for Aircraft Resistance to Bird Impact. Bird Strike Committee Europe 15, WP 23; 4-8 May, 1981; Brussels, Belgium.
Abstract: Describes layout and expected contents of a design guide for bird tolerant aircraft components.
Keywords: BSCE; ENGINEERING; GUIDANCE; HAZARD MANAGEMENT; MATHEMATICAL MODELS; STATISTICS

ABBHA Ref. #: 1243
Citation: HILD, J. New Organization of German Board Birdstrike Prevention. Bird Strike Committee Europe 15, WP 25; 4-8 May, 1981; Brussels, Belgium.
Abstract: This paper discusses the new, legally binding form to address bird hazards to German aircraft.
Keywords: BSCE; GERMANY; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 1244
Citation: THORPE, J. Accidents and serious incidents due to bird strikes to transport aircraft. Bird Strike Committee Europe 15, WP 26; 4-8 May, 1981; Brussels, Belgium.
Abstract: Accidents and serious incidents throughout the world during 1979 and 1980 are briefly summarized. In these two years, there have been no hull losses and no injuries due to bird strikes to this class of aeroplane. This is a considerable improvement on previous years, but it is not known if this is due to greater awareness, improved bird control measures, or is purely random.
Keywords: BSCE; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 1245
Citation: KUYK, F. Distribution patterns of gulls around Schipol airport and Leeuwarden air base in the period August 1980 - April 1981. Bird Strike Committee Europe 15, WP 27; 4-8 May, 1981; Brussels, Belgium.
Abstract: The Dutch Working Group for the Prevention of Collisions between Birds and Civil Aircraft conducted a literature survey on behavioral aspects and the distribution of gulls in the Netherlands. This information is deemed essential to combating the bird strike hazards posed by gulls.
Keywords: ATTRACTANTS; BIRD POPULATIONS; BSCE; GULLS; NETHERLANDS

ABBHA Ref. #: 1246
Citation: NISS, G. Bird strike testing of the Viggen aircraft at the Holloman test track, New Mexico, USA. Bird Strike Committee Europe 15, WP 28; 4-8 May, 1981; Brussels, Belgium.
Abstract: During the autumn of 1980 seven bird strike tests were made at the test track, five of them in combination with escape testing and two as separate tests. The aim of the tests was to verify the bird proofing of the windshield canopy and structure. For bird weights around 2 lbs the windshield strength seems to agree with the existing curve while a smaller bird punched a hole at a much lower energy level. Background, test procedures and conclusions are presented together with a few photos showing damage to the different test objects.
Keywords: BIRD IMPACT; BSCE; ENGINEERING; TESTING; TRANSPARENCIES

ABBHA Ref. #: 1247

Citation: EFANOV, B.N.; MALAKOV, E.N. Results of the analysis of birdstrikes to Aeroflot registered aircraft for the period 1970 to 1979. Bird Strike Committee Europe 15, WP 29; 4-8 May, 1981; Brussels, Belgium.
Abstract: This paper provides an examination of the results of studies on the birdstrike problem at aerodromes within the European territories of the USSR.
Keywords: BIRD POPULATIONS; BSCE; CIVIL AVIATION; CONTROL METHODS; STATISTICS; USSR

ABBHA Ref. #: 1248
Citation: ANONYMOUS. Identification of feather remains. Bird Strike Committee Europe 15, WP 30; 4-8 May, 1981; Brussels, Belgium.
Abstract: Provides addresses of experts to identify bird remains from bird strike mishaps.
Keywords: BSCE; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 1249
Citation: ANONYMOUS. 15th Meeting of the Bird Strike Committee Europe. Bird Strike Committee Europe 15; Brussels, Belgium, 4-8 May 1981.
Abstract: The BSCE is a joint civil-military committee and meetings are arranged every 18 months.
Keywords: BIBLIOGRAPHIC; BSCE; SYMPOSIA

ABBHA Ref. #: 1305
Citation: THORPE, J. The Implications of Recent Serious Bird Strike Accidents and Multiple Engine Ingestions. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: The paper provides details of three recent accidents to multi-engined aircraft due to birds resulting in the deaths of 58 people. These were to four-engined military aircraft having implications for the airline world. The paper also examines 10 years of data from incidents where UK registered airliners suffered ingestion in more than one engine. Analysis of the 73 cases (1.7% of 4,268 reported bird strikes) shows that the rate for this type of incident varies from 3 per million flights on twin-engined airliners to 8 on three-engined airliners and 5 on four-engined. In one case, on the latter, all four engines had to be changed. The strike rate is significant in safety terms. Gulls (Larus spp) were involved in 47% of the incidents followed by lapwings (Vanellus vanellus) with 15% ie "controllable" species. These percentages are similar to those for all bird strike incidents. Bird population data shows that the UK inland wintering population of both small and large gulls has risen steadily during the last 40 years, thus increasing the likelihood of such incidents. The threat from small birds e.g., starlings (Sturnus vulgaris) to turboprop aircraft, cannot be overlooked. Comparison with data from all bird strikes revealed that multi-engine strikes were more likely at dawn and dusk, but less likely during the day, possibly when flocks of birds were more easily seen by airport staff. The majority (76%) of incidents were at a height that was compatible with the aircraft being on or within the airport boundary. The paper concludes that the current level of risk can be reduced by the more rigorous

application of established bird control measures on airports using proven technology supported by scientific assessment of the effectiveness of new technologies in order to reduce the likelihood of bird/aircraft encounters. With the CAA and FAA's declared intention of improving aviation safety during the next decade, bird hazards are one of the areas of risk.
Keywords: BSCUSA; CIVIL AVIATION; STATISTICS

ABBHA Ref. #: 1306
Citation: ROBINSON, M. The Potential for Significant Financial Loss Resulting from Aircraft Bird Strikes in or Around an Airport. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Following a brief introduction, this paper outlines some arguments concerning the perceived need for maintaining an adequate bird dispersal program complemented by an adequate "airport and/or air traffic control legal liability" insurance program. It includes reference to known losses caused by bird strikes and an analysis suggesting that in an increasingly litigious world, bird dispersal measures must be vigilantly maintained.
Keywords: BSCUSA; INSURANCE; LEGAL ISSUES; LIABILITY

ABBHA Ref. #: 1307
Citation: ALLAN, J. Research into the Bird Strike Problem in the UK: Current Status and Future Prospects. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: This paper reviews the current projects being undertaken by the United Kingdom's Central Science Laboratory Birdstrike Avoidance Team, and identifies areas where further research is planned or should be considered. Current research topics include: 1) the International Birdstrike Research Group, 2) Development of Geographic Information Systems for Birdstrike Avoidance, 3) Use of DNA in bird remains identification, 4) Development of systematic bird hazard audits for major UK airports, 5) Guidelines for airport developers and planners, and 6) Analysis of the UK birdstrike database. Future projects planned are: 1) Seasonal variation in the distribution, size and abundance of bird flocks, 2) Evaluation of techniques to exclude birds from landfills, and 3) Analysis of factors which encourage bird use of reservoirs.
Keywords: AERODROME DESIGN; AVOIDANCE; BSCUSA; CONTROL METHODS; DNA ANALYSIS; EXCLUSION; IDENTIFICATION

ABBHA Ref. #: 1308

Citation: WARNER, J.; MACKINNON, B. Introduction to Bird Hazard Awareness Video-"Crossed Paths". Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Transport Canada and the Boeing Company have cooperatively produced a new bird hazard awareness video that is intended to update the aviation industry and its stakeholders on the issue of bird hazards to aircraft. The video provides general information on bird hazards, engine and airframe standards, and wildlife control techniques to the public, airport operators, pilots, flight training schools, and air traffic control personnel. Transport Canada will make available copies of the video for those who can benefit from it.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BSCUSA; FILM/VIDEO

ABBHA Ref. #: 1309
Citation: ESCHENFELDER, P. Incident at Latrobe--collision Between Aviation and Wildlife Interests. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: This aircraft accident involving a deer and a Beechcraft 1900 aircraft in December 1996 is indicative of and represents issues in conflict in the USA between aviation safety interests and expanding wildlife populations. A short briefing of the accident will be made along with discussions regarding warnings, governmental involvement, airport and flight crew actions. The accident is a microcosm of the problems faced today and a dress rehearsal for the larger accident to come.
Keywords: BSCUSA; CIVIL AVIATION; LEGAL ISSUES; MISHAP INVESTIGATION

ABBHA Ref. #: 1310
Citation: GIL, G. Flight Crew Guidance--What Is it and Where Is It? Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Discussion will be made of the information available today to flight crews regarding the seriousness of wildlife hazards and what crews can do to avoid it. Principally the Air Line Pilots Association will be soliciting input from knowledgeable participants in the conference to develop further guidance for crew behavior in the face of wildlife hazards.
Keywords: AVOIDANCE; BSCUSA; WARNING SYSTEMS

ABBHA Ref. #: 1311
Citation: SMITH, A.; KELLY, T.A.; ZAKRAJSEK, E. Bird Avoidance Model Development at Dare County Bombing Range, North Carolina and Moody AFB/Grand Bay Range, Georgia. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Bird Avoidance Model (BAM) developed for Dare County Bombing Range. An outline is given of the remote sensing equipment used to quantify bird strike risk. The remote sensing equipment is currently collecting data at Moody AFB and Grand Bay Range, Georgia. The collected data will be used for a BAM for both the bombing range and the airfield to reduce bird strikes. This project is the first to develop a BAM for an airport.

Keywords: AVOIDANCE; BSCUSA; MAPS; MILITARY AVIATION

ABBHA Ref. #: 1312
Citation: SHAMOUN-BARANES, J.; LESHAM, Y.; YORAM, Yom-T. Development of a Real-time Warning System for Bird Movements in the Middle East. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: As one of the most important bottlenecks of migratory flyways in the world, the risk of serious bird strikes is very high in Israel. Lesham conducted research mapping migratory bird paths, altitudes and chronology of diurnal migration. The resulting conclusions reduced serious bird strikes in the Israeli Air Force (IAF) by 88% and has saved the IAF $390 million (not including the pilot's lives) between 1984-1996. Presently we have initiated a joint project being undertaken by Tel Aviv University, The Society for the Protection of Nature and the U.S. Air Force Academy to develop a GIS-based Bird Avoidance Model (BAM) for the Middle East and Europe. Such a model will provide risk assessments of bird movements in correlation with flight planning. The USAF Academy has been developing a continental U.S. BAM, while we are developing in cooperation with the academy a Middle East and Europe BAM. Both systems will be compatible, creating a global system. The main focus of the Middle East and Europe model will be the effect of meteorological and climatic events on bird movements. This project is sponsored by EMC Cooperation, "The Storage Architects", Boston. Leshem recently met with representatives of the Jordanian Air Force and the Turkish Air Force who showed great interest in cooperative projects to improve flight safety in the area. In the future, we will develop a bird and weather radar network in Israel and throughout the Middle East. Such a network will provide a real time warning system throughout the area and pertinent bird and weather data from the radars will be integrated into the BAM.
Keywords: AVOIDANCE; BSCUSA; ISRAEL; MAPS; MILITARY AVIATION

ABBHA Ref. #: 1313
Citation: WATERMANN, U. Airport Falconry - Pros and Cons. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Airport falconry is the correct use of raptors to eliminate bird hazards to aircraft at airports. It came into being after jets replaced prop driven planes. The first successful programs were run in Scotland. From here airport falconry spread to other European countries. The first attempts at airport falconry in North America were done by Frank Beebe at Patricia Bay Airport, Victoria BC. It worked! Subsequently, contracts were opened to bids and awarded to unproven contractors on the merit of their own bids. Shortcuts were used and the promising new system of airport falconry was dragged down. In some cases bird strike levels rose above pre-airport falconry levels (e.g., Pearson International Airport, Toronto). Authorities should note that qualified companies have been pushed aside by the practice of "low-balling" and realize that hiring contractors with proven track records will save money and lives in the end. To hire low-ballers, just to be able to state "yes, we have a falconer on duty", wastes money and can result in uncounted millions of dollars in damage. Airport falconry in connection with alternative scare methods is the best method to combat bird problems caused by gulls,

starlings, swallows, blackbirds, crows, etc. Huge amounts of money are wasted in bureaucracy. A contract should read: "Get rid of the birds or we will get rid of you".
Keywords: BSCUSA; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1314
Citation: COOKE, M. Results Obtained Using Trained Falcons as Part of an Integrated Bash Program at Scott AFB, Illinois. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: The World Bird Sanctuary working at Scott AFB developed and tested the effectiveness of flying trained falcons as part of the BASH program. Scott AFB is on the Mississippi flyway, and during the spring and fall migration periods, huge flocks containing thousands of blackbirds and starlings fly directly over the airfield at heights of 200-1000 feet causing severe disruption to aircraft activity. The objective was to establish a zone over and around the airfield which invading birds would avoid due to the threat posed by a falcon flying in that zone. Five peregrine falcons (1 female, 4 males) were used to ensure full coverage from sunrise to sunset. Weather conditions influenced flock behaviors with the longest invasion periods occurring when weather fronts were moving through the area. It was demonstrated that the sight of a peregrine falcon in the air, up to a mile away, would cause a migrating flock to change direction away from it. By positioning the flight of the falcon relative to invading flock direction and wind condition, it proved possible to divert most migrating flocks away from the airfield.
Keywords: BSCUSA; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1315
Citation: ROSSELL, S. The Use of Trained Hawks and Falcons as Part of a Bird Control Unit. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: No matter what steps are taken to improve or alter habitat in or around an airfield, there will still be some birds which, for whatever reason, will continue to frequent the area. Scaring these birds so that they will leave basically consists of providing a threat level which is greater than the desire of the birds to use a particular area. The use of trained hawks and falcons when properly carried out can be extremely effective for the simple reason that birds have an instinctive fear of certain raptors which doesn't diminish over time as can happen with other, more commonly practiced, methods of bird scaring. This presentation will outline what falconry is, how it can be used to help in the fight against bird strikes and what is involved in instigating a falconry program.
Keywords: BSCUSA; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1316
Citation: PINOS, A. New ICAO Bird Strike Reporting System. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)

Abstract: This paper provides a brief summary of the present status of the International Civil Aviation Organization (ICAO) Bird Strike Information System (IBIS). It discusses the modernization of the system as well as the reporting and processing of bird strikes by the updated system. Described are the outputs now available through ICAO state letters and special requests including ICAO's 1995 World Bird Strike Analysis.
Keywords: BSCUSA; ICAO; REPORTING; STATISTICS

ABBHA Ref. #: 1317
Citation: DOVE, C. Bird Strike Identification and Proper Collection of Feathers. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Proper collection of feather samples is important to the accurate identification of bird strike remains. This presentation will review the feather identification process and discuss problems that have been encountered with feather samples. A 5-minute video featuring Roxie Laybourne also will be shown. The video was part of a recent display on feather identification exhibited at the Museum of Natural History, Smithsonian Institution.
Keywords: BSCUSA; COLLECTION PROTOCOL; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 1318
Citation: PRAST, W. Extension of BRIS with an Interactive Geographic Information System on Bird Migration and a Computer-assisted Key for Macroscopic Feather Characters. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: BRIS (Bird Remains Identification System) is a user-friendly interactive multimedia information system on CD-ROM, which assists in the identification of bird remains, using microscopic characters of the downy part of contour feathers. BRIS, based on Linnaeus II software, contains information on 200 species form Europe and the Middle East, potentially involved in bird strikes. In conjunction with the CD-ROM, additional professional identification service in Europe is possible by a joint service of laboratories at the University of Amsterdam and Tel Aviv University. We intend to expand BRIS with a macroscopic (whole feather) expert-system including: (1) a bird movement/migration database and (2) a DNA identification database. We are currently working on two pilot studies BiFIS and BiMIS. BiFIS is an expert-system to be connected to a future edition of BRIS, containing photographs and an identification key of the most important types of whole feathers for species involved in bird strikes. Species which are difficult to identify using microscopic characters will be studied first. The pilot study focuses on a limited number of species. BiMIS is a project to produce a database detailing bird movements in relation to place, time and conditions. These data are at the present scattered among institutes throughout Europe, often in unusable or difficult-to-access form. A European network of experts will be formed to collate these data and to enter them into a single European database and to use this information to develop an interactive Geographic Information System on bird mobility. We are now actively recruiting research groups to join the BRIS-project to help expand the system. We actively solicit comments, suggestions, and input from ornithologists and other relevant specialists.

Keywords: BIOCHEMICAL; BSCUSA; ELECTRONIC MEDIA; FEATHERS; IDENTIFICATION

ABBHA Ref. #: 1319
Citation: MERRITT, R.L. A Review of Bird Strike Hazards at Dallas/Fort Worth International Airport. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: At approximately 1636 on 7 January 1997, an American Airlines MD-80 struck a flock of birds during take-off from Runway 36R at Dallas/Fort Worth International Airport (DFW). The aircraft reported a multiple strike and immediately returned to the airport, landing without further incident on Runway 36L. Approximately 300 starlings were found on the runway at the WK taxiway intersection. This incident along with increasing reports of bird hazards at DFW during January and February 1997, resulted in a Geo-Marine, Inc., biologist reviewing DFW bird hazard issues. The review, conducted the week of 3 March 1997, was contracted by the Facilities Planning Department of DFW, and identified several areas of concern. First, the FAA bird strike database has only captured a fraction of the bird strikes reported at the airport. Second, DFW does not have a comprehensive bird/wildlife management plan that has been reviewed or approved by the FAA. Third, the current agricultural out-lease program and wetlands on the airport are contributing to hazardous bird conditions, especially during fall and winter months. Fourth, ecological assessments provided by USDA/APHIS/ADC biologists covered short periods of time and may have overlooked important bird hazard dynamics. And finally, DFW has unique remote sensing technology available (Terminal Doppler Weather Radar and Next General Weather Radar) that may be useful in developing bird hazard advisories. Following this report and other reviews, the Southwest Regional Office of the FAA required DFW to develop a wildlife management plan to be included in the Airport Certification Manual.
Keywords: AERODROME SURVEYS; BSCUSA; DALLAS-FORT WORTH IAP; NORTH AMERICA; UNITED STATES

ABBHA Ref. #: 1320
Citation: FEINBERG, P. Syracuse Hancock International Airport Ecological Study. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Sixty-three bird strike reports at SHIA had been filed with the FAA over the past 7 years. Reported bird strikes indicated that the airport was experiencing a wildlife hazard management problem. The FAA Airport Certification/Safety Inspector determined that the airport must conduct an ecological survey. The primary objectives of the study were: (1)determine the extent of wildlife activity at the airport; (2)provide the information necessary to determine if more intensive control procedures to mitigate wildlife activity are necessary and (3)identify the features and activities on or near SHIA which contribute to wildlife hazards to aviation. The occurrence of wildlife on airport grounds was documented by weekly field surveys from 25 January 1996-16 January 1997. Observations were conducted from 11 fixed observation points which commanded a complete view of the airport grounds. Data for high species groups (those species and groups with the highest potential for bird/aircraft interactions) were sorted according to airport zone and date. Raptors, blackbirds and starlings, gulls, waterfowl, doves and wild turkeys were identified as species groups with a high probability for bird/aircraft interactions which could result in equipment damage or loss of life. Continued monitoring was

recommended to ensure that changes in airport wildlife use which may create a hazard do not go unnoticed. Continued monitoring will provide a detailed description of the problem, support remedial action, and provide a means by which the effectiveness of the established controls can be measured.
Keywords: AERODROME SURVEYS; BSCUSA; NORTH AMERICA; SYRACUSE HANCOCK IAP; UNITED STATES

ABBHA Ref. #: 1321
Citation: HALL, T.C. Wildlife Hazard Management Plans. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Most commercial airports are bound to FAR 139.337, Wildlife Hazard Management, which gives airports guidance on the need for ecological studies and wildlife hazard management plans. The ecological study provides the details about an airport's environment necessary to reduce wildlife hazards and to complete a wildlife hazard management plan should FAA determine it is necessary. In 1996, the USDA, Animal Damage Control Program in California completed a Wildlife Hazard Management Plan for Sacramento International Airport in collaboration with their personnel. This plan was approved by FAA favorably and has been implemented. The plan has provided strong guidance for the airport and assisted in land-use decisions near the airport. Furthermore, the plan has been sent to over 100 airports worldwide and provided the foundation for other plans. Wildlife hazard management plans should include sections on authority (roles and responsibilities), habitat management objectives, laws and permit, wildlife control resources available to the airport, wildlife control procedures, training, and evaluation. A number of appendices such as the ecological study, report forms, maps, species-specific wildlife control, and wildlife disease precautions are also good to include.
Keywords: BSCUSA; HAZARD MANAGEMENT; PLANS

ABBHA Ref. #: 1322
Citation: DAVIS, R.A.; DAVIS, T.J.; HARRIS, R.E. Evaluations of Bird Control Techniques - the Need for Full-scale Field Trials. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Many products and techniques are advanced as being helpful at controlling birds in various situations. While it is important that the efficacy of the active agents in these techniques be tested scientifically under controlled conditions, it is also important that full-scale field trials be undertaken. Techniques and products that are effective in confined controlled conditions may not be useful in real-world situations. To illustrate this point, this paper presents the results of a 3-week test (20 June-7 July 1995) of the effectiveness of the taste aversion agent ReJeX-iT (active ingredient, methyl anthranilate) for controlling gulls at a major urban landfill near Toronto. In controlled experiments, the application of ReJeX-iT to potential food items has been shown to render them inedible to birds. However, the use of ReJeX-iT was ineffective in reducing gull numbers during the test at this landfill. The reasons for this result relate to the inability to economically cover the food waste at a large landfill on a consistent and continuous basis and to the lack of gull behavioral responses to treated food items. Without the full scale field trials, these limitations would not have been understood. KW: control methods KW:

chemicals
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS; REPELLENTS

ABBHA Ref. #: 1323
Citation: VOGT, P. Effective Bird Management on Airports with ReJeX-iT TP-40. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: The fogging of ReJeX-iT TP-40 offers an efficient method for the dispersal of nuisance birds from many diverse areas. The amount of the active ingredient is greatly reduced over any treatment of the food source for repellency. The method is direct and if needed, it can be automated in many applications. As with many methods, combination with other bird management tools increases its effectiveness even further. While the application by fogging works immediately, it takes several applications to get long term results. Usually 4-6 applications at 2-4 gallons per 100 acres are sufficient to repel established flocks of birds for the season. For best results, it is important to expose as many birds as possible to the aerosol in the first two applications. Any successive application at a reduced rate is more focused to convince the birds not to return to the area. For use on airports generally large model foggers are used that can efficiently fog ReJeX-iT TP-40 at a rate of 30-60 gallons per hour and cover a wide area in a short time. For hangars, warehouses, and other open structures, small electric foggers can be used with great success.
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS; REPELLENTS

ABBHA Ref. #: 1324
Citation: WEBER, R.I.C.H.A.R.D.; CLARK, L.A.R.R.Y.; STEVENS, G.W.E.N. Design and Preliminary Results from a Radar-activated Deterrent System Using Methyl Anthranilate AU: Weber, Richard AU: Clark, Larry. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Human hazing is typically effective at deterring birds, especially waterfowl, from landing on process ponds if vigilance is maintained. Automated hazing techniques such as propane cannons are effective for a short period of time, but birds become habituated to predictable or constant activation. Duplicating the effectiveness of human hazing requires activating deterrents only when birds are present. We have accomplished this through the use of radar. Knight Piesold developed and tested a radar-activated system in 1990. Results of the system were inconclusive regarding the hazing effect, but radar was shown to be significantly more effective at detecting birds and was effective at night. In 1995, PacifiCorp retained Knight Piesold with the assistance of the National Wildlife Research Center (NWRC) to develop and install a radar-activated system on two process ponds of 90 acres and 180 acres, respectively. This system incorporates traditional hazing devices and a chemical deterrent, methyl anthranilate (MA). Hazing devices include a sound system and numerous "screamer" (pyrotechnic) launchers. A computer masking program has been incorporated to allow flexibility in alarm zone manipulation. In cooperation with PacifiCorp and NWRC, a research study is being conducted to determine the effectiveness of MA over a large area. Ongoing laboratory work includes chamber testing concentrations of MA to determine avian threshold sensitivity levels. Field work includes determining spray dispersal patterns and MA concentrations achieved downwind of the sprayers.

The results will be used in the field to adjust concentrations of MA and the number and locations of sprayers to optimize coverage.
Keywords: BSCUSA; CHEMICAL/REPELLENT; CONTROL METHODS; PYROTECHNICS; REPELLENTS

ABBHA Ref. #: 1325
Citation: KELLY, T.C.; BOLGER, R.; MURPHY, J. High Intensity Sound and a Barrier Technique in Bird Hazard Control. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: A commercially available high intensity sound source was used in an attempt to reduce bird hazards at Dublin Airport. The technique was deployed against overflying, feeding and loafing Corvidae (Corvus frugliegus), Laridae (Larus ridibundus) and Vaneillinea (Vanellus vanellus). While all bird species showed an initial minor response (e.g., alertness), the control effects were nonexistent. The high frequency sound was also directed against a nesting colony of rooks (C. frugliegus). However, the number of nests increased over the period during which the experiment was conducted. Infrastructural works lead to exposed soil and ponding which attracts gulls and plovers. It has been demonstrated that these negative impacts can be overcome through the use of "Humming Twine" which, when attached to bamboo canes, is an easily deployed, highly effective and cheap deterrent.
Keywords: BSCUSA; CONTROL METHODS; SOUND

ABBHA Ref. #: 1326
Citation: WEDEMEYER, K.L.; FOX, P.N.; SLEDGE, M.A. Goose Management at Elmendorf Air Force Base, Alaska after the 1995 "AWACS" Plane Crash. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: After a geese/plane crash killed 24 people in September 1995, Elmendorf Air Force Base concentrated BASH efforts on 1) community efforts; 2) practical research; 3) habitat changes and; 4) creating a Bird Exclusion Zone of intense dispersal. Community efforts were focused on organizing wildlife agency and aviation working groups to develop an urban goose management plan to address flight and traffic hazards, and droppings on ball fields. The resulting plan may be the most powerful tool in decreasing the flight hazards, but requires effort and patience over an extended period. Our goose movement research identified locations supplying the highest proportions of geese frequenting the airfield for the plan. Analyzing what draws birds safety, food, water, or shelter drove both the habitat changes and dispersal efforts. Research includes native stiff, tall and unpalatable airfield vegetation, testing radar bird detection and tracking urban geese movement patterns. Our 1996 around-the-clock effort using graduated levels of force to deter geese and using passive devices to create the illusion of animated danger resulted in 1,200 dispersals of over 22,000 birds, primarily geese. Changes in habitat and methods decreased numbers of geese entering the exclusion zone, greater ease in dispersing, and a need for fewer dispersal personnel. Bird strikes of all kinds decreased by 80%. These changes were based on our specific circumstances which differ most markedly from other airports in the notable lack of wetland breeding habitat. However, the general principles can be applied to any airport.

Keywords: AERODROME SURVEYS; ATTRACTANTS; BIRD POPULATIONS; BSCUSA; CONTROL METHODS; GEESE; MILITARY AVIATION; PUBLIC RELATIONS

ABBHA Ref. #: 1327
Citation: YORK, D.L.; CUMMINGS, J.L.; WEDEMEYER, K.L.; JOHNSON, R.E.; BELANT, J.L.; BOURASSA, J.E.A.N. Movements, Distribution, and the Effects of Hazing on Radio-collared Canada Geese at Elmendorf Air Force Base, Anchorage, Alaska. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: We monitored radio-equipped and/or neck-collared lesser Canada geese (Branta canadensis parvipes) during August-October 1996 in Anchorage, Alaska to identify flocks that frequent Elmendorf Air Force Base (EAFB); ascertain local movements, flock cohesion, and post-molt dispersal; and to evaluate the effectiveness of hazing at EAFB. Telemetry data and visual observations of collared geese indicated the majority (55%) of geese observed at EAFB were from nesting sites within 10 km of EAFB. One hundred twenty-one marked geese from 14 capture locations were observed once on EAFB, and 63% of geese observed >2 times on EAFB were from sites within 10 km of EAFB. A significant ($P < 0.01$) relationship was found between proportion of geese invading the EAFB air dome and distance captured from EAFB. However, other factors such as overcrowding and forage availability at heavily used sites could be affecting movements onto EAFB. After attaining flight, geese from north Anchorage initially moved greater distances from molt locations to feeding sites. In addition, marked geese were located with other members of their original flock during 70% of visual observations, indicating the maintenance of discreet, identifiable flocks after dispersal from molt and nesting locations. Intensive hazing was successful in keeping geese out of an exclusion zone surrounding the runways on EAFB, and effective in preventing the majority (67%) of geese from returning. However, hazed geese did not disperse far from the exclusion zone. We also documented peak movements of geese on EAFB during afternoon hours between 1200-1759 hr (46% of observations).
Keywords: AERODROME SURVEYS; BIRD POPULATIONS; BSCUSA; CONTROL METHODS; GEESE; MARKING/BANDING; MILITARY AVIATION; NORTH AMERICA

ABBHA Ref. #: 1328
Citation: STEFFEN, R.F. Combined Anti-bird Collision (CABC) Light System as an Aircraft Early Warning Device to Prevent Bird Strikes. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Numerous years' study of all relevant documentation has shown that bird strikes can only be avoided when the attention of the birds can be caught, information as to the direction and speed (or distance) of the aircraft can be transmitted, and habituation effects eliminated. These four factors plus the "sun effect" are the keys to prevent bird strikes; biologists and ornithologists agree that birds are visual animals (one calls them also flying eyes) with an absolute instinct for an escape route. Due to the fact that true dimensional sight is missing, with the exception of nocturnal hunters such as owls, birds are almost always surprised by fast aircraft. In an emergency, many birds try to fly a deviation maneuver directly into a bright landing light, which

they interpret as being the sun with an obstacle-free escape route. This behavior I call "sun effect". In this case, a collision is almost inevitable. A solution is offered in the form of two stroboscope lamps, horizontally mounted approximately 2-20 m apart on the fuselage or wings, to deliver direction information. Both these flashing lights begin to blink with increasing frequency during taxiing for take-off, whereby an acceleration is shown and attention increases up to 200 times. Apart from this, the birds are frightened away by the two penetrating stroboscope lights and the sun-effect is eliminated. After landing, the frequency of the flash is reduced, showing a speed reduction. The habituation effect is eliminated by this change of rhythm and a continuous asynchronous flashing of + 100 ms.
Keywords: AIRCRAFT APPEARANCE; BSCUSA; ENGINEERING; FLASHING LIGHT; LIGHTS

ABBHA Ref. #: 1329
Citation: STEPHAN, P.M. Airborne Radar for Autonomous Bird Strike Avoidance. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Detection of threatening birds by existing military airborne radar is being investigated. Conceptual designs are constrained to software additions to minimize retrofit cost, and analyzed to predict performance. Preliminary results indicate that pilot cueing sufficient to prevent bird strikes is feasible. Benefit is thought to be maximum for low and fast flight outside the airport environment. There are natural extensions to other flight regimes, and possibly to infrasound.
Keywords: BSCUSA; DETECTION; MILITARY AVIATION; RADAR

ABBHA Ref. #: 1330
Citation: OCHS, A. Vestibular Disturbance Induced by Microwave Radiation. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Short (50 usec) s-band microwave pulses activate the vertebrate auditory system producing responses equivalent to those elicited by an auditory click stimuli. Several lines of investigation suggest that the absorbed energy produces a hydrostatic pressure wave within the auditory cochlea, transiently deforming the basilar membrane in the same manner as an ordinary auditory click stimulus, causing hair cell deflection and the resultant excitation of the auditory nerve. The vertebrate inner ear is composed of three separate motion detection systems, each using a deflection of hair cells as a primary transduction mechanism. In addition to vibration detection by the auditory system, three orthogonal semicircular canals detect rotary acceleration and two otoliths detect linear acceleration. The characteristic frequencies of the vestibular system are matched to the range of rotation frequencies of the head. In primates, this is from 0.01 Hz to 5 Hz. Although no direct evidence exists for avian species, we speculate that the range extends to 10 Hz. We hypothesize that microwave radiation will act on vestibular sensors as it does on the cochlea. In this case, a bird might well experience a sense of nausea similar to that of a human when undergoing a vestibular disturbance. To test the hypothesis, we propose to deliver

50 usec bursts of s-band microwave radiation at vestibular pulse rates and observe the behavior of an unrestrained bird in a cage. A behavioral test is proposed as there is no non-invasive physiologic test for a vestibular response.
Keywords: BIRD POPULATIONS; BSCUSA; CONTROL METHODS; MICROWAVES; PHYSIOLOGY

ABBHA Ref. #: 1331
Citation: LENHARDT, M.L.; GENOVA, J. How Mammals Hear Microwaves and Why Birds Shouldn't. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Microwave hearing has been documented in a number of mammalian species. It was first reported in humans and described as high frequency clicks, buzzes or hisses. Individuals with hearing loss above 5000 Hz do not hear microwaves, while those with middle ear problems do. These observations led investigators to speculate that the mechanism of microwave hearing involved bone conduction. Most experts now agree that microwave stimulation results in thermoelastic expansive waves that are detected by the cochlea. The frequency of the auditory waves are independent of the microwave stimulation and are likely a function of brain diameter. To test this possibility, microwave induced brain fundamental frequencies were computed for mammals varying in brain diameters from elephants to small rodents. For brain diameters 4 cm and greater, the fundamental frequency generated in a spherical model of the brain, with a constrained boundary, was within the high frequency resolving power of the ear. For mammals with brain diameters smaller than 4 cm, the high frequency limit of the ear was consistent with the resonant frequency predicted in a stress-free spherical model. Further, when microwave induced cochlear microphonics were reported in mammals, the frequency of the microphonic was similar to the predicted resonant frequency of the brain. The cochlear microphonics were much higher than predicted from skull resonance. Finally, birds with small diameter brains and skulls, have predicted resonance well outside the frequency response of their inner ears.
Keywords: BIRD POPULATIONS; BSCUSA; MICROWAVES; PHYSIOLOGY

ABBHA Ref. #: 1332
Citation: LENHARDT, M.; OCHS, A.; SISMOUR, E.; GENOVA, J.; KELLEY, M. Infrasonic and Microwave Hearing in Six Avian Species. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Birds have well developed hearing but this sense has not been adequately exploited in reducing the number of bird/aircraft strikes. If sound is presented in novel ways, birds may attend longer and hence make use of auditory cues in avoiding aircraft. Infrasound can be detected in some species as pigeons and may be available to other species when delivered as substrate vibration. We report preliminary avoidance behavior to a combination infrasonic and low sonic frequencies in waterfowl. It is also possible that birds can detect microwave energy as sound, although not by the same mechanism as mammals. Microwave-evoked bioelectric activity was recorded from surface electrodes implanted in chickens, ducks, doves and turkeys. These microwave induced potentials were very similar to click auditory potentials recorded in the same animals. From these observations we concluded that birds were detecting microwave activity as sound. It is not possible for the bird inner ear to detect the sound elicited by their brain resonance

directly; however, the bird has a connection between the brain fluid and the inner fluid that is much wider in diameter than in mammals. Further, the cochlear windows are larger in birds in reference to the cochlear length. We propose that there is a bulk fluid movement when the brain is resonating that is conveyed to the inner ear, which in turn distends the cochlear windows setting the middle ear into its natural resonant frequency. This idea is supported by some evoked potential records in which cochlear microphonics are visible. Otoacoustic emissions are now being explored to verify this middle ear resonance mechanism of microwave avian hearing.
Keywords: BIRD POPULATIONS; BSCUSA; CONTROL METHODS; INFRASOUND; PHYSIOLOGY; SOUND

ABBHA Ref. #: 1333
Citation: GENOVA, J.J. Airborne Microwave Avian Warning System for Bird Strike Reduction. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Raven, Incorporated, is developing a system which will greatly reduce the incidence of bird/aircraft collisions, thereby reducing the cost and improving the safety of aviation while making airfields safer for birds. Unlike other bird strike mitigation techniques, the Raven concept is to assist the birds in avoiding the aircraft. Birds detect and, thus, avoid aircraft by means of visual and audible stimuli. Raven is developing an airborne microwave avian warning system which makes it easier for birds to hear' the approaching aircraft via the transmission of audible microwaves from the aircraft during take off and landing. The objective of this study is to measure the costs and benefits of this concept. The literature search, theoretical analysis, and laboratory testing showed concept feasibility. Field tests results quantitatively measured bird avoidance behavior associated with an approaching ground vehicle with and without an audible alert stimulus. The project results to date show that birds can audibly detect microwaves and that the presence of the audible cue lead to modified avoidance behavior of birds in the wild. The common problem of habituation is eliminated by coupling the audible cue with the present danger of the potential collision. This project demonstrates the advantage of examining the aircraft as perceived by the birds as a means to reducing bird strikes in an environmentally safe manner. The use of audible microwaves to alert birds is a very promising new approach to bird strike reduction. The concept of a clear and present danger can be used to develop bird strike reduction techniques to which birds do not habituate.
Keywords: BSCUSA; CONTROL METHODS; MICROWAVES; SOUND

ABBHA Ref. #: 1334
Citation: POCHOP, P.A.; CUMMINGS, J.; WEDEMEYER, K.L.; ENGEMAN, R.M.; DAVIS, J.E. Preference of Ground Covers by Canada Geese at Elmendorf Air Force Base, Anchorage, Alaska. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: Bird strikes to aircraft are a serious safety and economic problem in the United States. Maintaining vegetation height to reduce bird use is a common approach to habitat management at airports. Waterfowl, specifically Canada geese (Branta canadensis), are

generally attracted to airfields because of a variety of preferred forage and large open areas. At Elmendorf Air Force Base, Alaska our study determined Canada goose foraging preferences for alternative vegetation types not normally planted on this airfield. We compared Canada goose preference for Kentucky bluegrass (Poa pratensis), bluejoint reedgrass (Calamagrostis canadensis), beach wildrye (Elymus mollis), silver hairgrass (Aira caryophyllea), lupine (Lupinus nootkatensis), dandeloins (Taraxacum spp.) and flightline turf (a mix of Alaska brome (Bromus sitchensis), dock (Rumex acerosella), and red fescue (Festuca rubra). There was a significant treatment-by-choice interaction ($F = 25.36$; $P = 0.0001$; 4, 136 d.f.) Flightline turf was preferred over Kentucky bluegrass and silver hairgrass was marginally less preferred than Kentucky bluegrass. Lupine, bluejoint reedgrass, and beach wildrye were avoided when Kentucky bluegrass was present as an alternative choice.
Keywords: AERODROME DESIGN; BSCUSA; CONTROL METHODS; HABITAT MODIFICATION

ABBHA Ref. #: 1335
Citation: KELLY, T.A. Judgment Call: a Computer-based Expert System for Training Airport Personnel to Evaluate Bird Strike Risks. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: The paper contains a summary of a computer-based system to train airport personnel in quickly evaluating the risk posed by birds on or near an airport. The program includes an interactive training course in bird strike risk management followed by a 10 question test. The test includes an expert system to evaluate the students' answers and provide context specific evaluations after each question. The paper is presented with examples of how risk management principles and training can improve a bird control program. The program was originally developed for military airports but the approach is applicable to civilian airports.
Keywords: BSCUSA; ELECTRONIC MEDIA; HAZARD MANAGEMENT; TRAINING

ABBHA Ref. #: 1336
Citation: KELLY, T.A.; EVANS, W.; SMITH, A. Monitoring Nocturnal Flight Calls to Identify Migrant Bird Species Hazardous to Aircraft. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: An automated nocturnal flight call monitoring system was tested at Dare County Bombing Range, North Carolina, to assess the equipment for detecting night bird migratory activity. The technique has been successfully used to determine neo-tropical migrants passing over the range. The technique has demonstrated the ability to detect avian species hazardous to aircraft. The poster outlines the limitations of the original system in an airfield or bombing range environment and improvements currently in development and testing. The potential for this method to identify some of the bird species observed by radar at the site is discussed.
Keywords: BSCUSA; DETECTION; RADAR; SOUND

ABBHA Ref. #: 1337
Citation: LINNEL, M.A.; CONOVER, M.J.; OHASHI, T.J. Biases in Pilot-reported Bird Strike Data. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: Bird-aircraft collisions are a major concern throughout the world because they

threaten aircraft safety and result in costly repairs. Most bird strike data have been based on pilot-reported bird strikes that may be incomplete or biased. To assess this, we compared pilot-reported bird strikes at a Hawaiian airport (1990-1994) to a more complete record of bird strike obtained through regular runway searches for dead birds. We documented 526 bird strikes of which only 25% were reported by pilots. Pilot reporting rates (percent of all strikes reported by pilots) varied by the avian species involved, the bird's mass, number of birds struck, season, time of day, and location on the runway during the landing phase. Pilot reporting rates were independent of wind speed, wind direction, and percent cloud cover. Reporting rates were similar during landings and takeoffs. These results indicate that bird strike data based on pilot reports were biased. Reliance on such data can lead to inaccurate conclusions, and may cause airports to select inappropriate measures to reduce bird strikes.
Keywords: BSCUSA; CIVIL AVIATION; REPORTING; STATISTICS

ABBHA Ref. #: 1338
Citation: CLEARY, E.C.; WRIGHT, S.E. The National Wildlife Strike Database for Civil Aviation in the United States, 1992-1996. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: Bird and other wildlife strikes to aircraft are a serious economic and safety problem in the United States. The Federal Aviation Administration (FAA) has a standard form (5200-7) for the voluntary reporting of bird and other wildlife strikes with aircraft. Although FAA personnel have monitored these reports since 1965 to determine general patterns in wildlife strikes, no quantitative analyses of these data were conducted until 1995. The United States Department of Agriculture (USDA) National Wildlife Research Center, through an interagency agreement with the FAA, initiated in April 1995 a project to obtain more objective estimates of the magnitude and nature of the bird and other wildlife strike problem nationwide for commercial aviation. This project includes: 1) editing all strike reports (Form 5200-7) sent to the FAA since 1990 to ensure consistent, error-free data; 2) entering all edited strike reports since 1990 into a Wildlife Strike Database; 3) supplementing FAA-reported strikes with additional, non-duplicating strike reports from other sources; 4) providing FAA with an updated computer file each quarter containing all edited strike records; and 5) assisting the FAA with the production of annual reports summarizing the results of analyses. Such analyses are critical to determine the economic costs of wildlife strikes, the magnitude of safety issues, and most importantly, the nature of the problems (e.g., bird species, aircraft and engine types, airports, seasonality) so that corrective actions can be justified and taken. In November 1995, the first annual report on wildlife strikes to civil aircraft in the USA, covering 1994, was completed. In December 1996, a second report, summarizing data for the 3-year period 1993-1995, was completed. A third report, completed in August 1997, presents an analysis in tabular and graphic form of data on wildlife strikes to civil aircraft in the United States for 1992-1996. For this 5-year period, 11,571 (avg. 2,314/year) non-duplicating strike reports were obtained. Strike reports were received from all 50 states and some U.S. territories. About 97% of the reported strikes involved birds and 3% involved mammals. We estimate that <20% of all wildlife strikes were reported and that total costs of the strikes to civil aviation exceeded $200 million/year. This report is available from the authors.
Keywords: BSCUSA; CIVIL AVIATION; REPORTING; STATISTICS; UNITED STATES

ABBHA Ref. #: 1339
Citation: KELLEY, M. Special Bird Strike Awards. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: Examination of aircraft bird strike data has resulted in several interesting discoveries. Analysis efforts have shown there are several indicators/symptoms of exceptionally good and not-so-good reporting programs. There are also indicators/symptoms that seem to indicate organizations with significant bird/animal hazards. Analysis techniques and results described in this paper can be used by interested organizations to see how their bird strike reporting programs and hazard control programs compare to programs in other similar organizations. Agencies and individuals wishing to see good and not-so-good programs could use similar analysis techniques to decide who to visit. The database used for this study was created from the bird strike reports submitted to the FAA by aircraft operators, airports, and others. The numerous sheets of paper were computerized by the USDA under a contract effort to the FAA. The version of the database I used covered from January 1992 to May 1996, almost 4.5 years. Analysis of the bird strike data, supplemented by data/information from some other sources, shows there are some organizations and accomplishments/occurrences which are worthy of recognition. Several Special Bird Strike Awards have been created in various categories, and the winners of these awards will be announced. The first award (with winners in three categories) recognizes organizations with excellent bird strike reporting programs. Some organizations that have the symptoms/indications of excellent bird strike hazard reduction programs will also be identified. Other awards are much less prestigious, and some organizations might wish to try and avoid ever qualifying for such awards. One award is tasty, and will be available to all meeting attendees at a designated break.
Keywords: BSCUSA; REPORTING; STATISTICS

ABBHA Ref. #: 1340
Citation: LOVELL, C.D. USAF Bird Avoidance Model (BAM) - Reducing Bird Strikes to Military Aircraft in Low-level Environments. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: The United States Air Force (USAF) developed a Bird Avoidance Model (BAM) in the early 1980s to evaluate low level training routes for bird strike hazards throughout the contiguous United States. Although bird strikes have caused more than $453 million in damage and the loss of 33 lives since 1986, the BAM has not been widely used until recently. Through an interagency agreement, I have provided BAM evaluations to USAF and other military personnel since April 1996. From 1996-June 1997, I evaluated 1,983 training routes and areas for bird strike hazards. The current BAM incorporates waterfowl and raptor species which account for the majority of damaging bird strikes to military aircraft. Because major changes have occurred to bird populations of relevant species throughout North America (e.g., Canada geese, double-crested cormorants, gulls, etc.), there is a need for an updated model which contains current population data for a larger array of bird species. The USAF is in the process of developing a Geographic Information System (GIS)-based BAM which will contain current

population data on an expanded diversity of species that pose a threat along low-level training flights.
Keywords: AVOIDANCE; BSCUSA; LOW LEVEL; MAPS; MILITARY AVIATION; NORTH AMERICA

ABBHA Ref. #: 1341
Citation: HUIZER, R.H.J.; FAIRBAIRN, D.; WHITFORD, J. Pickering Airport Lands Avifauna Study. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only; poster.)
Abstract: Transport Canada, under the federal Aeronautics Act, is considering developing draft Airport Zoning regulations for the Pickering Airport Lands, near Toronto. This 1-year study collected avifauna data and defined draft bird hazard zones, within which restrictions would be placed on activities and land uses which could contribute to bird hazards to aircraft. Weekly counts documented spring migration, summer (post-breeding), fall and winter bird numbers and movements within a 50 kilometer radius of the airport reference point. Ring-billed gulls and herring gull were identified as the primary bird hazard species. Canada goose, raptors, European starling and snow bunting were identified as potential hazard species. The Brockwest Landfill, farm compost sites, and plowed fields represented the greatest attractants to gulls. Compost sites were an equally important winter food source as the landfill; 11,191 gulls were recorded at one site in late March 1996. During the study, the early winter closure of the landfill did not result in a drop in gull numbers. Following closure, gulls shifted their feeding activities to compost sites. Gull movements between roosting sites and reliable feeding and loafing sites followed well established flight lines, with travel distances up to 60 km. Movements typically occurred at between 70-100 m AGL, with heights of 300-400 m AGL commonly recorded during thermal activity. At the landfill, gull towering altitudes of 500 m AGL were frequent, with altitudes of 800-1100 m AGL observed. Primary and secondary bird hazard zones, extending 15 km and 6.5 km respectively, from the airport reference point were identified, based upon bird movements, approach slopes, and altitudes below which aircraft would have the greatest potential for bird strikes.
Keywords: ATTRACTANTS; BSCUSA; FOOD; GULLS; LAND USE; LANDFILLS; LEGAL ISSUES

ABBHA Ref. #: 1342
Citation: CULLEN, T.J.V., III. Why Falcons? Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Why in this age of space exploration and computer technology is the aviation industry looking to the ancient art of falconry to help in the battle to reduce the hazards of planes striking birds? To answer this question, we need to look at several complex issues which include: Where have the standard tools used on airports to prevent bird strikes succeeded and where have they failed? The adaptations of prey species based on their survival requirements. The adaptations of falcons to specifically address their ability to counteract the adaptations of prey species.
Keywords: BSCUSA; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1343
Citation: SMITH, N. Observations of Wintering Snowy Owls at Logan Airport. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: Snowy owls (Nyctea scandiaca) wintering at Logan International Airport were studied over the 15-year period of 1981-1997 through visual observation and physical capture. This study was undertaken to determine: when do the owls arrive at the airport each year and how long do they stay; how many pass through each winter; what do they feed on; what are their roosting and hunting habits; do the same birds return to the airport each year? To answer these questions, 227 snowy owls were banded and color-marked to track their movements. Fifty-six owls were re-observed outside the airport vicinity, and 11 were observed more than 150 km away. Dietary preferences based on observations of hunting and feeding owls recorded a total of 192 different prey species, ranging from as small as voles to as large as a great blue heron. Although a total of 5,039 pellets were collected and examined, an analysis of their contents has not yet been conducted. Educational programs are an important part of the ongoing research efforts being undertaken at the airport.
Keywords: BIRD POPULATIONS; BSCUSA; OWLS

ABBHA Ref. #: 1344
Citation: LAYBOURNE, R. Development of a Tool for Feather Identification. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: In the 1950s, my feather identifications were done by visual examination. Later, when FAA wanted identifications of birds ingested by aircraft engines, I had to devise a method to identify mangled remains. Feathers are composed of pennaceous barbs that are stiff in texture and provide color and protection; and downy or plumulaceous barbs, located at the base of the feather for insulation. I tried to follow Chandler's (1916) work on the microstructures of the pennaceous barbs, but found that it was not practical. He had done some work on the plumulaceous or downy barbs and had illustrated the barbules of a few families. With this information I realized that the downy barbs might be the part of the feather that would be the answer to my problems. With that in mind I began my research on downy barbules that I still continue. From my research I have found that these microstructures vary with the type of feather, the location of the barb on the feather, the location of the barbule on the barb as well as the position of the nodes on the barbule. Because characteristics of the microstructures of downy barbules in non-passerines are more consistent, determining the family in this group of birds as a rule is much easier than in the passerines (perching birds). Microstructures in passerines exhibit much more variation within the family; so much so, that it is often difficult to determine even the family from microstructures alone. Once the family has been determined, then the properly cleaned feather remains are studied for size, shape, texture, color, and type. This information, together with experience gained from bird identification in field and laboratory, is used to consider to which species the material might belong. The next step is to check this material with a museum specimen of the suspected species. If it matches, then the circumstantial data given in the report (e.g., locality; time of year and day) are taken into account. After this tentative identification, occurrence of that particular species for that locality and the habits of the bird are

researched in the literature. The bird remains are only identified when the species is accurately determined and conforms to all the information gained from the study of the case at hand. The few identifications made by using only downy barbules are those in which the microstructure are so distinct that they cannot be confused with those of any other family. This tool, like any high-tech tool, requires special training in order to use it properly and efficiently; training for use of this tool does not come quickly or easily.
Keywords: BSCUSA; FEATHERS; IDENTIFICATION; MICROSCOPIC

ABBHA Ref. #: 1345
Citation: HAMILTON, P.L. Bird Strike Risk Assessment at a Major Airport. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: In the course of preparing an Environmental Impact Statement for bird control measures at John F. Kennedy International Airport, it was necessary to perform a bird hazard risk analysis. Although only 20th in total operations, this airport is ranked first in the nation in reported bird strikes, largely as a consequence of care in tracking bird strike data. This dependence of strike rate upon quality of reporting illustrates the difficulty in assessing absolute risk. Even if we could calculate an estimate of absolute risk, there would be the problem of determining an acceptable level. Finally, accidents, by definition, are rare events, often too rare for meaningful statistics. Elsewhere in aviation, it is customary to examine leading indicators classes of events that are correlated with accident risk but occur more often. Such indicators include air traffic controller operational errors and pilot deviations. Increases in either are considered to show a deterioration in the margin of safety, even if no accidents, incidents, or near-accidents take place. We chose not to attempt to calculate absolute accident risk. Instead, crew-reported and airport-reported bird strikes, along with rates of engine and aircraft damage, and departure aborts were used to estimate the relative risk of a bird-related accident. The question became not "what is the absolute risk of an accident", but rather, "what is the risk relative to historical risk levels." This approach avoids the problem of "how safe is safe enough" by comparing risk to past levels which were deemed acceptable.
Keywords: BSCUSA; HAZARD MANAGEMENT; RISK ASSESSMENT

ABBHA Ref. #: 1346
Citation: ROSSI, C.L.; WILMOTH, W.F. Data Management System for Wildlife Observations and Control Activities on Airports. Bird Strike Committee USA,1997; Boston, Massachusetts. (abstract only.)
Abstract: USDA/APHIS/WS, in cooperation with Anchorage International Airport, developed a database designed to efficiently manage wildlife hazard information at airports. The database, referred to as the Wildlife Hazard Management Information System or WHMIS, was produced in a "user friendly" format to compliment the Wildlife Services Manual for Managing Wildlife Hazards at Airports. Several "pre-calculated" reports have been built into the system to facilitate the assembly of Ecological Studies and/or Direct Control Reports. WHMIS can accurately track wildlife damage, wildlife control activities, and wildlife hazard studies and/or evaluations. These separate data sets can be gathered individually or simultaneously within the system. In addition, WHMIS can calculate species trend analyses of wildlife activity based on any of a number of criteria (e.g., weather, time of day, date). While WHMIS has many specific functions associated

with the standard procedures of USDA's Wildlife Services program, it also offers the flexibility to accommodate the individual conditions associated with any airport. WHMIS is currently in its second year of use at Anchorage International Airport. The system has proven to be an extremely valuable tool in managing wildlife hazard information.
Keywords: BSCUSA; HAZARD MANAGEMENT; INFORMATION SYSTEMS

ABBHA Ref. #: 1347
Citation: ANONYMOUS. Bird Strikes to Canadian Aircraft: 1991 Summary Report. Transport Canada Airports, report TP10573E: 34 p.
Abstract: This report is based on birdstrike data supplied to Airports Group by various sources. A total of 842 birdstrikes were reported. Of these, 757 occurred at Canadian sites, 55 occurred outside Canada and 30 were of unknown origin. Of the strikes reported, 43% could not identify the bird involved. The type of bird most often hit were gulls (24%). August was the month with the most strikes (22%). Fifty percent of incidents occurred at 100 feet AGL; 25% did not report altitude.
Keywords: BSCC; CANADA; CIVIL AVIATION; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 1348
Citation: ANONYMOUS. Minutes of the 17th Meeting of the Bird Strike Committee Canada. Bird Strike Committee Canada; Transport Canada Report AKP 5158-36-22-51: 11p (w/Appendices).
Abstract: Accounts of the briefings and discussions on a number of topics including wildlife control procedures, landfill sites near airports, birdstrike identification, birdstrike statistics, bird control at JFK international airport, bird population enhancement at Ascension Island, bird impact damage tolerance, engine ingestion, and statistics.
Keywords: ASCENSION ISLAND; BIRD POPULATIONS; BSCC; CONTROL METHODS; ENGINEERING; HAZARD MANAGEMENT; JFK IAP; STATISTICS

ABBHA Ref. #: 1363
Citation: TURESSON, Lars-O. BSCE Data Bank: Proposal for an implementation. Bird Strike Committee Europe 17, WP 1; Rome, Italy, 15-19 October, 1984: 37.
Abstract: At BSCE 16 it was decided that a BSCE Data bank should be built that could contain a list of books, documents, slides, films, etc. dealing with the bird strike problems of aviation.
Keywords: AUDIO-VISUAL; BIBLIOGRAPHIC; BOOKS/MANUALS; BSCE; FILM/VIDEO; SLIDE-TAPE; SYMPOSIA

ABBHA Ref. #: 1364
Citation: RICHARDS, P.F. Manual for the design of bird impact resistant structures and transparencies. Bird Strike Committee Europe 17, WP 2; Rome, Italy, 15-19 October, 1984: 38-59.
Abstract: Provides a copy of the Introduction to the Various Parts of the Manual for the Design of Bird Impact Resistant Structures and Transparencies. This provides a useful summary of the

origins and scope of the material contained therein and describes the intended means of circulation of the manual.
Keywords: BSCE; ENGINEERING; GUIDANCE; TRANSPARENCIES

ABBHA Ref. #: 1365
Citation: THORPE, J. European airlines bird strikes: 1976-1980. Bird Strike Committee Europe 17, WP 3; Rome, Italy, 15-19 October, 1984: 60-87.
Abstract: Birdstrikes reported world-wide between 1976 and 1980 by European airlines from 14 countries have been analyzed. The analysis of over 7300 strikes includes the annual strike rate for each country, for aircraft types and airports, all based on aircraft movements. It also covers bird species and weights, part of aircraft struck, effect of strike, and cost. The paper shows that gulls were involved in over 40% of the incidents where the type of bird was known, and that only one percent of the birdstrikes involves birds of over 4 pounds. The major effects have been damage to over 330 engines and the loss of a Boeing 737 and Learjet (total value US$6 million). Engineering costs are estimated to be about $17 million excluding the Boeing 737 and Learjet.
Keywords: BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 1366
Citation: SPEELMAN, R.J.; MCCARTY, R.E. Improvement of aircraft windshield system birdstrike resistance. Bird Strike Committee Europe 17, WP 4; Rome, Italy, 15-19 October, 1984: 88-107.
Abstract: USAF aircraft repeatedly prove that birds and aircraft cannot occupy the same airspace at the same time; over 1000 birdstrikes per year cause millions of dollars in damage to USAF aircraft. During the past fifteen years eleven military pilots have been killed and eighteen aircraft have been destroyed due to bird impact. More of these losses are due to birdstrikes on the windshield subsystem than to any other subsystem. Windshield systems on several different aircraft are being evaluated as to their birdstrike resistance and/or are being redesigned to provide improved tolerance of the birdstrike event. These analytical and experimental efforts to define and improve windshield system birdstrike resistance are reviewed in general terms. Some technical voids in designing for, and integration of, birdstrike resistance are identified.
Keywords: BIRD IMPACT; BSCE; ENGINEERING; MATHEMATICAL MODELS; MILITARY AVIATION; TESTING; TRANSPARENCIES

ABBHA Ref. #: 1367
Citation: SONNETTE, J.C. Bird Strike Collision Risk: Pilot's point of view. Bird Strike Committee Europe 17, WP 5; Rome, Italy, 15-19 October, 1984: 108-109.
Abstract: The information procedures, as recommended by the BSCE, seem to be satisfactory. However, problems remain as far as their implementation is concerned.
Keywords: AVOIDANCE; BSCE; CERTIFICATION STANDARDS; ENGINEERING; VERBAL NOTIFICATION

ABBHA Ref. #: 1368
Citation: BESSE, J.; JANUEL, J.P. French Experimental research program on the behavior of aramid epoxy composite structures on bird impact. Bird Strike Committee Europe 17, WP 6; Rome, Italy, 15-19 October, 1984: 110-136.
Abstract: Considering the development in aeronautics of aramid epoxy composite structures and the scarcity of bird impact tests conducted in the past, the French STPA has sponsored, in CEAT, an experimental investigation on the behavior of these structures in bird impact. This paper summarizes the results.
Keywords: BIRD IMPACT; BSCE; COMPOSITE-STRUCTURES; ENGINEERING; MATERIALS; TESTING

ABBHA Ref. #: 1369
Citation: JACOBY, V.E. Possibility to use precision approach radars for bird strike prevention. Bird Strike Committee Europe 17, WP 7; Rome, Italy, 15-19 October, 1984: 137-146.
Abstract: Detailed evaluation of factors for consideration in using precision approach radars for bird targets.
Keywords: BSCE; DETECTION; RADAR; USSR

ABBHA Ref. #: 1370
Citation: LEEMING, G. Military aircraft bird strike analysis: 1981. Bird Strike Committee Europe 17, WP 8; Rome, Italy, 15-19 October, 1984: 147-153.
Abstract: This is the fourth analysis in the abbreviated format using birdstrike data from the Royal Danish Air Force, German Air Force, Royal Air Force, and the Swedish Air Force. Gulls topped the list of birds most frequently involved in birdstrikes. One aircraft was reported lost.
Keywords: BSCE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 1371
Citation: LEEMING, G. Military aircraft bird strike analysis: 1982. Bird Strike Committee Europe 17, WP 9; Rome, Italy, 15-19 October, 1984: 154-163.
Abstract: An update of the military birdstrike analysis reported in 1982.
Keywords: BSCE; MILITARY AVIATION; STATISTICS

ABBHA Ref. #: 1372
Citation: BROUGH, T. Average Weights of birds- Summary. Bird Strike Committee Europe 17, WP 10; Rome, Italy, 15-19 October, 1984: 164.
Abstract: This paper lists the average weights (and ranges where known) of 2256 bird species obtained from some 250 reference sources. It has been prepared largely for the benefit of people interested in birdstrike problems to aircraft. (Paper available from author.)
Keywords: BIRD POPULATIONS; BODY DENSITY/WEIGHT; BSCE

ABBHA Ref. #: 1373
Citation: HOFFMAN, O. Bird strikes to German registered civil aircraft in 1983 which caused high repair costs. Bird Strike Committee Europe 17, WP 1; Rome, Italy, 15-19 October, 1984: 165-166.
Abstract: Aircraft incident summaries.
Keywords: BSCE; CIVIL AVIATION; COSTS; GERMANY

ABBHA Ref. #: 1374
Citation: AGAT, I.; SUARETZ, S. Summary and Analysis of bird-analysis collisions and presence of bird carcasses on runways at Ben Gurion International Airport: 1983. Bird Strike Committee Europe 17, WP 12; Rome, Italy, 15-19 October, 1984: 167-197.
Abstract: The purpose of this summary is to present important basic data obtained from reports received and information gathered on bird-aircraft collisions and presence of bird carcasses on runways at Ben Gurion Airport. From these reports, we are able to determine the types and numbers of birds involved in collisions, the problematic sections of the runway, the most vulnerable sections of the aircraft, flight stage and so on, and thus to reach conclusions regarding methods of minimizing these hazards. Our conclusions will without doubt be influenced by the degree of reliability and speed with which the data can be collected in the future.
Keywords: AERODROME SURVEYS; ASIA AND MIDDLE EAST; BEN GURION IAP; BSCE; ISRAEL

ABBHA Ref. #: 1375
Citation: PERESEMPIO, R. Italian birdstrike statistics: 1981-1983. Bird Strike Committee Europe 17, WP 13; Rome, Italy, 15-19 October, 1984: 198-211.
Abstract: In 1982, the Civil Aviation Authority set up a "Permanent Study Group on the presence of birds over airports" to study the problem and make proposals on how to distance and above all prevent the presence of birds over airports and in the immediate vicinity. The Group, after examining measures already adopted in other countries, and together with various organizations connected with the world of civil aviation, proceeded to draw up a detailed map of each Italian airport open to civil aviation traffic. The results indicate that in Italy the coefficient of risk is not so very high, perhaps because of the scarce presence of avifauna in Italy. Statistics show that the public menace number one is the seagull, a protected species in Italy, not sought after by sportsmen. A discussion of various control measures is included.
Keywords: BSCE; CIVIL AVIATION; CONTROL METHODS; ITALY; STATISTICS

ABBHA Ref. #: 1376
Citation: BUURMA, L.S.; DEKKER, A.; BROM, T.G. On the spatial and temporal distribution of bird species involved in RNLAF bird strikes. Bird Strike Committee Europe 17, WP 14; Rome, Italy, 15-19 October, 1984: 212-226.
Abstract: Recent results of the analysis of RNLAF bird strikes are summarized, with special reference to the temporal and spatial variation in the contribution of different bird categories and species. Especially the seasonal fluctuations of ratios exemplified for collisions "above airbases"

and "en route" respectively show how many details can be extracted from a relatively small database. Proper identification procedures, to start with microscopic examination of feather remains, appeared to be a prime prerequisite. Aircraft "en route" collide with an avifauna of a very different species composition than during start and landing. Especially small birds constitute a high proportion, while peak occurrences of certain bird types coincide with well-known mass movements. On the contrary, birdstrikes at and near airfields are dominated by collisions with more heavy, non-passerine birds.
Keywords: BSCE; NETHERLANDS; STATISTICS

ABBHA Ref. #: 1377
Citation: HILD, J. Recommendations for bird control on airports. Bird Strike Committee Europe 17, WP 15; Rome, Italy, 15-19 October, 1984: 227-228.
Abstract: It is proposed that the BSCE publish a set of recommendations for bird control on airports
Keywords: BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 1378
Citation: HILD, J. Falconry as a bird deterrent on airports. Bird Strike Committee Europe 17, WP 16; Rome, Italy, 15-19 October, 1984: 229-230.
Abstract: Many times the use of falcons has been recommended giving the impression that falcons would be the single, biological and successful method for scaring birds. This paper investigates critically the difficulties involved in falconry at airports.
Keywords: BSCE; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1379
Citation: HILD, J. Birdstrike problems on airbase Decimonannu/Sardinia, Italy. Bird Strike Committee Europe 17, WP 17; Rome, Italy, 15-19 October, 1984: 231-240.
Abstract: Since 1965, the German Air Force has trained pilots at the Italian Air Force base Decimonannu/Sardinia. Between 1968-1979 more than 100 birdstrikes were reported at the airbase and in the vicinity. Ecological investigations led to special proposals to solve the birdstrike problem.
Keywords: AERODROME SURVEYS; BSCE; ITALY

ABBHA Ref. #: 1380
Citation: BAKKER, C. Birdstrikes during 1983. Bird Strike Committee Europe 17, WP 18; Rome, Italy, 15-19 October, 1984: 241-247.
Abstract: KLM report
Keywords: BSCE; CIVIL AVIATION; NETHERLANDS

ABBHA Ref. #: 1381
Citation: HILD, J. Flight Procedures of the German Armed Forces Concerning the Prevention of Birdstrikes. Bird Strike Committee Europe 17, WP 1; Rome, Italy, 15-19 October, 1984: 248-249.
Abstract: Discussion on the BIRDTAM warning system based on actual observations of bird migration and birdstrike risk forecasts based on season, weather, and bird reports.
Keywords: AVOIDANCE; BSCE; GERMANY; HAZARD MANAGEMENT; MILITARY AVIATION

ABBHA Ref. #: 1382
Citation: DAHL, H. A Desirable Harmonization of ICAO Documentation on Bird Hazards. Bird Strike Committee Europe 17, WP 20; Rome, Italy, 15-19 October, 1984: 250-259.
Abstract: Problems raised by the presence of birds at airports are not new. According to the annual report of the ICAO Council 1983 the ICAO Bird Strike Information System (IBIS) received 3,159 reports on birdstrikes from 37 states concerning strikes occurring in 94 states during 1983. The vast majority of strikes occurred at or near aerodromes and were nearly equally divided between approaches and departures. Forty nine percent of the strikes occurred at or below 30 m (100 feet) above ground and 62 percent at or below 150 m (500 feet). Two percent of the strikes resulted in substantial damage to the aircraft and 8 percent in minor damage. The major effect was damage to 61 engines. During the year birdstrikes were estimated to have cost European airlines at least US$3 million.
Keywords: BSCE; EUROPE; ICAO; REPORTING; STATISTICS

ABBHA Ref. #: 1383
Citation: DAHL, H. New Danish Regulations regarding management of airports. Bird Strike Committee Europe 17, WP 21; Rome, Italy, 15-19 October, 1984: 260-265.
Abstract: This paper contains a description of the measures imposed upon Danish aerodromes to reduce the risk of collisions between aircraft and bird/game on aerodromes. The concessionaires of the aerodromes are obliged to become acquainted with the extent of the birdstrike risk, reduce the risk accordingly, report birdstrikes, identify remains and in general, comply with EEC regulations.
Keywords: AIRFIELD PROCEDURES; BSCE; DENMARK; HAZARD MANAGEMENT

ABBHA Ref. #: 1384
Citation: BENTZ, P.G. Greenland Snow Buntings in transit at Andoya airport in northern Norway. Bird Strike Committee Europe 17, WP 22; Rome, Italy, 15-19 October, 1984: 266-275.
Abstract: The snow bunting (Plectrophenax nivalis) is a Holarctic passerine. Each spring large flocks of Snow Buntings gather on the northernmost point of the island of Andoya, where the airport is close to the sea. The Snow Buntings that congregate at the airport are a considerable hazard to aircraft as they gather in great numbers on the snow mounds adjacent to the runway. The possible control might relate to removal of the snow mounds.
Keywords: AERODROME SURVEYS; BIRD POPULATIONS; BSCE; CONTROL

METHODS; EUROPE; HABITAT MODIFICATION; NORWAY; PASSERINES

ABBHA Ref. #: 1385
Citation: LIND, H.; GLENNUNG, A.M. Birdstrikes in Copenhagen airport during a ten year period. Bird Strike Committee Europe 17, WP 23; Rome, Italy, 15-19 October, 1984: 276-281.
Abstract: In Copenhagen airport, bird scaring started in 1963. From 1974-83 bird remains were collected and identified. Twenty-three species have been involved in collisions, but only six are of major importance. The total number of strikes per year has not changed but the distribution among the species has changed. Actions against the Herring Gull has been successful. About 20% of the birdstrikes occur in and near the airport.
Keywords: AERODROME SURVEYS; BSCE; COPENHAGEN IAP; DENMARK; EUROPE; STATISTICS

ABBHA Ref. #: 1386
Citation: LAYBOURNE, R. Identification of bird remains from bird aircraft incidents by the microstructure of the downy part of the feathers. Bird Strike Committee Europe 17, WP 24; Rome, Italy, 15-19 October, 1984: 282-283.
Abstract: Discussion of the methodology used to examine bird remains from birdstrike incidents.
Keywords: BSCE; FEATHERS; IDENTIFICATION; MICROSCOPIC

ABBHA Ref. #: 1387
Citation: THORPE, J.; VAN WESSUM, R. Bird strikes during 1982 to European registered civil aircraft. Bird Strike Committee Europe 17, WP 25; Rome, Italy, 15-19 October, 1984: 287-307.
Abstract: The strikes reported throughout the world in 1982 by operators from ten European countries have been analyzed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost and airlines affected. The strike rate in 1982 was similar to the two previous years at 4.6 per 10,000 movements. Gulls (Larus spp) were involved in one third of the incidents. The major effect was damage to 69 engines.
Keywords: BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 1388
Citation: THORPE, J.; VAN WESSUM, R. Bird strikes during 1981 to European registered civil aircraft. Bird Strike Committee Europe 17, WP 26; Rome, Italy, 15-19 October, 1984: 308-328.
Abstract: The strikes reported throughout the world in 1981 by operators from ten European countries have been analyzed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost and airlines affected. The strike rate in 1981 was similar to the two previous

years at 4.3 per 10,000 movements. Gulls (Larus spp) were involved in nearly half the incidents. The major effect was damage to 80 engines.
Keywords: BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 1389
Citation: THORPE, J. Serious Bird Strikes to Civil Aircraft: 1981-1984. Bird Strike Committee Europe 17, WP 27; Rome, Italy, 15-19 October, 1984: 329-339.
Abstract: The paper contains detailed histories of accidents and serious incidents (e.g., double-engine ingestions; holed airframe) for the years 1981 to date. An attachment contains a summary of all fatal accidents due to bird strikes between 1912 and 1980. The paper is divided into three groups: (1) transport aeroplanes over 5700 kg (12,500 lbs) and executive jets; (2) aeroplanes below 5700 kg; and (3) helicopters. No attempt has been made to analyze the information although it is apparent that for transport aeroplanes the critical area is engines and for light aeroplanes and helicopters the windshield may be critical. The author would welcome any new or additional information.
Keywords: BSCE; CIVIL AVIATION; EUROPE; STATISTICS

ABBHA Ref. #: 1390
Citation: HILD, J. Activities of the Bird Movement Working Group. Bird Strike Committee Europe 17, WP 28; Rome, Italy, 15-19 October, 1984: 340-341.
Abstract: Progress report, future program direction and recommendations of the working group.
Keywords: BIRD POPULATIONS; BSCE; HAZARD MANAGEMENT; ORGANIZATION

ABBHA Ref. #: 1391
Citation: KULL, R. Bird Avoidance for Military Low-level Operations in the United States. Bird Strike Committee Europe 17, WP 29; Rome, Italy, 15-19 October, 1984: 342-349.
Abstract: In order to provide information as to waterfowl hazards along military low-level routes in the United States, the USAF Bird/Aircraft Strike Hazard (BASH) Team developed a computer-generated Bird Avoidance Model (BAM). The model is based on 40 years of waterfowl migration data and wintering areas coupled with longitude and latitude of all published military low-level routes. The computer output is a graph predicting the bird strike potential along any of the routes with respect to time of day and time of year. The BASH Team determined the model to be 70-75 percent effective and is in the process of incorporating raptor data into the model.
Keywords: AVOIDANCE; BSCE; LOW LEVEL; MAPS; MILITARY AVIATION; UNITED STATES

ABBHA Ref. #: 1392
Citation: CAITHNESS, T.A. Controlling a Gull Colony near a New Zealand Airport: 1965-1984. Bird Strike Committee Europe 17, WP 30; Rome, Italy, 15-19 October, 1984: 350-356.
Abstract: It was earlier reported the details of a poisoning operation aimed at eliminating a breeding colony of the southern black-backed gull, Larus dominicanus, which were nesting on the Ahuriri Plain within 200 meters of Napier Airport, an important secondary airfield in New Zealand. After many years of subsequent population control, it is concluded that the efficacy of the measures warranted continuance.

Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; DEPREDATION; GULLS; NEW ZEALAND

ABBHA Ref. #: 1393
Citation: MANUEL, J.P. Experimental comparison of three bird strike test techniques using different projectiles. Bird Strike Committee Europe 17, WP 31; Rome, Italy, 15-19 October, 1984: 357-368.
Abstract: The CEAT uses freshly killed chickens. Tests are conducted to determine what the best impact test subject is.
Keywords: BIRD IMPACT; BSCE; ENGINEERING; TESTING

ABBHA Ref. #: 1394
Citation: STENMAN, O. Radar Observation on the Migration of Arctic Birds in Finland. Bird Strike Committee Europe 17, WP 32; Rome, Italy, 15-19 October, 1984: 369-370.
Abstract: The aim of this study is to combine visual and radar observation on the migration of arctic birds (Clangula hyemalis, Melinitta nigra, Branta bernicla, and B. leucopsis) in such a way as to provide an efficient warning system for air traffic during the pre-migration periods. Tables are provided.
Keywords: BIRD POPULATIONS; BSCE; DETECTION; EUROPE; RADAR

ABBHA Ref. #: 1395
Citation: VAN WESSUM, R. Garbage dump problems in the Netherlands and the need for rules and research. Bird Strike Committee Europe 17, WP 34; Rome, Italy, 15-19 October, 1984: 374-376.
Abstract: In the Netherlands, district authorities design a regional landscape plan. The same authorities are also responsible for a garbage disposal plan. This means that, among other matters, new garbage disposal sites appear in the regional landscape design plans. The Civil Aviation Authority has advised all local district authorities responsible for landscape planning on potential birdstrike problems related to garbage dumps.
Keywords: ATTRACTANTS; BSCE; GARBAGE; LANDFILLS; LEGAL ISSUES

ABBHA Ref. #: 1396
Citation: BLOKPOEL, H. A Ring-billed Gull versus Flight Safety: a Continuing Conflict in Ontario, Canada. Bird Strike Committee Europe 17, WP 35; Rome, Italy, 15-19 October, 1984: 377-381.
Abstract: The Ring-billed Gull (Larus delarwarensis) is a species that nests only in North America. Nesting colonies are found in southern Canada and in northern United States. Since the mid-1940's the Great Lakes Ring-bill population has shown a tremendous increase. Long-term harassment has provided a large drop in gull populations.
Keywords: BIRD POPULATIONS; BSCE; CONTROL METHODS; GULLS; NORTH AMERICA

ABBHA Ref. #: 1397
Citation: CRESPO, D.D. Practical observations on falconry as a bird deterrent method on

airports. Bird Strike Committee Europe 17, WP 36; Rome, Italy, 15-19 October, 1984: 382.
Abstract: Personal opinion on the effectiveness of falconry.
Keywords: BSCE; CONTROL METHODS; FALCONRY

ABBHA Ref. #: 1398
Citation: DEGRIECK; DUPONT. Bird Observation System Semmerzake (BOSS). Bird Strike Committee Europe 17, WP 37; Rome, Italy, 15-19 October, 1984: 383-385.
Abstract: A description of the BOSS basic operating procedures is discussed.
Keywords: BSCE; DETECTION; EUROPE; RADAR

ABBHA Ref. #: 1399
Citation: WEITZ, HEINRICH. Standardized bird counts on German airfields - Method and first results from Frankfurt Airport. Bird Strike Committee Europe 23, Working Paper 26; London, 13 - 17 May 1996: 267-275.
Abstract: To get a representative description of the avifauna of Frankfurt airfield, bird countings according to the "point count transect method" were started in January 1994. This method is widely accepted in field ornithology. The first results after one year of field work were very encouraging, therefore the Bird Strike Committee Germany (DAVVL) decided to apply this method to most of the German airports, starting in autumn 1995. For this task, the DAVVL took experienced ornithologists under contract. On Frankfurt airport, more than 50 counts have been made up to now. After a short presentation of the method, some results will be presented. These will mainly describe the species of birds observed and their numbers and distribution on Frankfurt airfield in the course of the year.
Keywords: AERODROME SURVEYS; BSCE; EUROPE; BIRD POPULATIONS; DETECTION; VISUAL; GERMANY; FRANKFURT;

ABBHA Ref. #: 1400
Citation: HAHN, EDMUND. Falconry and bird control of a military airfield and a waste disposal site. Bird Strike Committee Europe 23 Working Paper 37; London, 13-17 May 1996: 347-351.
Abstract: The paper reports results of a study about the effect of falconry on bird control at a military airfield and a waste disposal site over a period of one month with four peregrine falcons, two gyrfalcons and one hybrid falcon near Cuxhaven, Germany. The main target species were gulls during 130 flights. For analyzing the effects on flocks different parameters like weather condition, number of present species, distance between falcon and prey, hunting success, tinge of flight and scaring etc. were ascertained. By the use of correlation we tested the coherence between flight-time and scaring-time or number of the present birds respectively species with the scaring-time. There was no significant correlation found. By comparing the scaring-time between the military airfield and the waste disposal site, the period between take wing and return of the flocks at the airfield was longer. On the basis of this results we cannot recommend falconry because the success by using falconry for bird control is correlated to a lot of different factors and the effort is not proportional to the success.
Keywords: BSCE; CONTROL METHODS; FALCONRY; GERMANY

Appendix I. ABBHA Keywords

Aerodrome Surveys
- Airport (name)
- Continent/Region
  - Africa
  - Asia and Middle East
  - Australasia
  - Central/South America
  - Europe
  - North America
- Country (specific)

Aerodrome Design
- Buildings/Structures
- Illumination
- Landscaping
- Siting

Attractants
- Agriculture
- Borrow Pits
- Environmental
- Food
  - Carrion
  - Garbage
  - Invertebrates
  - Vegetative
  - Vertebrates
- Lighting
- Landfills (rubbish tips)
- Loafing/Safe Areas
- Roosts
- Sewage
- Slaughterhouses
- Structures
- Water/reservoirs
- Weather
- Wetlands

Avoidance
- Airfield Procedures
- Enroute MANUEVERING
- Maps
- Preflight Planning
- Warning Systems
  - Birdtam/Notam
  - Verbal Notification

Bibliographic
- Audio-visual
  - Film/Video
  - Slide-tape
- Books/Manuals
- Electronic Media
- Literature Survey
- Symposia

Bird Populations
- Bird (common name)
- Body Density/Weight
- Diseases
- Flock Density
- Marking/Banding
- Local Movements
- Migration
- Physiology
- Resident
- Roosting
- Sensory
  - Auditory
  - Olfactory
  - Gustatory
  - Tactile
  - Visual

Control Methods
- Arm-waving
- Balloons
- Chemicals
  - Herbicides
  - Pesticides
  - Repellents
- Depredation
  - Eggs/nests
  - Poisons
  - Predators
  - Shooting
- Dyes
- Effigies
- Eyespots
- Exclusion
  - Nets/Wires
  - Sharp devices
- Falconry
- Flashing Light
- Food Sources
- Gas cannons

Control Methods (cont.)
- Habitat modification
  - Buildings
  - Long-grass
  - Trees and shrubs
  - Water
- Lasers
- Mechanical Devices
- Microwaves
- Pyrotechnics
- Remote control
  - Aircraft
  - Watercraft
- Sound
  - Bioacoustics
  - Infrasound
  - Ultrasonics
- Trapping

Detection
- Electronic
- Infrared
- Radar
- Satellite Tracking
- Sound
- Visual

Engineering
- Aircraft System
  - Airframe
  - Engines
  - Propellers/rotors
  - Subsystems
  - Transparencies
- Aircraft Appearance
  - Color
  - Lights
  - Markings
  - Noise
  - Profile
- Aircrew equipment
- Certification Standards
- Finite Element Analysis
- Helicopter
- Human Factors
- Materials
- Mathematical models
- Optics
- Testing
  - Bird impact
  - Artificial Birds

ABBHA KEYWORDS
(continued)

Hazard Management
- Bird Control Team
- Forecasting
- Guidance
- Organization
- Plans
- Risk Assessment
- Surveys
- Training

Identification
- Biochemical
  - Chromotography
  - DNA Analysis
  - Electrophoresis
  - Molecular sequencing
  - Serology
- Collection Protocol
  - Feathers
    - Macroscopic
    - Microscopic
      - Scanning Electron

Legal Issues
- Conservation
- Domestic Animals
  - Homing Pigeons
- Hunting
- Land Use
- Liability
  - Insurance
- Mishap Investigation
- Permits
- Policy
- Regulations
- Standards

Public Relations

Statistics
- Aircraft (specific type)
- Airline
- Airport (name)
- Civil Aviation
- Cost
- Country (specific)
- ICAO
- General Aviation
- Military Aviation
  - Low-level
- Reporting

Appendix II. Keyword Index for ABBHA, Bird Strike Committee References.

Keyword="Aerodrome Design" (Contains 9 references)

198; 258; 314; 865; 990; 1144; 1238; 1307; 1334

Keyword="Aerodrome Surveys" (Contains 26 references)

317; 863; 864; 865; 878; 879; 882; 910; 956; 979; 985; 989; 1011; 1028; 1188; 1189; 1198; 1319; 1320; 1326; 1327; 1374; 1379; 1384; 1385; 1399

Keyword="Attractants" (Contains 49 references)

137; 156; 161; 212; 266; 268; 271; 274; 289; 331; 364; 384; 389; 411; 432; 461; 615; 863; 877; 878; 891; 914; 915; 931; 959; 972; 980; 981; 989; 997; 998; 1029; 1030; 1147; 1156; 1158; 1162; 1163; 1181; 1191; 1192; 1193; 1194; 1199; 1235; 1245; 1326; 1341; 1395

Keyword="Avoidance" (Contains 70 references)

130; 159; 172; 177; 186; 207; 256; 258; 263; 267; 270; 276; 281; 282; 284; 286; 287; 301; 328; 335; 337; 350; 351; 364; 382; 395; 412; 420; 423; 424; 433; 442; 444; 446; 612; 613; 615;

881; 887; 896; 897; 898; 900; 917; 921; 937; 953; 960; 976; 1012; 1143; 1148; 1149; 1150; 1203; 1208; 1210; 1212; 1214; 1224; 1229; 1237; 1307; 1310; 1311; 1312; 1340; 1367; 1381; 1391

Keyword="Bibliographic" (Contains 38 references)

127; 131; 141; 146; 148; 151; 155; 171; 179; 185; 220; 226; 345; 378; 379; 383; 396; 398; 592; 594; 595; 611; 871; 906; 908; 936; 957; 1024; 1138; 1169; 1183; 1187; 1191; 1233; 1236; 1249; 1308; 1363

Keyword="Bird Populations" (Contains 126 references)

135; 159; 160; 177; 186; 203; 204; 206; 211; 222; 249; 251; 253; 259; 269; 272; 274; 276; 277; 281; 282; 287; 290; 291; 293; 300; 301; 305; 307; 308; 310; 311; 318; 350; 365; 386; 387; 389; 397; 406; 410; 412; 417; 424; 446; 461; 581; 583; 587; 596; 600; 607; 608; 618; 622; 623; 629; 854; 857; 860; 862; 870; 875; 877; 878; 879; 880; 882; 884; 899; 911; 915; 922; 923; 926; 938; 939; 947; 958; 959; 975; 982; 984; 996; 999; 1008; 1013; 1015; 1017; 1028; 1137; 1148; 1149; 1150; 1151; 1153; 1178; 1190; 1192; 1197; 1198; 1199; 1204; 1206; 1207; 1208; 1210; 1211; 1213; 1237; 1245; 1247; 1326; 1327; 1330; 1331; 1332; 1343; 1348; 1372; 1384; 1390; 1392; 1394; 1396; 1399

Keyword="Control Methods” (Contains 167 references)

130; 140; 142; 143; 145; 149; 161; 184; 185; 190; 191; 194; 198; 212; 222; 232; 247; 248; 259; 262; 266; 268; 288; 297; 302; 303; 304; 310; 318; 326; 331; 334; 335; 341; 353; 354; 360; 361; 362; 367; 368; 401; 410; 411; 457; 461; 463; 468; 581; 584; 593; 596; 615; 616; 617; 619; 622; 623; 624; 625; 626; 628; 853; 854; 864; 865; 876; 880; 888; 889; 890; 892; 901; 914; 927; 930; 931; 932; 933; 934; 935; 937; 939; 949; 952; 961; 969; 970; 971; 972; 973; 980; 981; 982; 985; 986; 988; 992; 1004; 1005; 1006; 1007; 1008; 1009; 1014; 1015; 1018; 1019; 1022; 1023; 1027; 1030; 1142; 1145; 1146; 1152; 1156; 1157; 1158; 1159; 1160; 1161; 1164; 1165; 1166; 1170; 1177; 1187; 1188; 1196; 1199; 1200; 1203; 1204; 1215; 1223; 1224; 1225; 1226; 1227; 1236; 1238; 1240; 1247; 1307; 1313; 1314; 1315; 1322; 1323; 1324; 1325; 1326; 1327; 1330; 1332; 1333; 1334; 1342; 1348; 1375; 1378; 1384; 1392; 1396; 1397; 1400

Keyword="Detection" (Contains 78 references)

160; 170; 173; 174; 175; 177; 186; 201; 202; 205; 206; 207; 208; 211; 249; 251; 280; 282; 300; 307; 308; 345; 351; 368; 382; 395; 411; 412; 420; 423; 434; 442; 443; 607; 608; 609; 610; 611; 612; 613; 855; 856; 857; 861; 869; 874; 880; 884; 887; 896; 897; 898; 899; 916; 917; 921; 922; 926; 938; 939; 947; 954; 996; 1012; 1148; 1149; 1150; 1199; 1204; 1206; 1213; 1214; 1329; 1336; 1369; 1394; 1398; 1399

Keyword="Engineering" (Contains 73 references)

139; 163; 188; 194; 214; 227; 228; 229; 230; 239; 265; 298; 323; 328; 333; 347; 348; 356; 357; 373; 390; 394; 409; 425; 447; 451; 459; 460; 588; 589; 590; 591; 845; 900; 902; 903; 925; 962; 974; 975; 977; 978; 982; 987; 994; 999; 1000; 1001; 1016; 1017; 1031; 1141; 1152; 1204; 1215; 1216; 1217; 1218; 1219; 1220; 1221; 1224; 1228; 1232; 1242; 1246; 1328; 1348; 1364; 1366; 1367; 1368; 1393

Keyword="Hazard Management" (Contains 157 references)

132; 133; 134; 144; 150; 154; 157; 164; 165; 166; 167; 168; 171; 176; 180; 182; 183; 185; 187; 189; 197; 204; 209; 210; 221; 226; 237; 238; 255; 256; 263; 265; 266; 269; 270; 272; 274; 275; 277; 278; 293; 294; 295; 304; 306; 312; 313; 316; 317; 326; 327; 335; 339; 342; 362; 363; 364; 370; 371; 374; 378; 382; 385; 386; 392; 399; 400; 402; 403; 407; 419; 435; 441; 447; 450; 452; 469; 579; 584; 585; 586; 590; 592; 597; 598; 599; 601; 602; 603; 604; 605; 606; 612; 614; 618; 619; 620; 621; 627; 629; 630; 813; 842; 846; 847; 848; 849; 850; 851; 852; 860; 865; 867; 868; 880; 881; 882; 884; 885; 896; 901; 913; 929; 937; 940; 946; 950; 956; 963; 969; 976; 986; 999; 1005; 1009; 1020; 1025; 1026; 1147; 1196; 1197; 1202; 1203; 1230; 1233; 1234; 1242; 1243; 1321; 1335; 1345; 1346; 1348; 1377; 1381; 1383; 1390

Keyword="Identification" (Contains 36 references)

147; 178; 195; 196; 231; 279; 309; 324; 325; 396; 416; 419; 448; 602; 904; 905; 906; 907; 909;

910; 918; 920; 924; 945; 966; 1154; 1155; 1169; 1185; 1186; 1248; 1307; 1317; 1318; 1344; 1386

Keyword="Legal Issues" (Contains 34 references)

134; 136; 137; 233; 268; 295; 296; 312; 314; 340; 343; 381; 441; 472; 586; 587; 593; 619; 946; 949; 967; 968; 988; 991; 1002; 1003; 1138; 1144; 1180; 1209; 1306; 1309; 1341; 1395

Keyword="Public Relations" (Contains 7 references)

624; 868; 869; 1003; 1191; 1205; 1326

Keyword="Statistics" (Contains 161 references)

133; 157; 164; 166; 167; 169; 176; 182; 183; 185; 197; 200; 204; 215; 223; 237; 239; 264; 265; 273; 276; 277; 294; 306; 309; 312; 316; 322; 336; 346; 349; 362; 370; 371; 372; 373; 374; 375; 376; 377; 379; 380; 381; 384; 399; 400; 402; 403; 404; 405; 419; 435; 447; 450; 451; 464; 467; 469; 470; 471; 579; 580; 597; 598; 599; 600; 601; 602; 603; 604; 605; 606; 620; 814; 842; 843; 844; 845; 846; 859; 866; 869; 882; 885; 886; 893; 894; 895; 896; 905; 910; 912; 923; 928; 941; 942; 943; 944; 945; 948; 951; 955; 958; 964; 978; 979; 983; 986; 991; 993; 995; 1010; 1011; 1016; 1021; 1139; 1140; 1141; 1167; 1168; 1171; 1172; 1173; 1174; 1175; 1176; 1177; 1178; 1179; 1181; 1182; 1184; 1185; 1189; 1197; 1203; 1205; 1218; 1222; 1229; 1231; 1242; 1244; 1247; 1305; 1316; 1337; 1338; 1339; 1347; 1348; 1365; 1370; 1371; 1375; 1376; 1382; 1385; 1387; 1388; 1389