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Reducing Gull Hazards to Aviation by Controlling Nesting Populations

John L. Seubert

Denver Wildlife Research Center
Building 16, Denver Federal Center
Denver, Colorado 80225
USA

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 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 quickly by other methods, there should be no reluctance to making habitat unsuitable for nesting or killing gulls using humane methods. Countries that reduce adult gull populations have accepted the premise that if gulls become hazards then they 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. Enhancement of U.S. bird management programs is needed and would require higher priorities, greater resources, and the adoption of a stronger safety ethic by the responsible agencies.

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Year	Num L
1979	
1980	1
1981	1
1982	1
1983	4
1984	6
1985	8
1986	6
1987	1
1988	1
1989	1
Totals	80

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1.0 Introduction

This paper is prompted by a serious gull hazard problem at John F. Kennedy Airport (JFK), N.Y., N.Y. caused by a colony of nesting laughing gulls (See Appendix A for scientific names) located in Jamaica Bay Wildlife Refuge within 0.4 km (0.25 mi) of the airport. The refuge consists mostly of open bays and salt marsh islands and is part of Gateway National Recreation Area administered by the U.S. National Park Service (NPS).

The gulls nest on three islands encompassing 477 acres: Joco Marsh, East High Meadow, and Silver Hill Marsh. The gulls arrive in April and migrate south in October. The nesting population began with 15 pairs in 1979, increased to 325 pairs in 1981, 2741 pairs in 1985, an estimated 3000 pairs in 1989 (Table 1.0), and about 6000 pairs in 1990 (R.A. Dolbeer, pers. commun.). This accelerated growth was much greater "than could have occurred from reproduction in the colony, suggesting that many of the gulls immigrated from expanding colonies in New Jersey" (Dolbeer et al. 1989:38). New Jersey laughing gull colonies are about 113 km (70 mi) from JFK and were censused in 1989 using a helicopter. About 59,000 birds were counted. This figure represents a minimum estimate of the total population (R.M. Erwin, pers. commun.)

Collisions between laughing gulls and aircraft have increased considerably from two strikes in 1979 to 180 strikes in 1988 and 179 in 1989 (Table 1.0). These high numbers of strikes in 12-month periods probably were only exceeded in the United States by the large numbers of Laysan and black-footed albatrosses struck or killed by aircraft on Midway Island (Robbins 1966).

Table 1.0 Birds involved in strikes with aircraft, JFK Airport, and estimated number of nesting pairs in laughing gull colony on Jamaica Bay, 1979-89 (Excerpted from Dolbeer et al. 1989, Table 2).

	Number of gulls (% of all gulls)					Estimated
Year	Laughing gulls	Other gulls	All gulls	Other birds	All birds	Nesting Pairs a/
1979	2 (2)	111 (98)	113	25	138	15
1980	19 (17)	96 (83)	115	28	143	235
1981	18 (22)	63 (78)	81	40	121	325
1982	14 (17)	70 (83)	84	61	145	715
1983	43 (29)	106 (71)	149	55	204	1,805
1984	60 (30)	139 (70)	199	90	289	2,802
1985	86 (30)	199 (70)	285	100	385	2,741
1986	62 (57)	46 (43)	108	25	133	3,000
1987	137 (65)	75 (35)	212	32	244	2,875
1988	180 (55)	149 (45)	329	32	361	2,665
1989	179	109	288	29	317	>3,000
Totals	800 (41)	1,163 (59)	1,963	517	2,480	

a/ Laughing gulls -- Jamaica Bay Wildlife Refuge.

In addition to the great number of laughing gull strikes at JFK, airport records indicate that since 1986 three DC-10 takeoffs were aborted because of laughing gull ingestions into engines. One incident required an engine change and another involved a damaged engine. Therefore, even though the laughing gull weighs less than several other species commonly involved in bird strikes, e.g., herring, great black-backed, and the ring-billed gull (See Appendix B for bird weights), this species is hazardous to aircraft since even one 10-12 ounce (284-283g) bird can cause severe engine damage. Furthermore, laughing gull strikes involving three or more birds have been increasing (Dolbeer et al. 1989). Because laughing gulls account for the majority of strikes at JFK, it would seem prudent that all measures should be taken to reduce this hazard.

For suggestions and technical information I thank D.G. Buechler, R.R. Cowser, W.H. Drury, J.L. Guarino, C.H. Halvorson, C.A. Ramey, and J.E. Seubert.

2.0 Actions to Resolve the Laughing Gull Hazard at JFK Airport

In 1989, at the invitation of the NPS, a panel of four biologists from other countries assessed the hazard at JFK caused by laughing gulls nesting on NPS marshes in Jamaica Bay, and made recommendations for reducing the hazard. Their report states in part, "that the laughing gull colony in its present location presents an unacceptable hazard to aircraft operations at JFK." The panel also expressed the opinion that an effective control program for the 1990 nesting season should include the oiling of all eggs in the colony (Thomas et al. 1989).

3.0 Bird Hazards to Aviation

3.1 Incidents and Accidents

An extensive literature documents that many species of birds, especially gulls, are serious hazards to aviation in many countries. Most of the serious incidents are bird strikes on engines and windscreens. Gulls account for a high proportion of bird strikes, and they have caused damage to many aircraft and even the loss of aircraft and occupants (Seubert 1963, 1977, Hild 1969, Blokpoel 1976, Rochard and Horton 1980, Frings 1984, Thorpe 1988, Thorpe and Hole 1988, DeFusco 1988, Hovey and Skinn 1989).

One gull (or bird) at the wrong place at the wrong time can cause an aviation tragedy or high economic loss, especially if ingested into a turbine-powered engine. Although an engine manufacturer has stated that "one bird was not a hazard, and that from a manufacturing viewpoint, he could take responsibility for one bird and for a one engine out situation" (Weaver 1989:8), the accident records show quite clearly that one bird in an engine can result in serious incidents or accidents as follows. A Convair 580 crashed at takeoff at Kalamazoo, Michigan, when one American kestrel was ingested into an engine (Thorpe 1984). A 737 overran a runway at a Gosselies, Belgium, while attempting to abort a takeoff after one wood pigeon was ingested into an engine (the aircraft

was a total loss) (Thorpe 1984). At Rio de Janeiro, a CFM 56 engine of a 737 failed during takeoff after a barn owl was ingested. The aircraft successfully continued the takeoff on the remaining engine, but the damage to the failed engine was substantial (B.C. Fenton, pers. commun.).

At the Dublin, Ireland Airport on 7 December 1985, the No. 1 engine (JT8D-9A) of a 737 failed in an uncontained manner during takeoff after ingesting one or possibly two black-headed gulls. The aircraft successfully continued the takeoff on the remaining engine in spite of serious associated problems as described in the official accident report (McStay 1987:24) as follows:

> "The sudden loss and displacement of the No. 1 engine, the loss of the nose cowl, the abrupt reduction in the rate of climb, the slamming closed of the power lever controlling No. 1 engine, the audio and visual warnings and the buffeting and behavior of the aircraft presented the flight crew with an emergency not rehearsed or envisioned."

There are other examples where several birds were ingested into an engine with disastrous results: an aero commander turbo prop crashed at takeoff into Lake Michigan, Chicago, Illinois, after ingesting gulls (Larus sp.) into one engine (Seubert 1978) and a DC-10 was destroyed by fire at JFK after ingesting great black-backed gulls into the right engine (Seubert 1976).

In addition, very costly and extremely dangerous incidents have occurred when birds are ingested into more than one engine. An example of such an event occurred at Los Angeles Airport in September 1989 when a 747-300 ingested four domestic pigeons into the No. 1 engine and five into the No. 2 engine on takeoff. Violent compressor stalls occurred on both engines. The No. 1 engine recovered, but the No. 2 did not, and was shut-down. Fuel was dumped and the aircraft landed at 630,000 pounds, gross weight. The No. 1 engine suffered extensive fan damage, and the No. 2 engine underwent transverse fracture of one fan blade, extensive fan and cowl damage, and loss of tailcone. These bird ingestions occurred during a critical takeoff regime -- at rotation, where the pilot was committed to continue the takeoff. If the No. 1 engine had not recovered in this incident, it is doubtful that the takeoff could have safely continued.

3.2 Bird Hazards to Turbofan Engines

Although birds are seldom ingested into turbofan engines, when this does occur it results in damage in about one half of the incidents. To obtain a better understanding about this problem, the Federal Aviation Administration (FAA) has been conducting studies to assess the extent of bird hazards to engines. Some of their results are presented in this paper, since they bear directly on my concerns regarding bird hazards to aviation, especially when large numbers of a hazardous species are nesting very close to an airport.

The FAA has assessed the potential hazards of dual engine bird ingestions to large, high-bypass turbofan engines during the take off/climb phase of flight (Cheney et al. 1981). The executive summary and conclusions include the following:

-- Parties concerned about bird hazards to aviation, such as aircraft and engine certification personnel, airframe and engine manufacturers, and airport evaluators, have difficulty in assessing overall bird strike hazards and in identifying safety trends because of a fragmented data base for bird strikes.

-- The risk of bird strikes will increase with the addition to air fleets of more wide-body transport aircraft with high-bypass turbofan engines in the short and medium haul airline markets.

-- An analysis of the best bird engine ingestion data available indicates that a dual engine failure involving a current wide-body aircraft will occur within the service life of the aircraft type, and it is estimated that several additional dual engine failure events will occur within the service life of newly certified wide-body aircraft.

-- Overall bird strikes and engine ingestions involving flocks of birds can be significantly reduced through airport bird control procedures, especially at major foreign and domestic airports.

The study by Cheney et al. (1981) presented good information for its time (B.C. Fenton, pers. commun.). However, another similar study (FAA) presently underway, will provide a much greater base of data for the years 1989-1991. A final report should be completed in early 1992.

In 1981, an investigation was begun by the FAA to determine the numbers, weight, and species of birds that are ingested into large high-bypass ratio turbine aircraft engines during service operation and to determine what damage, if any, resulted (Frings 1984). This information was requested from the three major engine manufactures under contracts with the FAA. The aircraft involved were the DC8, DC10, B747, B757, B767, A300, A310, and L1011. The executive summary and conclusions included the following:

-- Most bird ingestions, engine damage, and engine failures occurred in the bird weight range between 9 ounces (255g) and 24 ounces (680g). United States birds are heavier than birds in foreign environments. For example, Rochard and Horton (1980) report that during an 11-year period in the United Kingdom, 62.5 percent of 1541 bird strikes involved species weighing 10.6 ounces (300g) or less.

-- Gulls are the most commonly ingested bird worldwide, accounting for 35 percent of all ingestions.

-- Four-engine (wing-mounted) aircraft experience about twice the ingestion rate of wing-mounted two-engine aircraft.

-- The majority of bird ingestions resulted in either minor or some damage to engines.

-- Most ingestions occurred during takeoff or landing.

-- The probability of an engine failure resulting from the ingestion of one or more birds is about five percent.

The FAA also has a 3-year study underway to determine the numbers, sizes, and type of birds that are ingested into medium and large inlet area turbofan engines and to determine what damage, if any, results. Bird ingestion data are being collected for the B737 aircraft equipped with either JT8D or CFM 56 engines. Preliminary findings were presented in the executive summary and conclusions of an interim report that covered the first year of this 3-year study (Hovey and Skinn 1989). The findings include the following:

-- Ingestion rates appear to be proportional to either the inlet area or diameter of the engine, since no statistically significant difference in the ingestion rate of the two engines was detected after the data were adjusted for inlet area or diameter.

-- When more severe damage is inflicted on an engine, unusual crew actions are more likely.

-- The majority of bird ingestions (273 of 302) involved a single bird and a single engine on the aircraft and resulted in little or no engine damage.

A final report covering three years of data collection will not be completed until late 1990.

3.3 Engine Out Procedures

Transport turbofan aircraft with two, three, and four engines are designed to be able to takeoff even if one engine fails at V-1 a/ or later (FAA 1989). If an engine fails during takeoff the pilot can take action to abort the takeoff up to V-1. If an engine fails at V-1, the pilot can either abort or takeoff. If there is an engine failure above V-1, then the pilot is committed to takeoff (Federal Aviation Administration 1978) and should be successful if all remaining engines and systems function properly. Unfortunately, accidents have occurred with one engine out (See Bird Hazards to Aviation). The matter becomes more serious in a worst case scenario (aircraft at maximum weight), if power is lost in more than one engine shortly (a few seconds) after V-1 and the pilot is committed to continue the takeoff.

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a/ V-1 - Takeoff decision speed. Formerly denoted as critical engine failure speed. [Speed that an aircraft can accelerate to and still abort a takeoff.]

To obtain some idea about the performance of various aircraft, I asked several experts if either 2, 3, or 4-engine aircraft would be able to continue a takeoff shortly after V-1 if thrust was lost from the equivalent of 1 1/2 engines. Such a situation would result in a loss of 75 percent of the thrust in a 2-engine aircraft, 50 percent loss in a 3-engine aircraft, and 37.5 percent loss in a 4-engine aircraft. The consensus was that the takeoff probably could not continue.

Also, Cheney et al. (1981:39) discuss a worst case scenario involving a dual engine failure during the takeoff or climb regime. The authors state that "figures do not directly estimate the probability that an aircraft will be lost due to such an occurrence" and that "there are too many variables to predict the sequence of events following a dual engine failure at or above V-1, but that it should be assumed that the aircraft will overrun the runway or make a forced landing at best."

A bird ingestion into a large high bypass ratio turbine engine "is considered a rare (2.33×10^{-6}) but probable event" (Frings 1984:ix). Nevertheless, in my opinion, one would not want to lose even one engine to a bird(s) on a heavily laden aircraft shortly after V-1.

4.0 Gull Populations

4.1 Growth

The large growth in the NPS laughing gull colony adjacent to JFK is not unique. Gull populations in many countries have grown dramatically during the past 40-50 years. Drury (1963) and Kadlec and Drury (1968) document increases in New England herring gull populations, and conclude that these populations had been doubling about every 12 to 15 years, growing to an estimated 623,700 birds by 1965 (excluding the Great Lakes and the Gulf of St. Lawrence). Harris (1970) reports that herring gulls have increased greatly in Britain, probably doubling in numbers between 1950-1970. Hickling (1969) reports that black-headed gulls increased in England and Wales in excess of 25 percent during a 20-year period. A colony of silver gulls increased from 8 pairs in 1970 to 50,000 pairs in 1986 at Devonport, in northern Tasmania, according to P.M. Davidson (pers. commun.). The black-headed gull and the herring gull increased significantly in Denmark during the past several decades (Asbirk and Joensen 1974). Herring gulls increased in The Netherlands to such an extent that gulls have been controlled since 1934 (Bruyns 1958). Gibson (1979) states that a silver gull population breeding on the Five Islands, New South Wales, Australia, increased spectacularly from about 1000 pairs prior to 1940 to over 50,000 pairs in 1978. In 1989 (P. Straw, pers. commun.) estimates this population at 30,000 pairs.

An enormous increase in the number of gulls (Larus sp.) in the Ontario, Canada, portion of the Great Lakes has occurred since 1976, when the ring-billed gull (RBG) population increased from 40,787 to 163,593 nests in 1984. The RBG population in the entire Great Lakes area increased from 281,000 pairs in 1976 to 648,000 pairs in 1984 -- an average annual growth rate of 11 percent. Substantial future increases are predicted in

the numbers of RBGs nesting in the Great Lakes and St. Lawrence River region (Blokpoel 1983, Blokpoel and Tessier 1986). The growth of the RBG population at the Eastern Headland of the Toronto Outer Harbour is another good example. In 1973, 21 pairs of RBGs nested; in 1982 and 1983 there were 75,000 to 80,000 pairs (Blokpoel 1983:2).

The increase in gull populations has been attributed mainly to legal protection, availability of nesting habitat, characteristics of gulls that are suitable to man's environment, and an abundance of food -- man's waste, especially garbage, and fish waste in some areas. The use and importance of garbage is well documented (Bruyns 1958, Harris 1965, Drury and Nisbet 1969, Spaans 1971, Kihlman and Larsson 1974, Conover et al. 1979, Burger 1981, Horton et al. 1983, Patton 1988).

4.2 Gull Problems and Control

The destruction by gulls of the eggs and chicks of many other species (e.g., Sandwich, common, Arctic, and roseate terns; black guillemot; Atlantic puffin; razorbill; redshank; storm petrel; common eider; avocets) nesting on their traditional breeding grounds and gull hazards to aviation are the principal problems caused by gulls (Larus spp). These problems have become exacerbated by the growth of gull populations. Many countries have implemented control programs and the principal methods have been the oiling or pricking of eggs; shooting; harassment; exclusion; collection of eggs; destruction of eggs and nests; the use of narcotics (alpha chlorolose, alpha chlorolose plus seconal); or the use of poisons (3-chloro-4-methyl benzeamine hydrochloride [DRC-1339] or strychnine).

4.3 Rationale for Gull Control

Many countries have accepted the fact that if certain bird species are to be retained and if aviation hazards are to be reduced, other species that are detrimental to man's interests must be controlled (Monaghan 1984, Blokpoel and Tessier 1986, Mullen and Goettel 1986). Thus, for many people concerned about gull depredations and hazards to aircraft, moral or ethical questions regarding such control activities have long since been resolved.

4.4 Gull Control to Benefit Other Birds

Many world-wide examples of gull control to reduce damage to other birds have been reported: Europe (Bruyns 1958, Drost 1958); Great Britain (cited by Thomas 1972, Duncan 1978); and the United States (Kress 1983, Mullen and Goettel 1986, Folger and Drennan 1988). Some are as follows: About 38,000 herring gulls were killed with alpha chlorolose (A-C) on the Isle of May in Scotland during the years 1972-1977 (Duncan 1978). In a moorland colony near Lancashire, England, about 50,000 herring and lesser black-backed gulls were killed with A-C during the period 1978-1982 (Wanless and Langslow 1983). In The Netherlands, about 29,000 herring gulls were killed with strychnine during the period 1954-1956 (Bruyns 1958). A total of 3000 great black-backed and herring gulls were killed

with DRC-1339 in 1987 and 1988 at Matinicus Isle,. Maine (T.A. Goettel, pers. commun.).

The destruction of eggs and nests was used successfully during a 5-year period to limit gull production on Monomoy National Wildlife Refuge, Massachusetts (Lortie et al. 1984) and on Matinicus Rock, Maine during the late 70's (Mullen and Goettel 1986). According to T.A. Goettel (pers. commun.), herring and great black-backed gull nests located in the middle third of South Monomoy Island, Monomoy National Wildlife Refuge, Massachusetts were sprayed with oil and formalin in 1979 with a high degree of effectiveness. Ring-billed gull eggs have been sprayed with oil and formalin or oil during the period 1984-1990 to control reproduction on an island in Banks Lake, Washington. J.G. Oldenburg and M.E. Pitzler (pers. communs.) report that the number of RBG nests declined from 5445 in 1986 (the first year that all nests were sprayed), to 3626 nests in 1990 -- a decrease of 34 percent. An estimated 958,421 herring gull eggs were pricked or oiled during the period 1934-1952 in gull colonies located on islands along the northeastern U.S. coast mainly to reduce gull populations (method reported to be 95 percent effective), but in part to benefit terns (Gross 1952).

4.5 Gull Control to Reduce Hazards to Aviation

Gulls have been controlled frequently for the benefit of other birds, however, examples are fewer where this has occurred for reasons of air safety, even when nesting colonies are very near an airport (Dolbeer et al. 1989, Tessier 1989). Since gulls are viewed by those concerned with aviation safety as a serious hazard, there are instances where actions have been taken to reduce or eliminate dangerous local populations. My first experience with a serious airport gull hazard was in 1961 when I observed about 750 pairs of herring gulls on breeding territories at Logan Airport, Boston, Massachusetts (Drury 1963). The U.S. Fish and Wildlife Service immediately recommended that the gulls should be killed. The airport population was controlled as the result of two years of shooting -- 4468 gulls were killed (Seubert 1963).

A colony of about 8000 silver gulls, on a small coastal island near the city of Devonport in northern Tasmania, Australia, was eliminated after two years of baiting (1986-1987) with A-C bread baits. The colony was about 2.5 km (1.6 mi) from the airport. No nesting occurred on the island in 1988, although some gulls still fed at a local solid waste site. This is an example where local population elimination was very successful (P.M. Davidson, pers. commun.).

Caithness (1968, 1969, 1984) presents a chronology of 19 years of effort to control a nesting colony of southern black-backed gulls located about 0.4 km (0.25 mi) from an airport at Napier, New Zealand. Alpha chlorolose was used very successfully to kill several thousand gulls, but repeated poisoning (and some shooting) has been necessary to keep the colony free of birds each nesting season. The author believes that the control efforts have reduced bird strikes at the airport, but does not have pre-control strike statistics with which to compare. The control program will continue.

Thousands (ca 44,000) of RBG eggs were collected in 1985 and 1986 at Mugg's Island 1 km (0.62 mi) from Toronto Airport and on the airport to reduce and eliminate threats to air safety. During the same years a RBG colony of 75,000 - 80,000 nests located at the Eastern Headland, Toronto Outer Harbor, was reduced to 40,160 pairs through non-lethal means (e.g., harassment, distress calls, flying raptors). This colony is about 5 km (3.1 mi) from the Toronto Airport (Blokpoel and Tessier 1987, Tessier 1989).

Efforts to reduce herring gull hazards at Kastrup Airport, Denmark, have been reported by Lind 1971, Lind and Clennung 1977, 1984, Dahl 1984, Lind 1986, Glennung 1988. Thousands of eggs were oiled beginning in 1969 at a nesting colony located 5 km (3.1 mi) from Saltholm Island. The oiling reduced the 1969 breeding population (ca 40,000 pairs) to about 20,000 pairs by 1976. To accelerate the reduction, A-C was used for several years beginning in 1976 until the population was reduced to 5,000 pairs. Only oiling has been used since about 1987. Gull control measures at Saltholm resulted in fewer herring gulls and fewer herring gull strikes at the airport during 1976-1981. However, the total number of strikes has not decreased since 1981, and the authors suggest that the black-headed and common gulls have become more prominent. They have requested that they be able to include these species in the control program.

Finland has had an extensive gull control program for many years to reduce gull hazards at the Helsinki-Vanta Airport (and to benefit other species). To reduce the number of young herring gulls that concentrated in the airport area, the reproduction of about 6500 nesting pairs was restricted at almost all colonies in the Helsinki Archipelago located within 40 km (24.8 mi) of the airport. Collecting eggs twice during the nesting season was the most frequently used control method. Birds also were shot on the airport and shot and trapped at a garbage dump located 4 km (2.5 mi) from the airport. The trapped birds were killed with carbon monoxide. These measures have resulted in reduced gull hazards at the airport (Kunsela and Stenman 1979, Helkamo et al. 1982, Helkamo and Stenman 1984, O. Stenman, pers. commun.).

Rochard (1987) reports that a mixture of A-C and seconal was used successfully over a 3-year period to control great black-backed and herring gull colonies located on the Royal Air Force Tain Air Weapons Range. He also reports that 350 nests in a herring gull colony located in an explosive storage area were treated successfully with the same narcotic mixture. An effort to control Mediterranean gulls at RAF Gibraltar was not successful.

Also, many thousands of gulls have been shot at airports. For example, 3840 gulls were shot at the Aalborg Airport, Denmark during a 12-month period (Eis 1986). In 1978, more than 1000 herring and black-backed gulls were shot at the Helsinki-Vanta Airport, Finland (Kunsela and Stenman 1979).

5.0 Strategies for Controlling Nesting Colonies of Gulls Near Airports

The selection of methods to control nesting gull colonies should be based on the gull species involved, other birds that might be affected, the distance of a colony from an airport, the history of bird strikes, the degree of continuing risk aviation authorities are willing to assume, Federal and State regulations, the attitudes of conservation interests, and bird biology and behavior. Each problem situation requires an ecological assessment before control measures are selected and implemented. Various control strategies are as follows.

5.1 Habitat Elimination or Alteration

Much of the literature about bird hazards to aviation places the utmost importance on habitat modification as the key to permanent or long-term solutions. Aldrich et al. (1961:6) state that "steps should be taken to make the habitat on and in the vicinity of an airport less attractive to them (birds)." This early recognition of the importance of habitat has been acknowledged by many subsequent researchers. But the emphasis has been on the airport per se and not to the environment surrounding an airport except for concerns about garbage dumps. In the airport services manual published by the International Civil Aviation Organization (ICAO) methods are discussed in Chapter 7, Part 7.10, for reducing gull populations in nesting colonies that occur only in the immediate vicinity of airports (ICAO 1978). No mention is made, however, about managing or altering the habitat of nesting colonies on or off an airport. The value of environmental management is emphasized, however, under Part 6.1.3 (ICAO 1978:15) where it is stated that "with reference to bird hazards to aircraft on an airport, killing and scaring birds are therefore palliatives that should be temporary, but environmental management is the basic remedy."

Thomas (1987:5) discusses the importance of adopting a program for bird management beyond an airport, so that the numbers of birds coming to the vicinity of an airport can be reduced, thereby decreasing the amount of bird control needed on an airport. He states that "it is self evident that the close proximity of a breeding colony to an airport is incompatible with aviation safety; however, sites of this nature can often be of significant biological importance so the case for control has to be strong." Burger (1983) reports that the carrying capacity of the environment can be altered by habitat manipulation that includes the elimination of roosting areas, food sources, and fresh water. Burger (1983:123) does not include nesting colonies, yet states that "the most effective means of reducing bird strikes and maintaining low rates of them near airports are to use habitat manipulation to reduce drastically the carrying capacity of the environment for birds,...."

Wright (1968:104 and 105) reviews various methods of bird control by means of habitat modification and states that the "ultimate answer is to make airfields and their immediate surroundings unattractive to birds, or at least those species that constitute the major hazard." He further states that "Environmental control is costly, but it offers the best hope

for a long-term solution to bird control." The author suggests that species that breed on the ground might be discouraged by cultivation of the land.

Thomas (1972:122) examines habitat modification, including breeding habitat, as one means of limiting adult and immature gulls, and is of the opinion that habitat change to limit gull numbers could be a costly and time-consuming activity that "could have profound implications on non-gull species as well." He further states that habitat modification activities might have to be restricted to areas where only gulls occur in high numbers, and "to places where extreme habitat manipulation could be tolerated (e.g., alongside airstrips)." Solman (1970, 1973a, 1984) also stresses the importance of habitat modification, especially on airports, as a means of effecting long-term hazard reduction.

If as a last resort, a decision was made to eliminate or alter U.S. gull nesting habitat for reasons of aviation safety, it would be very difficult to accomplish because of the need to comply with Federal regulations concerned with environmental protection (unless prompted by an aviation disaster caused by gulls from a nearby colony). For example, if the destruction of nesting habitat would entail the placement of fill material in a wetland, a permit would be required from the Army Corps of Engineers in accordance with Section 404 of the Clean Water Act (Corps of Engineers, Department of the Army 1986). The Corps issues such permits in accordance with Section 404(b)(1) guidelines promulgated by the Environmental Protection Agency (EPA 1980). These guidelines have specific requirements for considering practical alternatives to such filling activities, and for mitigating unavoidable impacts (replacement of habitat). The procedures these agencies will use to define mitigations are addressed in a recent Memorandum of Agreement (MOA) between these agencies (EPA 1990, D.G. Buechler, pers. commun.).

Furthermore, if an action by a Federal agency might potentially adversely impact migratory birds, the need to prepare an Environment Assessment (EA) must be considered under the National Environmental Policy Act (NEPA). If such an EA determines that a significant impact will occur, an Environmental Impact Statement (EIS) would be required. Also, any taking of a migratory bird or its eggs or young requires an advance permit from the Law Enforcement Division of the U.S. Fish and Wildlife Service (USFWS) (D.G. Buechler, pers. commun.).

Under the USFWS Coordination Act, the USFWS, the National Marine Fisheries Service, and State Fish and Wildlife agencies are consulted for advice under both the Clean Water Act and NEPA. The USFWS recommendations regarding habitat will be provided in accordance with its Mitigation Policy which states a preference for replacement of in-kind habitat values on or near a project site for a species regarded as important (USFWS 1981, Buechler, pers. commun.).

In NEPA, the term mitigation includes: "(a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and

its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments" (USFWS 1981:7657). These steps are also essentially described in the USFWS mitigation policy which the Service follows when fulfilling its advisory role to the Corps of Engineers. This sequence of mitigation is further defined in the recent MOA between the Corps and the EPA which provides guidance on how to meet the requirements of EPA's Section 404(b)(1) guidelines (EPA 1990, D.G. Buechler, pers. commun.). Mitigation is generally considered to include avoiding or minimizing adverse impacts on fish and wildlife and their habitat, and compensating for unavoidable losses of those resources (Soileau et al. 1985).

The acquisition of permits to alter habitat involves a complex process. Nevertheless, if other options are inappropriate or unavailable, there should be no reluctance to obtain permits to alter or remove habitat if such actions are needed to accomplish a permanent solution to a serious bird hazard, even if the habitat is located at a sanctuary or refuge. An example of how aviation hazards might be affected by the modification of gull nesting habitat very near to an airport is given in Table 5.1.

Table 5.1 Eliminate or Alter Nesting Habitat a/

	Result/Outcome
Degree of Control Achieved	100 percent
Number of Gulls b/	None
Number of Young Produced	None
Degree of Hazard c/	None

a/ Plow, cultivate, plant, dredge, fill, pack, etc.
b/ In nesting colony.
c/ If habitat change was made between nesting seasons, and if gulls returning to nest would not remain in the airport area.

5.2 Gull Population Control

Although there have been only a few instances where gull nesting colonies have been depopulated for reasons of air safety, the methods used have been very successful and hazards to aviation presented by these colonies have been eliminated or significantly reduced. If gulls establish nesting colonies in very close proximity to an airport and pose a serious hazard to aviation, colony depopulation is an option that should receive serious consideration. However, because of societal concerns for the environment and wildlife and because of international agreements and State and Federal regulations that safeguard man's environmental interests, the killing of a migratory species, even for purposes of aviation safety, would require very strong justification and a broad base

of support from all interested parties. A proposal to depopulate a gull colony in the United States would require adherence to mitigation procedures under the USFWS Mitigation Policy.

In North American there appears to be little hesitancy (with few exceptions) on the part of resource managers, biologists, State and Federal agencies, and conservation organizations to support the killing of gulls on local nesting grounds for the benefit of other birds. My perception is that there is less enthusiasm for killing gulls on nesting grounds for aviation safety. Control of regional gull populations by use of narcotics or poisons is purported to be: impractical, too time consuming, too costly, ineffective because of immigration of birds from other areas, a potential hazard to nontarget species, subject to criticism from animal rights organizations, socially unacceptable in many countries, unfeasible, logistically difficult, and probably would require international cooperation (Thomas 1972; Solman 1973b, 1983; Blokpoel 1976, 1983, 1984; Blokpoel and Tessier 1986). These are real concerns, however, these potential drawbacks should not preclude the use of lethal measures to eliminate local gull nesting populations that pose hazards to aviation. Thomas (1972:125) states that "at homogeneous colonies of gulls, direct narcotization or poisoning seem the most efficient methods even if the work must be done annually, and one does not have to resort to the laborious time-consuming activities directed against eggs and chicks."

My point is that local gull nesting populations have been successfully eliminated or significantly reduced and the concerns heretofore mentioned regarding large scale population control programs have not been obstacles. When gull nesting colonies cause severe hazards to aviation, there should not be a reluctance to kill gulls, if significant hazard reduction cannot be accomplished quickly by other methods. Logically, gull control to benefit aviation safety should have a higher priority (or just as high a priority) than control to benefit other birds, and should not require a greater level of justification than needed to control gulls for the benefit of other birds. For society to place a higher value on bird life rather than human life is sheer hypocrisy. The knowledge and means exist today that would permit the control of nesting gull populations humanely, safely, and efficiently. An example of how aviation hazards might be affected by the depopulation of gull nesting colonies very near to airports is given in Table 5.2.

Before programs to kill gulls for aviation safety could be initiated, however, various necessary elements must be present as follows: (1) high motivation to enhance aviation safety; (2) strong justification for a proposed action supported by biological data and objective ecological rationale documenting that alternative measures were evaluated; (3) the availability of approved or registered lethal or narcotic agents; (4) the availability of humane methods; (5) professional public relations programs about the need for a proposed action; (6) adequate resources and time; (7) effective program management; (8) adherence to all applicable State and Federal regulations; (9) program monitoring and assessment; and 10) international cooperation (if needed).

Table 5.2 Depopulate Nesting Colony, i.e., Kill Adults a/

	Result/Outcome
Degree of Control Achieved	Almost 100 percent
Number of Gulls b/	None/Very Few
Number of Young Produced	None/Very Few
Degree of Hazard c/	None/Very Low

a/ Use ORC-1339 or alpha chlorolose; some shooting required. Control method would be needed each year that gulls nested.
b/ In nesting colony.
c/ The hazard probably would be high the first spring of control before gulls are killed. Hazard probably would be low to moderate in successive springs prior to subsequent depopulations, depending on the number of new gulls that would attempt to nest.

5.3 Control of Reproduction

5.3.1 Collect Eggs or Destroy Eggs and Nests

Examples have been given in this paper about programs to reduce or eliminate gull depredations on other birds and gull hazards to aviation either through collection of gull eggs or the destruction of eggs and nests. For such strategies to be most effective, control of colonies (elimination or reduction) should be accomplished when they are relatively new, when only a few gulls are involved, and before they have become well established. New gull colonies can increase to thousands of birds in two or three years (Blokpoel and Tessier 1987), especially if there are other populations nearby that could be a source of immigrants. The laughing gull colony in Jamaica Bay, N.Y. is a good example.

If airports with a gull problem similar to that at JFK were not able to effect more permanent solutions to abate gull hazards (e.g., alter gull nesting habitat or depopulate a colony), a strategy of collecting eggs or egg and nest destruction might be considered. However, Morris and Siderius (1990:125), state that "Removing eggs usually proves unsatisfactory because adults will renest after a brief refractory period." Thus, egg collections must be made several times during the nesting season, and the adults could cause aviation hazards between nesting attempts.

According to the Royal Society for the Protection of Birds (RSPB), if the intent is to prevent gull nesting, the success of egg and nest removal (destruction) could depend on the species of gull (RSPB 1982:2). The RSPB statement is as follows:

> "The removal of eggs and nests is successful in discouraging the breeding of gulls in small, new gull colonies and also in the large

colonies of black-headed gulls. Herring and lesser black-backed gulls however, do not respond to such methods when in large colonies. They remain faithful to their nesting territories and fight off all other gulls and terns."

Thus, if other gull species reacted as do black-headed gulls to egg and nest destruction, nesting would be discouraged and the control method might be used at a colony located adjacent to an airport so long as gull activity between nesting attempts did not cause increased aviation hazards. However, if other gull species reacted to egg and nest destruction as does the herring gull in Great Britain, additional measures such as harassment might be necessary. This was the case in several Canadian operations where harassment was used in addition to egg collections to reduce or eliminate ring-billed gull colonies (Blokpoel and Tessier 1987). Egg and nest destruction or the collection of eggs plus harassment, would not be an appropriate strategy at a gull colony located adjacent to an airport because harassed birds could present hazards to aviation. An example of how aviation hazards might be affected by the collection of eggs or the destruction of eggs and nests at a gull colony very near to an airport is given in Table 5.3.1.

Table 5.3.1 Control of Reproduction: Collect Eggs or Destroy Eggs and Nests a/

	Results/Outcome
Degree of Control Achieved	>95%
Number of Gulls b/	Many thousands
Number of Young Produced	Very Few
Degree of Hazard c/	High

a/ Control method would be needed each year that laughing gulls nested; some shooting would be required.
b/ In nesting colony.
c/ The hazards (mostly adults) probably would be high before nesting, between nestings, and after final egg collection or egg and nest destruction (if most of the adults remained in the airport area).

5.3.2 Oil Eggs

As has been reported earlier, gull reproduction has been controlled by spraying eggs in nests with a mixture of oil and formalin. The treating (spraying) of eggs with petroleum products appears to have a direct toxic effect on embryos (Eastin and Hoffman 1978). White, et al. (1979) reported that when No. 2 fuel oil was applied experimentally to laughing gull eggs in the field (20u/per egg), embryonic mortality occurred in 83 percent of the eggs. Morris and Siderius (1990) experimentally treated

RBG eggs in the field with two or three applications of a mixture of 65 percent light grade commercial petroleum oil (dormant oil) and 35 percent water. The authors report that with two applications of the oil, irrespective of the stage of embryo development, the hatchability of RBG eggs was reduced to zero. Also of considerable interest is that incubation of treated eggs continued for more than 6 weeks after the usual time of hatching. Gull reproduction appears to be effectively controlled by oiling eggs, especially if more than one application of oil is made in the case of the RBG. An example of how aviation hazards might be affected by the oiling of eggs at a gull colony very near to an airport is given in Table 5.3.2.

Table 5.3.2 Control of Reproduction: Oil Eggs a/

	Results/Outcome
Degree of Control Achieved	>95%
Number of Gulls b/	Many thousands
Number of Young Produced	Very Few
Degree of Hazard c/	High

a/ Control method would be needed each year that laughing gulls nested; some shooting would be required.
b/ In nesting colony.
c/ Hazard (mostly adults) probably would be high before nesting and after nest abandonment (if most of the adults remained in the airport area), and low while clutches of oiled eggs are being incubated.

Before gull eggs could be oiled operationally in the United States, a State or an EPA registration would be needed. If a Federal registration were needed, considerable time and expense could be required. Field research can be conducted under an Experimental Use Permit (EUP) if issued by EPA. Gull control operations per se must be conducted under a State-issued Special Local Needs Registration (24-C), or under a Federal EPA Section 3 Registration that usually includes all of the United States. A Section 18 Special Exemption may be issued by EPA to resolve an acute health, safety, or economic problem (EPA 1989).

If the goal is to prevent the production of young to stabilize or reduce nesting populations, the technique of oiling gull eggs appears to be an effective management strategy (Gross 1952, Lind 1971, Dahl 1984). However, if the goal is to eliminate gull colonies because they present unacceptable hazards to aviation, oiling would be a very poor strategy, because no information from world-wide sources indicates that oiling of eggs has ever resulted in gulls completely abandoning a colony. Thus, oiling would curtail reproduction, but a significant reduction in the adult breeding population is highly unlikely. If a colony were adjacent

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to an airport, many adult gulls would be in close proximity to the airport during nesting seasons and present hazards to aviation as long as the population existed.

To rely on interference with gull reproduction at nesting colonies located very near airports as a means of controlling hazards to aviation exposes air carrier passengers and crews to unnecessary risks in view of the availability of more effective means of hazard reduction. Gull control measures should be used that will eliminate hazards as soon as possible.

5.4 Other Control Methods

Other methods have been examined for preventing gulls from nesting at a colony very close to an airport, but for one or more reasons were not considered appropriate.

Harass birds using pyrotechnics (shell crackers), broadcast distress calls, owl models, the flying of raptors, vehicle patrols, foot patrols, whistles, tethered hawks and owls, dead gulls thrown into the air (Blokpoel and Tessier 1987), propane cannons, shellcrackers, scarecrows (Lortie et.al. 1984), shooting, and human disturbance (Kress 1983). According to H. Blokpoel (pers. commun.), RBGs can be prevented from nesting with intensive harassment using a variety of methods. Constant harassment of herring and black-backed gulls eventually results in the temporary abandonment of a colony site (Mullen and Goettel 1986). Harassment, however, could adversely affect nontarget birds, and probably would cause increased hazards to aviation. For example, Lortie et al. (1984) reported that laughing gulls either ignored harassment or were seriously disrupted.

Introduce predators such as red foxes and raccoons. Decreases in the size of herring gull colonies and the abandonment of islands as breeding sites occurred after red foxes and raccoons were released on gull nesting islands (Kadlec 1971). Predators, however, would adversely affect nontarget birds, and disturbance of a colony could cause increased hazards to aviation.

String wires or monofilament lines above ground to exclude gulls from nesting habitat (Blokpoel and Tessier 1983). Gulls would be excluded from the wired or lined areas, however, the suitability of this technique would depend on the size of an area, the nesting density, topography of a site, type of substrate, and the availability of resources to ensure proper maintenance -- repair structure and remove birds that became entangled (H. Blokpoel, pers. commun.). Nontarget birds could be adversely affected.

Mow or burn vegetation. Nontarget birds could be adversely affected.

6.0 Discussion

I view any situation where thousands of gulls are in a nesting colony very close to an airport (e.g., < 1.6 km or < 1 mi) as a very serious hazard -- one that warrants prompt and aggressive corrective measures. Furthermore, allowing such a colony to continue to exist places airport managers in the untenable position of being responsible for ensuring that an airport is safe from bird hazards, yet leaves managers unable to control the source of such hazards. Persuading those in control of such sites to eliminate hazards probably would be difficult, especially if nesting colonies were located on sanctuaries or refuges. Those responsible for airport safety could be practicing the state-of-art in bird management on an airport, but with thousands of birds nearby, could they ensure a high level of safety? Thus, in case of accidents caused by gulls from nearby colonies not under the control of airports, the courts would be faced with a dilemma - who would be held responsible?

Scorer (1988), a solicitor who has been involved in bird hazard litigation, discusses how airports may avoid liabilities due to bird strikes by the adoption of effective, efficient, and well documented bird control procedures. His paper does not indicate, however, how an airport can protect itself from being overwhelmed with birds, when bird attractants, such as breeding colony sites, roosts, and garbage dumps are near an airport, and cause high hazards to aviation when the birds intrude onto or over the airport.

The record clearly shows that when even one bird of relatively light weight is ingested into a turbine powered engine during a critical takeoff regime, severe engine damage, engine failure, and the loss of an aircraft and occupants can occur. Thus, overall airport bird management should have the goal of providing safe airport environments vis-a-vis bird hazards regardless of the source of birds. Therefore, management of birds and habitat beyond airport boundaries must receive a much higher priority -- even if litigation is needed to obtain approval to eliminate certain highly hazardous bird species or alter their habitats.

Actions have been taken or are underway in the United States to address certain aspects of the problem. Completed or near-completed FAA studies to determine the hazards from birds ingested into turbofan engines will be "useful in re-evaluating engine certification test criteria specified in 14 CFR 33.77, and, as a result, future jet engines can be designed to withstand more realistic bird threats" (Cheney et al. 1981, Frings 1984, Hovey and Skinn 1989:1). In a very recent development, the FAA issued a new order in January 1990 (5200.5A Waste Disposal Sites On Or Near Airports), that provides guidance on the establishment, elimination, or monitoring of landfills, open dumps, waste disposal sites or similar facilities on or in the vicinity of airports.

In addition to these FAA activities, the Aerospace Industries Association (AIA) has a propulsion subcommittee on bird ingestions with the objective of reviewing FAA Federal Air Regulations (FAR) regarding the adequacy of 14 CFR 33.77, Bird Ingestion Standards, and of making recommendations for

changes, if needed. The Flight Safety Foundation (FSF) has established an ad hoc power plant working group to: identify airports throughout the world viewed as the most hazardous to transport aviation with regard to flocking birds; advise airport and government officials about the significance of bird hazards at certain airports to create an appreciation of the magnitude of the concern of industry; and offer, if requested, technical advice on methods of hazard reduction (A.K. Mears, pers. commun.).

Although some progress is being made to reduce hazards, integrated bird hazard management programs are needed that involve all aspects of the problem -- what Miller (1985) might identify as a program of "System Safety." He defines "system safety" as "the application of engineering, operations, and management tasks specifically organized to achieve accident prevention over the life cycle of the air vehicle under consideration." The FAA made a commitment to air safety in their policy statement of March 1972 (still current), that states, in part, that ..."The agency will assume the initiative not only in attempting to identify unsafe conditions, but also in seeking to implement improvements or corrections before actual incidents occur..." (Cited by Miller 1985:3.2-4-5). There are examples, however, where safety measures were not adequately enforced, even though the hazards that caused them had been previously identified (Seubert 1976, Briscoe 1989).

In my opinion, significant enhancement is needed in the United States in bird hazard reduction programs. This includes: a much higher priority and greater resources; less concern about personal and institutional philosophies that oppose controlling bird species to benefit aviation safety -- safety should be the overruling priority; and the adoption of a stronger safety ethic of proactive hazard reduction by the responsible agencies -- the need is for the full implementation of safety measures as soon as bird hazards develop, not after serious incidents or accidents.

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8.1 Appendix A

Common and Scientific Names

Birds

American Kestrel	*Falco sparverius*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Avocet	*Recurvirostra avosetta*
Barn Owl	*Tyto alba*
Black-footed Albatross	*Diomedia nigripes*
Black-headed Gull	*Larus ridibundus*
Black Guillemot	*Cepphus grylle*
Common Eider	*Somateria mollissima*
Common Gull	*Larus canus*
Common Tern	*Sterna hirundo*
Great Black-backed Gull	*Larus marinus*
Rock Dove (domestic pigeon)	*Columba livia*
Herring Gull	*Larus argentatus*
Laughing Gull	*Larus atricilla*
Laysan Albatross	*Diomedea immutabilis*
Lesser Black-backed gull	*Larus fuscus*
Mediterranean Gull	*Larus melanocephalus*
Razorbill	*Alca torda*
Redshank	*Tringa totanus*
Ring-billed Gull	*Larus delawarensis*
Roseate Tern	*Sterna dougallii*
Sandwich Tern	*Sterna sandvicensis*
Silver Gull	*Larus novaehollandiae*
Southern Black-backed Gull	*Larus dominicanus*
Storm Petrel	*Hydrobates pelagicus*
Wood Pigeon	*Columba palumbus*

Mammals

Red Fox	*Fulvus vulva*
Raccoon	*Procyon lotor*

8.2 Appendix B

Bird Weights

Common Name	Weights	Source
American Kestrel	F-120±9.2g M-111±9.3g	Dunning 1984
Barn Owl	F-490g(382-580g) M-442g(299-580g)	do
Black-headed Gull	Avg. wt of 275g (116-390g)	Brough 1983
Great Black-backed Gull	F-1488g(1033-2085g) M-1829g(1380-2272g)	Dunning 1984
Herring Gull	F-1044g(717-1385g) M-1226g(755-1495g)	do
Laughing Gull	325±15.9g	do
Ring-billed Gull	F-471±46g M-566±42g	do
Rock Dove (domestic pigeon)	542±32.2g (494-616)	do
Wood Pigeon	Avg. wt. of 465g (258-739g)	Brough 1983

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REPORT OF THE CHAIRMAN

Monday, 21 May 1990

For the first time in the history of BSCE, we convene in Helsinki, the capital of Finland.

When I went through my files, I could see that the first indication of the possibility to meet here dates from a meeting 8 years ago between Lars-Olof Turesson and Helkamo during our meeting in Moscow, but the final decision was only revealed to us during the Rome meeting 6 years ago. This fact will illustrate that you have to plan well in advance of a BSCE meeting and I shall use this opportunity to urge countries which would like to act as host countries to contact me as soon as possible.

Since our last meeting in Madrid, the Steering Committee has met once. It was in Copenhagen in November last year. We made preparations for this meeting and had a discussion on some other items.

Among those items I shall mention the following:

1. We are faced with the deplorable fact that Vital Ferry whom we saw for the last time in Rome and who has participated in the meetings right from the beginning, will no longer be available. In fact, he retired in the beginning of this year. This fact has left us with the problem of the chairmanship of one of the working groups, the Communications Working Group. At the Steering Committee meeting it was, however, decided to dissolve this working group and transfer the work to other working groups. It is the Bird Movement and Low-Level Working Group and the Radar Working Group.

2. At the Steering Committee meeting we also discussed at some length the terms of reference both of BSCE and of the various working groups. If you compare the terms of reference of BSCE in the Invitation Letter with the terms of reference to be found previously, you will notice the addition of a new subpara. b) reading "establish liaison on further research programme in order to avoid duplication". In the same Invitation Letter you will also find

under para. 6, terms of reference of the various working groups as worked out during the Steering Committee meeting. You will remember from the last meeting that your chairman was asked to work out terms of reference of Bird Remains Identification Working Group and change the terms of reference of the Working Group Structural Testing of Airframes. At the Steering Committee meeting we used the opportunity to refrase the terms of reference of all the working groups to make them more consistent, but I would like at this point to stress that the terms of reference in the Invitation Letter are only tentative and that we expect in a Plenary meeting later this week to come to a decision as to the final terms of reference based upon proposals from the various working groups. Those of you who have participated in the past will also have noticed that the Analysis Working Group has been renamed Statistics Working Group. In this connection, I would add that I am aware that there will be a discussion within the Bird Movement and Low-Level Working Group to the effect that the name of this working group should be changed to Working Group Military Low-Flying Bird Strike, and that the Radar Working Group would like to be renamed Working Group Remote Sensing of Bird. It was further agreed that BSCE needed PR. Consequently, our Finnish hosts have arranged a press conference later today. I have made a press release regarding the work of our Committee and at the press conference, which is scheduled to take place just before lunch, I will face the Finnish press together with John Thorpe, Luit Buurma, H. Helkamo and S. Kirjonen. If you had turned on the Finnish channel 3 early this morning, you would also have seen Mr. Kirjonen discuss bird strike problems in the Finnish TV.

3. At the Steering Committee meeting we also agreed on some changes in the Invitation Letter as to our way in structuring and presenting the working papers. Among other things, you will see, and I will stress the importance of it that it is assumed that participants to the meeting have already studied the working papers, at least the working papers available at the beginning of the meeting. This should have as a consequence that the oral presentation of a working paper should be reduced to a summary of the paper and not take more than 15 minutes in order to allow time for discussion. To some extent, we have seen that the lecturers have taken good notice of our recommendation that working papers should contain

references to proceedings of earlier meetings to avoid recapitulation of the work done in the past.

I am quite satisfied that we this year have received 28 working papers compared with the 20 working papers received before the deadline two years ago.

As to the papers received after the extended deadline, you will find them at the entrance of the meeting place, and if you would like to present more working papers, you should address my secretary, Kirsten Mortensen, who will be responsible for numbering the papers so that we can avoid the confusion we to a certain extent had at our last meeting.

I shall now turn to the work performed the last two years in the various working groups, and the first will be the **Aerodrome Working Group** with Heikki Heikamo as chairman. The main task of the Aerodrome Working Group has been the updating of the BSCE Green Booklet, "Some Measures Used In Different Countries For Reduction Of Bird Strike Risk Around Airports", and publishing the fourth edition of this Booklet. It was in my hands yesterday. Members of BSCE have been very active by sending their contribution for the new edition following the recommendation of our meeting in Madrid in 1988. I am sure that the Green Booklet, as it is now, will be an effective tool in our work for reduction of bird strike risk. The importance of this Booklet should not be under-rated. From time to time, I receive requests to obtain samples of the Booklet from all parts of the world, and I think that this Booklet has been of great importance as to make our existence known all over the world, at least in aviation business.

In this connection, I draw your attention to the work being performed by ICAO in amending the new edition of the ICAO Airport Services Manual, Part 3, Bird Control and Reduction. After the Steering Committee meeting we indicated that we were willing to assist in the preparation of the new edition, and I have been informed by ICAO that they were very pleased to accept that offer. The best way to do that will of course be to have consolidated BSCE comments on the draft updated Manual. The draft is, by the way, to a certain extent based on the information contained in the third edition of the Green Booklet. This common approach I consider, however, is impracticable, but Mr. José Santamaria from ICAO has sent copies of the draft to all members of the Steering Committee. As usual, our German friends have

already answered, and I can promise that ICAO will also have an answer from the Danish authorities before 1 July, and I shall urge other countries to do likewise and inform both the chairman of the Aerodrome Working Group and me.

Next comes the work performed by the **Statistics Working Group**, or as it was previously named the Analysis Working Group.

At our last meeting, this group was left with 5 recommendations:

1. Military low-level en route strikes should be analysed separately by BSCE members after working out separate forms. This I am happy to announce has been implemented.

2. Details of military accidents and serious incidents should be sent by BSCE members to Dr. Becker, Germany, for inclusion in a paper describing serious strikes to military aircraft. This has also been implemented.

3. As to the third recommendation, the Working Group Chairman has written to ICAO and requested that the new field be added to the IBIS data base regarding the proposal that means should be provided to handle civil data to be analysed by reporter's occupation. We know that the United Kingdom and other countries have used this data for some years, and the appropriate authorities in other countries should be urged to provide it to ICAO.

4. Regarding the fourth recommendation that civil BSCE members should ask their major airlines for their movement data at airports in their system and that this data should be combined with reports from airports and be passed to the Working Group Chairman so as to indicate those airports where a bird strike problem exists, it is hoped that this recommendation be progressed at our meeting.

5. Regarding the fifth recommendation that BSCE analysis should be sent by BSCE members to the Working Group Chairman for civil analysis and to Dr. Becker for military data to the agreed timetable, I can inform you that some countries have been able to provide their data. I am further aware that the working group will propose that five-years papers be produced instead of

the annual analysis. The result of this will be that civil data for 1981–1985 will be presented at our meeting this year, and it is suggested that the data from the years 1986–1990 be presented at our next meeting.

Concerning the work of the **Working Group Bird Movement and Low-Level**, I have been informed that the chairman has not received any information concerning new bird hazard maps in the national AIP'ies nor airport vicinity maps as recommended during our last meeting. We should take into account that maps of protected areas and other areas of ornithological importance can be based on the Technical Publication No. 9 of the International Council for Bird Preservation, Important Bird Areas in Europe, which was revised last year.

Regarding an exchange of actual data concerning medium and high bird intensities, we emphasized at our last meeting that the procedures of bird strike warnings are mainly significant for military aircraft flying at low level. Consequently, the military participants agreed to intensify the contacts on this subject besides the regular meeting of the whole Working Group. This objective was realized at two meetings held in Germany in September 1988, and in September 1989. The work in session of experts also from the Radar Working Group took place in February 1989, and participants from the Belgian Airforce, Canadian Airforce, German Airforce, Royal Netherlands Airforce, Royal Airforce, and US Airforce surveyed the actual situation and agreed to the following recommendations:

1. Nations should pursue the aim of calibrated electronic assessment of radar data concerning the low level bird hazard.

2. Nations should evaluate the capability of currently deployed radar systems and the future or projected radar systems to fulfil the aim of electronic assessment of such radar data.

3. Nations should investigate the possibility of contributing to a dedicated multi-national system for detecting and reporting of actual data concerning medium and high intensities of bird migration as well as the dissemination of bird strike hazard warnings.

4. And finally, that national air staffs should consider or reconsider how the bird strike warnings can be obtained without delay and loss of information.

Next, I will turn to the **Radar Working Group**, and I am very happy to report that the chairman has brought with him a booklet on The Application Of Radar For Bird Strike Reduction. It is a collection of empirical experiences. You will observe that the work on the booklet has just been finished, if you look at page 75 with the picture of a NF-5 grounded after collision with racing pigeons 4 May 1990, Holland.

Regarding the other work of the Radar Working Group, I will take my starting point in a discussion we had at our Steering Committee meeting and which I have very briefly mentioned in the beginning of my report.

The Steering Committee expressed some concern regarding the not too clear separation of tasks among the working groups Bird Movement and Low-Level and Radar.

During a recent meeting of some of our experts in the beginning of last month mainly composed by members of the Bird Movement and Low-Level Working Group, the participants agreed upon a proposal which, I understand, will be discussed in the working groups concerned. The participants were aware that the meeting, which was convened as a Bird Movement and Low-Level Working Group meeting, could not be considered as a pure working group meeting of that working group. A roughly equal amount of time was spent on matters related to the work of the Statistics Working Group, the Bird Movement Working Group and the Radar Working Group. Matters which belong to the working groups Structural Testing and Aerodrome also arose.

In a way, the discussion at the recently held meeting was restricted as it was reduced to the military aspects and only for a limited number of airforces, namely those that fly above Germany. The representatives, however, agreed that this meeting should not lead to a separation from BSCE and the bird problems in civil aviation. As most of you know, BSCE had as starting point the problem regarding bird strikes which faced the military, but we also know that the civil side has taken more and more interest. We are aware that solutions for civil aviation can often best

be tested by the military. One fact is that economical contraints are mostly less severe in that sector.

This has had as result that the Chairman of the Working Group Bird Movement and Low Level during the Working Group meeting will propose that the Working Group be changed to a Working Group Military Low Flying Bird Strike, and that the Chairman of the Radar Working Group will propose that the name of that Working Group be changed to Working Group Remote Sensing of Birds.

The reason for these proposals are as follows: By using the new name for the Bird Movement and Low Level Working Group we achieve a better indication of the items which are discussed and the work which is done i.e. discussion of all aspects of the prevention of en route bird strikes which up to now, as all know, is mainly a military problem. During BSCE meetings, this Working Group is open for the civil representatives and has a broad scope. Outside BSCE meetings, more specific military problems can be solved including classified aspects if they occur.

You do not miss much in leaving out the words "Bird Movements". The aim of the Working Group is not to study bird movements in itself, i.e. in a biological sense, but how to implement the results of bird movement studies into warning procedures

Thirdly, bird movements, as a biological issue within BSCE meetings, mostly show up during Radar Working Group meetings. The simple reason for this is that biologists can illustrate the potentials of different remote sensing technics by means of case studies, and consequently, the words "bird movement" are replaced to the old Radar Working group.

Fourthly, with the new name and the new procedure of the work being done, the Working Group Military Low Flying Bird Strike can include military bird strike statistics. There are good reasons to deal with military bird strike reports during the meetings usually held in Traben-Trarbach between the BSCE meetings. These "in-between" meetings could serve as a check of prevention measures, and we have to recognize that the Air Forces Flight Safety Committee Europe can consider the Working Group also as their specialist group. Finally, the platform for discussion on maps which was formerly an important topic within the old Bird Movement Working Group, could be either the Aerodrome Working Group for airport vicinity maps or

the Working Group Remote Sensing of Bird Movements, because methodology of how to produce such maps is, even in case of use of networks of visual observers essentially a matter of remote sensing. I feel certain that when the Working Group Chairmen present their reports to the Plenary at the end of the meeting, we will be able to come to an agreement on the above proposals, but I have felt it appropriate already at this stage of the meeting to go into these details.

The fifth working group I shall deal with is the **Working Group Testing of Airframes and Engines**. This Working Group was left with one recommendation and it was that BSCE members should seek information on the retention of bird strike capability after extended in service usage of engines and airframes. The Chairman has been in contact with the industry urging them to cooperate with the Working Group. Since the Madrid meeting, there has been a conference on aerospace transparant materials and enclosures in Monteroy, California, and the Chairman of the Statistics Working Group has attended that meeting presenting a paper on windshield strike data.

Regarding our sixth working group, the **Working Group Bird Remains Identification**, previously called the Feather Identification Sub-Group. Unfortunately, the chairman, Tim Brom, has fallen ill and will not attend. We welcome Dr. Wattel, also from Amsterdam, and I am also pleased to announce that Dr. Bentz from Norway will chair the meetings. A very interesting paper, it is Working Paper 24, has been prepared by Tim Brom with a suggestion to set up a European center for bird remains identification in order to standardize identification.

I shall now turn to the relations between BSCE and other international organizations. Regarding **ICAO**, we regret that this organization due to other commitments has not found it possible to be represented at this meeting. I have already mentioned our cooperation with ICAO concerning the new edition of the ICAO Airport Services Manual, Part 3, Bird Control and Reduction.

BSCE as such was invited to participate in the first **Eastern and Southern African Workshop** on reduction of bird hazards to aviation which was held in Nairobi in June last year. Luckily, John Thorpe was available for participation, and we have been informed that the Workshop was well organized and was attended by seven member states, the number of which were perhaps surprisingly active in the field in

view of their limited ressources. Regarding **ECAC**, after some difficulties I think that we have found a way to present the outcome of our work at the annual meeting of the ECAC Technical Committee.

Regarding **EEC**, I have nothing to report as to the EEC Directive on Bird Conservation. Another aspect has, however, popped up and you will see from the list of papers to be presented that the Danish delegation will present a paper in the Aerodrome Working Group, it is Working Paper 13, concerning EEC regulations to reforest farm land.

Finally, regarding **IATA**, we have noticed with great pleasure the interest IATA has shown towards our work, and I welcome the presence of pilots both as representatives from IATA and as members of national delegations.

I will also like to inform you that the 21st BSCE meeting will be held in Israel in the early spring of 1992, late March.

My last words during this session will be a repetition of what I have already indicated in the Invitation Letter. We suppose that all participants to the meeting have studied or will have the opportunity to study the working papers and consequently, the lecturers are kindly requested to avoid reading the paper so that a question and answer period is always available after the presentation of a paper. If not, we will be, as we have been before, faced with the problem of not having enough time. I wish you a successful meeting in the various working groups.

CHAIRMAN'S REPORT

AERODROME WORKING GROUP

1. General

The Working Group was attended by 71 participants representing 17 countries.

2. Agenda of the Working Group meeting

The following agenda was proposed and approved:

a) Approval of agenda

b) Recommendations from the 19th meeting, Madrid, May 1988.

c) Presentation of "The Green Booklet", 4th edition.

d) Presentation of Aerodromes Working Group papers.

e) Other business.

f) Recommendations.

3. Recommendations from the 19th meeting

The chairman reminded the participants of the 2 recommendations which were adopted at the Madrid meeting.

4. Presentation of "The Green Booklet", 4th edition

Mr. Olavi Stenman presented the updated edition of the Green Booklet to the Working Group. He noted that

- some European countries had not revised their methods since the last edition,
- some European countries did not communicate the information asked for,
- for the first time, the USSR had provided information to be included in the booklet. Also from Japan, some information had been received.

5. Working papers presented

WP 2 Bird Control At Geneva Airport
(Mr. Jacques Fritz, Switzerland)

WP 4 Influence Of Bird-Shooting On The Relation: Numbers Present/Incidents
(Ing. A. Klaver, The Netherlands)

WP 9 Bioacoustic Scaring Of Birds In Airports
(A.I. Rogachyov, USSR)

WP 10 Analysis Of Bird Collision With Planes And Possibility Of Utilization Of The Bird Strike Prevention Measures
(V.E. Jacoby and A.N. Servertzov, USSR)

WP 13 EEC Regulations Regarding Reforesting Of Former Farm Lands
(H. Dahl, Denmark)

WP 15 Starling Abatement At Pirinclik Air Station In Eastern Turkey
(L.S. Buurma and R. MacKenna, The Netherlands)

WP 21 Results Of Ornithofauna Study At Some Soviet Airfields 1972 - 1988
(J.E. Shergalin, USSR)

WP 27 HWH Airport Lawn Mover Type HS-2 Triplex And Experience Gathered At Aalborg Airport, Denmark
(N.E. Petersen, Denmark)

WP 31 Advising On Aerodrome Bird Control, Some Requirements And Complications
(N. Horton, UK)

WP 33 Nocturnal Bird Problems On Aerodromes
(T. Brough and N. Horton, UK)

WP 37 Scaring Away Birds By Laser Beam
(J.D. Soucaze-Soudat, France)

WP 45 Experiments Taking Place: Tests Of The Frightening Away Of Birds By Means Of Laser Gun
(M. Laty, France)

WP 47 The Impact Of A Lumbricide Treatment On Airfield Grassland
(Dr. J. Allan, UK)

WP 49 Bird Hazard Management At Manchester Airport
(C.S. Thomas, UK)

WP 50 The Development Of An Expert System To Minimize Bird Strikes At Airports
(M. Kretsis and C. Thomas, UK)

The two last papers were not presented at the Working Group meeting itself, but will be published in the proceedings of this meeting.

6. Other business

No points were brought up.

7. Recommendations

The Working Group proposes the following recommendations:

a) BSCE members from EEC countries are urged to ask the appropriate authorities to take into account, when dealing with applications for grants, that changes in land use may affect the potential birdstrike problem at a neighbouring aerodrome and that consultation with aviation authorities and aerodrome authorities might be desirable.

b) The BSCE members should draw the attention of the appropriate authorities to the existence of expert systems to integrate bird data, weather data and control methods. These systems will provide critical information for new personnel assigned to bird control and will assist management in scheduling efforts.

Heikki Helkamo

Chairman, Aerodrome Working Group
24 May 1990

CHAIRMAN'S REPORT

BIRD MOVEMENTS AND LOW-LEVEL WORKING GROUP

1. Title

Bird Movements and Low-Level Working Group.

2. Terms of reference

Implementation of data concerning bird concentrations and movements with the purpose of developing preventive measures to minimize the bird hazard to low flying aircraft.

3. Progress report

3.1 The chairman did not get any information concerning new bird hazard maps in the national AIPs as well as airport vicinity maps as recommended during BSCE 19.

A circular from 5 January 1990, should remind the members of the working group to the recommendations, but only Denmark did answer. Belgium presented the draft of an actualized set of maps during the 5th meeting "Bird Hazard at Low Level".

3.2 The military participants of the working group agreed to intensive contact on the prevention of birdstrikes during low-level flights. The following expert meetings were held since BSCE 19:

- 3rd meeting at GMGO Traben-Trarbach/FRG, 12-20 September 1988,

- working session of radar experts at CFB Lahr/FRG, 27-28 February 1989,

- 4th meeting at HQ RAFG Mönchengladbach/FRG, 4-5 September 1989,

- 5th meeting at GMGO Traben-Trarbach/FRG, 2-4 April 1990.

The results of the meeting are presented to BSCE 20 in a working paper.

4. Future programme

a) As the objective of the working group is the implementation of data obtained by remote sensing of bird movements (as selected by a radar working group) into flight safety procedures especially for military aircraft flying at low level, BSCE members agreed in renaming the "Bird Movements and Low-Level Working Group" into "Military Low Flying Bird Strike Working Group".

b) The main purpose of the renamed working group will be the exchange of actual data concerning medium and high intensities of bird migration as well as birdstrike warnings (BIRDTAM) in a standardized format via the civil and military Air Traffic Control or Weather (Wx) networks.

c) Implementation of bird hazard maps for the national civil and military AIPs should still be a matter to be dealt with in the Military Low Flying Bird Strike Working Group, while the scientific and methodological preparations should be taken care of by the (former) Radar Working Group to be renamed "Remote Sensing of Birds Working Group".

d) According to the recommendations of BSCE 19, airport vicinity maps should be drawn up in close co-operation with airport authorities.

Therefore, this objective of the Working Group will be transferred to the "Aerodrome Working Group".

e) The renamed Working Group will include military bird strike statistics for the verification of the warning and forecast procedures. General data concerning military bird strikes as well as serious bird strikes to military aircraft will be furthermore presented at the "Statistics Working Group".

5. Recommendations

a) The BSCE members should urge the appropriate national authorities to investigate the possibility of contributing to a dedicated multi-national system for the detection and reporting of actual data concerning medium and high intensities of bird migration.

b) The BSCE members should urge the appropriate national authorities to provide warnings (BIRDTAM) as well as bird movement forecasts which are available also for civil transport and general aviation.

c) The BSCE members should urge national air staffs and Air Traffic services to consider/reconsider now the warnings and forecasts can be obtained by pilots without delay and loss of information according to national necessities.

Jurgen Becker

Chairman, Bird Movement and Low Level Working Group
23 May 1990

CHAIRMAN'S REPORT

RADAR AND OTHER SENSORS WORKING GROUP (old title)

1. Terms of reference (from the Madrid meeting)

Exchange of information on methods used and results obtained regarding the use of radar sensors in the surveillance and identification and the risk assessment of bird presence and movements.

2. Activities and progress since the Madrid meeting

Following the recommendations of the 19th meeting with respect to the further development of electronic assessment of bird hazards by radar, contacts with countries active in this field were intensified. Most of the discussions were held during the specialist meetings in Germany (see the chairman's report of Bird Movements and Low Level Working Group). Apart from many contacts with the air forces performing low level flights over Germany, the chairman visited the US, Israel and Turkey for exchange of information. Dr. Larkin, working on the NEXRAD project in the USA, also visited The Netherlands to study the ROBIN system.

According to recommendation b) from the Madrid meeting, the RNLAF ornithological research continued to assess the quantitative importance of low level migration. Similar work was stimulated and performed in Germany and Switzerland.

Industries in the USA, Switzerland, Sweden and The Netherlands were approached with the BSCE specifications of dedicated bird radar. Serious talks with a Dutch/French company are still going on. The specifications have been included in the Radar Booklet, which was presented during this meeting.

3. Summary of discussions per nation

In the USA the USAF is improving the Bird Avoidance Model (BAM) primarily aimed at helping low level operations be performed along the most safe routes. The static information derived from a database consisting of bird distributions and phenology as well as birdstrikes has the potential of becoming more dynamic when also weather data will be fed into the model. This is possible, because BAM is based on a Geographical Information System (GIS, a certain class of software packages).

The first NEXRAD system will come into operation this year. It remains to be seen how well these radars will perform with respect to bird algorithms, because their functionality is tailored to detect meteorological phenomena optimally which may make the radar be optimal for bird detection. However, the potential of NEXRAD radars as indicators of hazardous bird densities in the air is enormous, especially in combination with the BAM.

Finland has a very old tradition in monitoring mass movements of arctic migrants and has established good cooperation with radars in the Baltic countries.

Renewing Vantaa Airport radar will cause a problem with respect to bird detection capability, but closer cooperation with the Finnish Air Force may not only solve this problem, but may also lead to improvements which can prevent collisions between birds and military aircraft flying low level as well. Finland has a high level of field ornithology which is incorporated in flight safety. The Finnish delegation was completely right in emphazising the importance of the human mind as a flexible computer.

USSR. Since 1966, Professor Jacoby used the surveillance radar of Tallin Airport for bird strike prevention. This work has been intensified during the last four migration seasons resulting in approximately 100 warnings, used by civil as well as military aircraft. Since 1986, there has been a close cooperation with Vantaa Airport with respect to monitoring arctic migrants. Also here, new radar equipment may cause future problems. Latvian radar is supporting Soviet airlines. In Lithuania Dr. Zhalakjavichius performed extended radar studies over 8 years ending up in a thesis next year

Sweden. Based on regional bird maps and weather forecasts a computer model is predicting bird presence including altitudes for 5-hour periods. Despite very sophisticated research it still does not seem possible to avoid all en route birdstrikes without real-time radar measurements which are not performed at the moment.

Norway. Because of the huge size of the country, building up a network of bird watching radars seems not feasible. Norway relies upon bird distribution maps and data from field ornithologists. Monitoring bird migration with a radar in the south may support the international BIRDTAM system.

Denmark. 3 radars continue to measure ad hoc the bird density by means of the FAUST system.

UK. Because migration is supposed to stop in the UK, a bird warning system has not been judged necessary. However, especially along the eastern coast, detecting birds by radar should make sense as has been shown by many old radar ornithological publications. Recently, the aviation bird unit (within the Ministry of Agriculture, Fisheries and Food) has proposed to map hot spots of bird flying activity within the flying routes.

Belgium. A video featuring the BOSS system at Semmerzake radar exemplified the possibilities to use modern radar types for bird detection. Belgium is trying to implement a network of airfield radars in the warning system.

France. Using more and more secondary radar, the French do not see possibilities to use civil Air Traffic Control radars. New interest in radar ornithology comes from l'Office National de la Chasse with the aim to monitor waterfowl migration.

Spain. The Spanish territory is considered too large to be covered by bird measuring equipment. Studies by Hilgerloh in the south of Iberia show that it may make sense to monitor concentrated migration. An obvious category of birds to be detected are soaring birds (see Israel).

Italy. The recently established Italian Bird Strike Committee is improving BIRDTAMs for airports and their vicinity. What has been said for Spain is valid for Italy too.

Austria. Studies of bird migration have been performed. A warning system does not exist.

Switzerland. Civil as well as military aviation is relying upon the continuing sound studies of the vice chairman, Dr. Bruno Bruderer, who was prevented from attending.

The advanced work done in Israel, Germany and The Netherlands has been illustrated in several working papers during the meeting.

4. Future programme

As was explained in the Chairman's Report, the close co-operation between the old Bird Movement and Low Level Working Group and the Radar Working Group has resulted in a more natural separation of the fields of work. This is reflected in the new title and recommendations of both Working Groups.

5. New Terms of Reference

Exchange of information on the use of radar and other sensors in the surveillance, identification and the risk assessment of bird presence and movements.

6. Recommendations

a) BSCE members should urge national authorities to encourage the appropriate military and civil personnel to evaluate the capability of

radar and other remote sensors to monitor bird presence and bird movements.

b) BSCE members should join attempts to further develop the electronic assessment and calibration of remote sensor output with respect to the bird hazard.

c) BSCE members should continue to cooperate with industry in the development of small, dedicated, commercially available bird-observation radars in accordance with the principles described in the BSCE radar booklet.

d) BSCE members should encourage the use of Geographical Information Systems (GIS) when quantifying the density, identity and potential hazard of bird movements, particularly at the lowest flight levels.

Luit S. Buurma

Chairman, Remote Sensing of Birds Working Group (new title)
24 May 1990

CHAIRMAN'S REPORT

WORKING GROUP TESTING OF AIRFRAMES AND ENGINES

1. Working Papers

a) WP 6 **Improving Bird Strike Resistance Of Aircraft Windshields** by Ralph Speelman and R.C. MacCarty, Air Force Aeronautical Laboratories, USAF

Continuing his work, Mr. Ralph Speelman presented ongoing efforts to improve the windshield system bird strike resistance of different USAF aircraft.

The windshield improvements obey the following imperatives:

1. knowing what philosophy you will follow
   - damage acceptance
   - hazard avoidance
   - damage reduction;
2. the bird strike improved resistance should not compromise the aircraft performances, nor the optical qualities and life duration of the windshield;
3. global cost reduction and maintainability increase must be taken into account.

Different technical voids were studied such as computational simulation, glass materials and sealand improvements, composite frames or frameless windshield.

In conclusion, M. Speelman insisted on the high payoff of windshield improvements.

b) **Contribution** of Mr. Rolph Wegmann, SAAB SCANIA, Sweden

Rolph Wegmann presented a short talk related to his Monterey Meeting paper.

SAAB has developed a computational tool used for windshield

development in order to predict the windshield deflection under birdstrike. Results obtained fit quite good with the impact description, as tests have shown. A second development phase is presently beginning to introduce failure criteria in the model.

SAAB also presented a video on the tests done – Gun characteristics were also given to the working group members.

c) WP 51 **Design Of Aviation Engine Elements For Bird Strike Action**

by Dr. Shorr, Central Institute of Aviation Motor, Moscow, USSR

Dr. Shorr presented an approximate engineering method for the calculation of bird strike action on fan or compressor blades. This method is suitable for performing the optimized calculations at design stage.

Dr. Shorr gave some typical design results, and, answering a question, precised that tests will be done to check the model.

d) WP 38 **Static Blade Under Load Program**

by J.P. Devaux, DGA/CEPr, France

The paper showed an attempt to analyse foreign object damage installation effects on the final results.

Due to surprising first results on high by-pass ratio engines blades, CEPr has mainly aimed its study first at projectile effects comparisons and secondly at propeller blades pre-qualification, with satisfactory results.

e) WP 39 **Propeller Foreign Object Damage Testing**

by J.P. Devaux, DGA/CEPr, France

CEPr proceeded with bird strike tests, that were started six years ago, on both metallic and composite propellers in order to qualify the latest.

Methods being used and results obtained were shortly presented. Test campaigns conclusions indicated clearly that current test requirements must be arranged in order to ensure test reliability and to decrease test cost.

A video of some tests was shown.

f) WP 40 **Propfan Bird Ingestion Testing**

by J.P. Devaux, DGA/CEPr, France

A short presentation of the main results obtained by CEPr in its preliminary study for propfan bird ingestion testing was made.

CEPr results showed that propfan behaviour will be between propeller and HBPR engines ones. As a consequence, regulations and test requirements should now take into account more precisely this fact.

2. Other items

2.1 Terms of Reference of the Working Group

The working group agreed to change the terms of reference as follows:

"Exchange of information on the methods of prediction, the test methods and test results for:

a) bird impact research and development, design and testing of materials, structural specimens, windscreens, engines, etc.

b) test to show compliance with airworthiness requirements.

Part 3 of the old terms suggesting that BSCE members should assist national organization in the production of design guidance, will be put as a recommendation by the working group.

2.2 Recommendations

BSCE members should:

a) Encourage the studies on composite materials bird strike resistance.

b) Analyse the influence of transparency systems bird strike impact on the structure adjacent parts, with particular emphasis on vibrations.

c) Send information on the state of the art technology used for protecting all parts of an aircraft in order to edit a BSCE Guide of Airframe and Engines Protection. This guide will also include airworthiness regulations and tests methods used.

d) Encourage studies about "substitute bird" to replace real birds in testing.

e) Seek information on the retention of bird strike capability after extended in service usage of airframes and engines.

2.3 The working group plans a meeting in Paris at CEPr Saclay on 16 May 1991 for testing airframes and engines specialists. Main topics of the meeting will be the "substitute bird" and testing booklet.

2.4 As Mr. Chalot will no more be able to continue BSCE work, he proposed to the members of the group to be replaced by Mr. Devaux from France. The proposal was accepted.

As Mr. Peresempio (Italy) had not attended the last three meetings, the working group members were asked if someone volunteered to replace him. Mr. Wegmann from Sweden was proposed and will give an answer within six months.

2.5 John Thorpe (UK) has indicated that new requirements are being discussed by JAR (European common regulations) for bird strike windshield resistance of helicopters and general aviation aircraft.

Jean-Pierre Devaux
Chairman, Testing of Airframes and Engines Working Group
24 May 1990

CHAIRMAN'S REPORT

BIRD REMAINS IDENTIFICATION WORKING GROUP

The Bird Remains Identification Working Group which was established during the 19th BSCE Meeting in Madrid had its first ordinary working group meeting on Tuesday 22 May 1990 in Helsinki. 21 participants from 11 countries made this meeting a very successful one and the future of the working group is really promising.

1. Terms of Reference

Exchange of information on the methods used and the results obtained on identification of bird remains.

2. Presentation of Working Papers

Six working papers were presented:

a) Feathers found in the wreckage of the Convair aircraft which crashed in the Skagerak in 1989 did not support the theory that a bird strike caused the accident (P.-G. Bentz, Norway & T.G. Brom, the Netherlands - WP 35)

b) Microstructures of the rachis, rami and rachidial barbules were discovered, by scanning electron microscopical (SEM) analysis, to show intraspecific differences (K. Perremans, Belgium - WP 3).

c) Electrophoresis of proteins extracted from feather keratin allows identification to the species level provided there is enough plumaceous or pennaceous feather elements. The techniques on protein

extraction have been refined and standardized (H. Ouellet & S.A. van Zyll de Jong, Canada - WP 8).

d) Feather colours (pigmentary and structural colours), studied by means of light- and scanning microscope can be used to a limited extent for identification to species level. Gull species cannot be separated due to the lack of colour differences (J. Dyck, Denmark - WP 48).

e) Use of a comparison microscope allows ducks, geese and swans to be distinguished relatively easily by means of differences in sizes of feather barbule features. This method is useful to break down the weight range of the Order Anseriformes (N. Horton, UK - WP 32).

f) A proposal for the establishment of a European Centre for the identifications of bird remains was presented. Such a centre could give an important contribution to the standardization of bird remains identification and thus give better and more reliable statistics (T.G Brom, presented by J. Wattel, the Netherlands - WP 24).

3. Recommendations

a. That the acting chairman of the BSCE Bird Remains Identification Working Group develop a checklist to inform Accident investigators of the steps necessary to ensure that bird strike as a possible accident cause is not overlooked and any evidence is properly protected and handled.

b. That the chairman of the BSCE Bird Remains Identification Working Group should exchange information on activity so as to prevent expensive duplication.

Per-Göran Bentz

Acting Chairman, Bird Remains Identification Working Group
24 May 1990

CHAIRMAN'S REPORT

STATISTICS WORKING GROUP

1. Change of Name

At the Copenhagen Steering Committee Meeting in November 1989 it was decided to change the name of the Analysis Working Group to "Statistics Working Group". This was endorsed by the Working Group meeting in Helsinki on 21 May 1990.

2. Recommendations from Madrid Meeting

The Working Group was left with four recommendations from the Madrid meeting of May 1988:

(i) That military "low-level" en-route strikes should be analysed separately by BSCE members. Separate forms will be necessary.

Response

The RNLAF Flight Safety Division has made a pilot study of 1988 data from six European Air Forces. The study demonstrates the feasability and usefulness of such a system of co-operation between members of the Air Force Flight Safety Committee Europe.

(ii) That details of military accidents and serious incidents should be sent by BSCE members to the German Geophysical Office (Dr. Becker) for inclusion in a paper describing Serious Strikes to Military Aircraft.

Response

Is has not been possible to implement this recommendation, but members were able to provide some information during the Helsinki working group meeting.

(iii) BSCE members should urge that means be provided to handle civil data by reporter's occupation. Members who already have this information should urge the appropriate authorities to provide it to ICAO.

Response

The Working Group Chairman has written to ICAO requesting that a new field be added to the IBIS data base. ICAO have responded that this will be considered at the next review of the Reporting Form layout and content, as well as a computer field "Reporter".

(iv) BSCE analyses should be sent by BSCE members to the Working Group Chairman for civil analysis and to Dr. Becker for military data, to the agreed timetable.

Response

Some countries have been able to provide their data. The Helsinki meeting agreed that a 5 year-paper be produced rather than attempting to produce annual papers at 2-yearly meetings. It was agreed that the objective should be a paper covering the years 1986-1990 for presentation at the 1992 meeting. The military analysis is dealt with in para 2 (i).

3. Activities Between Madrid and Helsinki Meetings

a) The Working Group Chairman attended the Conference on Aerospace Transparent Materials and Enclosures in Monterey California, January 1989. He presented a paper on Windshield Strike Data and co-chaired the session on Bird Hazards.

b) The Working Group Chairman also attended the first ICAO ESAF Workshop on Reduction of Bird Hazards to Aviation in Nairobi, June 1989. The well organized workshop was attended by Ethiopia, Kenya, Malawi, Rwanda, Swaziland, Tanzania and Zimbabwe. A number of countries were surprisingly active in the field in view of their limited resources. A visit was made to Nairobi Jomo Kenyatta airport to be

4. Paper

a)

b)

c)

shown the measures that had been taken to reduce bird hazards. The Working Group Chairman presented several papers and was able to gain a great deal from the workshop. (Note: Copies of papers can be made available).

4. Papers Presented at 20th Meeting, Helsinki

a) The Working Group Chairman gave a visual presentation of two papers, WP 28, "Analysis of Birdstrikes Reported by European Airlines 1981-1985" and WP 29, "Serious Birdstrikes to Civil Aircraft 1987-1989". Certain recent events were highlighted, including the 1988 B737 fatal incident in Ethiopia, due to speckled pigeons (Columba-Guinea at 320 gm) which killed 35 people, and the nighttime incident with herring gulls (larus argentatus) to a BAe 146 on take-off from Genoa, Italy, resulting in all 4 engines being changed. The 18 April 1990 accident which killed 20 of 22 on board a DHC6 Twin Otter just after take-off from an island near Panama City, was briefly described. The birds which damaged the engine are as yet unknown. Further information on an AN 24 accident in Poland on 2 November 1988 was requested. Discussion accepted the future use of 5 year-papers (see Recommendation No. 2).

b) WP 14, "Towards a European Data Base of Military Bird Strikes" by Mr. A. Decker & Mr. L.S. Buurma, the Netherlands, was presented. This paper covered the need for a combined database containing reliable, useful information. Input using computer/floppy disc was proposed. This paper has resulted in Recommendation No. 3.

c) WP 20, "Bird Strike Analysis in Estonia 1951-1988", was presented by Mr. J.E. Shergalin, USSR. Bioacoustics were used on airfields, pyrotechnics were not used. Egg removal and destruction had been used to control black-headed gulls, over 17,000 eggs per year were destroyed.

d) WP 25, "Finnish Air Force Bird Strike Summary 1981–1989", by Maj. J. Hipeli, Finnish Air Force. The paper showed that gulls were the major problem, trainer aircraft being involved in 60% of strikes. 2/3 of strikes were below 500 ft. More than 2/3 of strikes occur in June, July and August, the peak is in August (1/3 of all strikes). Flying is approximately equal each month.

e) WP 30, "The Use of Birdstrike Statistics to Monitor the Hazard and Evaluate Risk at UK Civil Aerodromes" by Mr. T. Milsom, UK Aviation Bird Unit. The paper suggests that simplistic interpretation may be misleading in determining if:

- the risk is increasing
- the bird control is effective.

The paper stressed the need for good reporting and for bird surveys as well as intelligent use of data to direct bird control efforts effectively. There was considerable discussion on the definition of an "acceptable standard".

f) WP 43, "Bird Strikes to USAF Aircraft 1988–1989" was presented by Maj. R.L. Merritt, USAF. The paper analysed data from 6,444 strikes costing 20 million US dollars per year. This included two aircraft destroyed. The paper, with the Proceedings, will include bird weight distribution.

g) WP 42, "US Navy Bird Aircraft Strike Hazard Problem 1985–1989" by B. Bivings & K.A. Medve, US Navy. Over 2,000 strikes per year were experienced, and these had cost 30 million US dollars since 1981. Two aircraft had been lost.

h) WP 16 and WP 17, Statistical Papers by N.A. Nechval and V.Y. Biryukov, USSR, were not presented as the authors were not present. The papers are included in the Statistics Papers.

5. Other Items and Discussion

a) Owing to the absence due to illness of the Vice Chairman, Bertil Larsson, Maj. Ron Merritt, USAF, volunteered to act as Vice Chairman for the meeting.

b) The USAF loses one aircraft for about every 1,500 reported bird strikes (the US Navy about one per 2,000).

c) As accident investigators may be unaware of the possibility that birds could be the cause of an accident it was suggested that a check list be developed to act as a reminder – see Recommendation No. 1 from Bird Remains Identification Working Group.

d) The need for a poster on Reporting and proper identification of remains, including feather remains was discussed. This would, if it was developed by BSCE, be useful publicity for BSCE (see Recommendation No. 1).

e) Military aircraft losses were described. Norway had lost two aircraft in the 1980's and the UK RAF had lost a Tornado in 1989. A factor was that the flight had been delayed and the Bird Control Unit was not on duty.

f) The effectiveness of the "eye" markings on engines used by a Japanese airline was questioned. Is was stated that the supposed effectiveness may not be statistically sound but anything that draws people's attention to the problem is to be encouraged.

g) Discussion on the effectiveness and trials of strobe lights revealed that many USAF studies had shown that they were not effective in reducing birdstrikes. In any case, strobes were necessary for air traffic see-and-be-seen purposes.

h) The Working Group Chairman thanked the speakers for their excellent presentations and commended the high quality of contributors' visual material.

6. Recommendations

a) That a poster be developed by the Steering Committee of BSCE to inform pilots, airport personnel, aircraft mechanics etc of the need to report bird strikes and to ensure that any remains, including feathers, are properly identified.

b) That civil BSCE members are urged to provide the Working Group Chairman with an analysis, or analyses, covering the years 1986–1990. The data should be sent to the Working Group Chairman by September 1991 so that a paper can be prepared for the March 1992 meeting.

c) That the military BSCE members urge that the Royal Netherlands Air Force work on Military Data analysis be continued in co-operation with Air Force Flight Safety Committee Europe (AFFSC(E)).

John Thorpe

Chairman, Statistics Working Group
22 May 1990

MINUTES OF THE PLENARY MEETINGS 24-25 MAY 1990

1. Opening of the Meeting

The meeting was opened by the Chairman.

2. German Video

J. Becker presented a training film of the German Federal Armed Forces starting with the history of aviation and describing the flight safety hazards to modern aviation caused by migrating birds. The video showed the procedures of the Federal Armed Forces with the intention of reducing the bird strike hazard, especially the existing observation, reporting, warning and forecast system of the German Military Geophysical service with respect to large-scale bird migration.

3. WP 24, Proposal For The Establishment Of A European Centre For The Identification Of Bird Remains

J. Wattel, The Netherlands, presented Working Paper 24. The central thesis of this Working Paper was that the statistics on bird strike problems must be unbiased to be really useful, and to achieve this not only the very obvious and easy remains should be identified, but also remains which are hardly recognizable as bird material. People should also send in the remains and not keep them to themselves or think that they are impossible to identify. A quick reporting system should be set up not only to aviation authorities, but also to airfield managers and even to pilots to inform them of the species of birds involved. A quick reporting system will significantly help in keeping these people, who are in the position to find bird remains, motivated to send them in. One of the obvious weaknesses of the present system, that many bird remains

were simply considered too small to be of any use, could in this way be removed. In The Netherlands, work has been going on along these lines for a long time, and the Zoological Museum in Amsterdam now proposes to extend their services on a more European scale by setting up a centre for difficult identification work. Such a centre would quickly and reliably report identification to all people interested and involved and this quick reporting system would be the principal incitement to continue the collection of bird remains. Such a facility would moreover guarantee that identification would be standardized. A centre being at a university would have the possibility to develop new techniques. It would also have a research and development function, and as these techniques are rapidly becoming more and more sophisticated an academic environment might be of a great help in bird identification. Having a centre would provide for continuity of expertise and not just hinge on one man/woman working only part of the time.

During the discussions of the Working Paper in the Working Group, the idea took shape as follows:

Those countries where there already exists a national centre for identification continue to operate this in a standardized way. These national centres could be encouraged to make use of a central facility in Amsterdam in those cases where very sophisticated techniques would be needed to solve the problem. Consequently, the European Centre in Amsterdam would in a way constitute a second-line facility. Regarding the countries that have only very limited facilities at present, such countries should either establish their own national centre or they could go directly to the European Centre. In that way, the European Centre could even be a first-line facility as it has been for a long time for The Netherlands.

John Thorpe, UK, stressed the need to encourage the sending

in of even the smallest bird remains and the advantage of information on that matter to appear on the national reporting forms of where remains are supposed to be sent. At the meeting in the Statistics Working Group, the need for a poster was recognized, a poster to inform pilots, airport staff, engineers, mechanics where they should send their remains and to the fact that remains are important. The Statistics Working Group will phrase a recommendation that the Steering Committee develop a poster to publicize these matters.

J. Wattel agreed and regretted that the airport personnel very often identified the birds involved themselves without sending remains of the bird to the identification centre. In this way the Centre would not be able to store the remains for further documentation and getting more information for instance on sex and age of the bird. Storing the remains indefinitely would make it possible for the Centre to apply new techniques as they become available.

M. Noel, Belgium, mentioned that it had been decided to open as a north centre of Europe the University of Louvain to be able to offer the same service as proposed at the Amsterdam Centre.

J. Wattel, The Netherlands, promised the cooperation if a Belgium centre exists or comes into existance and saw advantages in having two locations instead of a single centre for cross-wise second opinions if the identification is particularly critical. He was also aware of the fact that new techniques are being developed in Canada.

Y. Leshem, Israel, considered that something could be said for having a world centre which especially would be an advantage for the smaller countries.

J.-P. Devaux, France, considered that it would be preferable to establish a standard of working in bird remains and

identification before deciding what centre should be used.

J. Wattel, The Netherlands, considered that it should be a task for the Working Group on Identification of Bird Remains to set up a standard, but what he intended and what his Belgium colleagues intended was an offer of the service of the knowledge gained in the two countries over many years of work. He added that out of every 100 bird strikes probably only 15 are now properly identified.

L.S. Buurma, The Netherlands, stressed the importance of continuity of the work of proper identification of the bird involved. This could be ensured by the existence of the centres in Amsterdam and Louvain.

T. Brough, UK, appreciated J. Wattel's approach. In the UK a reasonably good system for identifying bird remains is available, but the UK is very happy to accept the invitation to have more difficult cases identified by other authorities such as the University of Amsterdam. If, however, a UK aircraft which suffered a birdstrike in the USA, the UK authorities might prefer to go elsewhere for bird remains identification. He considered that most countries would probably feel that in the first instance it is their right to identify their bird remains. He was a little worried as he understood J. Wattel's presentation as an indication that, provided enough bird remains would be sent to the University, the Amsterdam University would be tempted to analyze the data that was coming in and perhaps placing its own interpretation upon it. He thought it unwise to have just one unit which has collected all the data and interpretated these.

J. Wattel, The Netherlands, considered that interpretation of data is the free right of every authority, but considered that interpretation of data should be dealt with in the Statistics Working Group with the object of coordinating and centralizing the statistical questions.

After T. Brough, UK, had drawn the Meeting's attention to the fact that for instance the Smithsonian in Washington has got considerable experience in identifying bird remains, the Meeting agreed to a proposal from the Chairman that a recommendation should be made along the lines that BSCE members are urged to inform the appropriate authorities of the existence of European centres where bird remains could be identified adding that such centres are for example the Universities of Amsterdam and Louvain.

J. Thorpe, UK, observed that the Statistics Working Group would make a recommendation to the effect that the Steering Committee develop a poster to publicize the need to report and the need to have bird remains properly identified.

The Chairman observed that there was no opposition to the suggested recommendation from J. Thorpe and indicated that the further work would be done in the Steering Committee.

4. **WP 26, Bird Control On Aerodromes, French Regulations**

Ph. Vuillermet, France, presented Working Paper 26. The Paper deals with the new French regulations regarding bird control on French aerodromes and explains the reasons why a bird control service has been implemented on 143 aerodromes, the organization of the service in terms of personnel, equipment, procedures and the role of the different partners as far as funding is concerned. Relying on the expertise of Mr. Briot and Mr. Laty, the 143 areodromes are split in 5 categories depending on the risk, an A-airport being an airport where there is low traffic and estimated low risk, a B-airport being an airport with rather light traffic and moderate risk, a C-airport being an airport with much more important traffic and an average moderate risk, and ending with an E-airport where there is heavy traffic mainly by turbojet traffic and obviously a higher risk regarding the birds.

J.L. Briot, France, elaborated on the splitting up of the

different aerodromes and indicated that account has been taken of the local ornithological situation, the volume of commercial traffic, the most frequent type of aircraft and an analysis of bird strikes over the last 10 years. He added that the environmental actions included changes in the grass cutting technique, changes in cultivation of the area and that the scaring techniques included selected distress calls, broadcast by onboard synthesizers, pyrotechnic devises, hunting shotguns reserved for allowed species of birds and on some airports noise-makers places along runways. All other methods tried in the past, like falconry, have been stopped.

After the oral presentation, a funny, instructive video concerning an example of ecological expertise was shown.

5. **WP 36, The Application Of Radar For Bird Strike Reduction**

L.S. Buurma, The Netherlands, presented Working Paper 36. The Booklet contains a collection of emperical experiences that could serve as a reference for discussions on the application of radar for bird strike reduction and starts with an identification of the en route bird strike problem on the basis of bird strike statistics, continues with a short biological treatment of bird movement partly based on radar ornithological studies and concludes with a collage of short introductions and illustrations on radar.

6. **WP 22, Soviet Bibliography About Aviation And Radar Ornithology 1982 - 1990**

J.E. Shergalin, USSR, presented Working Paper 22.

The bibliography is compiled with the aim to make persons engaged in bird strike matters familiar with literature about aviation and radar ornithology after the 16th BSCE meeting, 1982. The literature has mainly been published in rare, separate editions with limited circulation and as a rule only in Russian without summaries. The bibliography

covers 160 reports of 92 Soviet specialists.

7. **USSR Bird Scaring Devises**

V.Y. Biryukov and Z. Lapinskis demonstrated bird scaring devises used on USSR airports.

8. **WP 40, Propfan Bird Ingestion Testing**

J.-P. Devaux, France, presented Working Paper 40 covering the main results obtained by CEPr (Centre d'Essais des Propulseurs).

9. **WP 7, Contact Persons Regarding Bird Strike Subjects**

The Chairman presented Working Paper 7 indicating that the list was based on replies from persons appearing in former lists and if no such replies had been received, repeated the information from the former lists. He asked that changes or errors be notified to him by the end of July 1990 that he might be able to present a revised list for inclusion in the Proceedings.

10. **Bird Remains Identification Working Group - Chairman's Report**

P.-G. Bentz, Norway, presented as acting chairman the report from the Bird Remains Identification Working Group.

After discussion which concentrated on the second recommendation, the following recommendations were adopted by the Meeting:

1. That the acting chairman of the BSCE Bird Remains Identification Working Group develop a checklist to inform Accident investigators of the steps necessary to ensure that bird strike as a possible accident cause is not overlooked and any evidence is properly protected and handled.

2. That the chairman of the BSCE Bird Remains Iden-

tification Working Group should exchange information with which he is familiar on activity so as to prevent expensive duplication.

The Chairman of BSCE paid tribute to Mr. P.-G. Bentz who with a very short notice agreed to act as chairman of the Working Group.

11. **Statistics Working Group - Chairman's Report**

J. Thorpe, UK, presented the chairman's report from the Statistics Working Group.

The following recommendations were adopted by the Meeting:

1. That a poster be developed by the Steering Committee of BSCE to inform pilots, airport personnel, aircraft mechanics etc of the need to report bird strikes and to ensure that any remains, including feathers, are properly identified.

2. That civil BSCE members are urged to provide the Working Group Chairman with an analysis, or analyses, covering the years 1986-1990. The data should be sent to the Working Group Chairman by September 1991 so that a paper can be prepared for the March 1992 meeting.

3. That the military BSCE members urge that the Royal Netherlands Air Force work on Military Data analysis be continued in co-operation with Air Force Flight Safety Committee Europe (AFFSC(E)).

To a question from McCloud, UK, J. Thorpe indicated that because of Recommendation 3, Statistics should no longer be sent to the German Military Geophysical Office, cf. Recommendation b from BSCE 19. After an intervention by M. Purdie, UK, J. Thorpe added that only the collection, analysis and presentation of the statistics have moved to RNLAF, but the identification of remains and other activity of the German Military Geophysical Office will continue as

normal.

The Chairman of BSCE finally paid tribute to the Working Group's acting vice-chairman, Major R. Merritt, US, who at a very short notice due to the illness of the vice-chairman, B. Larsson, Sweden, took on the task as vice-chairman.

12. Aerodrome Working Group - Chairman's Report

H. Helkamo, Finland, presented the chairman's report from the Aerodrome Working Group. He paid tribute to Mr. O. Stenman who is the principal editor of the 4th edition of the Green Booklet, and suggested that the Green Booklet be updated in the future, say every fourth year.

The following recommendations were adopted by the Meeting:

1. BSCE members from EEC countries are urged to ask the appropriate authorities to take into account, when dealing with applications for grants, that changes in land use may affect the potential birdstrike problem at a neighbouring aerodrome and that consultation with aviation authorities and aerodrome authorities might be desirable.

2. The BSCE members should draw the attention of the appropriate authorities to the existence of expert systems to integrate bird data, weather data and control methods. These systems will provide critical information for new personnel assigned to bird control and will assist management in scheduling efforts.

To a question from M. Purdie, UK, to the effect that the recommendations should be rephrased so as the Chairman of BSCE and not only BSCE members should communicate the recommendations directly to the appropriate authorities, the Chairman of BSCE indicated that BSCE is a rather inofficial body and that it was agreed during the last

meeting to phrase the recommendations as done by the Aerodrome Working Group.

The Chairman of BSCE finally paid tribute to the work being done by the Aerodrome Working Group in presenting the 4th edition of the Green Booklet.

13. Bird Movement and Low Level Working Group - Chairman's Report

J. Becker presented the chairman's report from the Bird Movement and Low Level Working Group and informed the Meeting that his Working Group and the Radar Working Group on Tuesday this week had a combined meeting.

Regarding future programme a), the Meeting adopted the following title of the Working Group: Military Low Flying Bird Strike Working Group.

Regarding future programme b), the Meeting approved that the terms of reference of the Working Group should be an exchange of actual data concerning medium and high intensities of bird migration as well as birdstrike warnings (BIRDTAM) in a standardized format via the civil and military Air Traffic Control or Weather (Wx) networks.

Regarding future programme c), the Meeting agreed that implementation of bird hazard maps for the national civil and military AIPs should still be a matter to be dealt with in the Military Low Flying Bird Strike Working Group, while the scientific and methodological preparations should be taken care of by the Remote Sensing of Birds Working Group.

Regarding future programme d), the chairman of the Aerodrome Working Group, H. Helkamo, agreed that the responsibility concerning airport vicinity maps be transferred to the Aerodrome Working Group.

Regarding future programme e), the chairman of the Statistics Working Group, J. Thorpe, agreed that the responsibility concerning military bird strike statistics

for the verification of the warning and forecast procedures be transferred to the Military Low Flying Bird Strike Working Group, whereas general data concerning military bird strikes as well as serious bird strikes to military aircraft will continue to be presented at the Statistics Working Group.

The Plenary agreed to the above-mentioned transfers of responsibilities.

The following recommendations were adopted by the Meeting:

a) The BSCE members should urge the appropriate national authorities to investigate the possibility of contributing to a dedicated multi-national system for the detection and reporting of actual data concerning medium and high intensities of bird migration.

b) The BSCE members should urge the appropriate national authorities to provide warnings (BIRDTAM) as well as bird movement forecasts which are available also for civil transport and general aviation.

c) The BSCE members should urge national air staffs and Air Traffic services to consider/reconsider how the warnings and forecasts can be obtained by pilots without delay and loss of information according to national necessities.

14. **Testing of Airframes and Engines Working Group - Chairman's Report**

J.-P. Devaux, France, presented the chairman's report from the Testing of Airframes and Engines Working Group.

The following terms of reference of the Working Group were adopted by the Meeting:

Exchange of information on the methods of prediction, the test methods and test results for:

a) bird impact research and development, design and

testing of materials, structural specimens, windscreens, engines, etc.

b) test to show compliance with airworthiness requirements.

The following recommendations were adopted by the Meeting:

BSCE members should:

a) Encourage the studies on composite materials bird strike resistance.

b) Analyse the influence of transparency systems bird strike impact on the structure adjacent parts, with particular emphasis on vibrations.

c) Send information on the state of the art technology used for protecting all parts of an aircraft in order to edit a BSCE Guide of Airframe and Engines Protection. This guide will also include airworthiness regulations and tests methods used.

d) Encourage studies about "substitute bird" to replace real birds in testing.

e) Seek information on the retention of bird strike capability after extended in service usage of airframes and engines.

J. Thorpe, UK, indicated that the new requirements are being discussed by JAR (European common regulations for bird strike windshield resistance of helicopters and general aviation aircraft), but no final decision has yet been taken.

As P. Chalot, France, has indicated that he would no longer be able to continue as chairman, the Working Group had elected J.-P. Devaux, France, as chairman.

As the vice-chairman, Peresempio, Italy, had not attended the 3 last meetings, R. Wegmann, Sweden, was proposed by the Working Group as vice-chairman and would give a

definite answer within 6 months.

The Meeting agreed to the above changes of chairman/vice-chairman, and the Chairman of BSCE paid tribute to the work done by P. Chalot in the Working Group and in BSCE.

15. **Radar and Other Sensors Working Group - Chairman's Report**

L.S. Buurma, The Netherlands, presented the chairman's report from the Radar and Other Sensors Working Group.

After discussion it was agreed that para. 3 should be named "Summary of Nations' Reports".

At the request of Krziwanek, Austria, the section describing the activities in Austria should read: Studies of bird migration have been performed. A warning system does not exist.

The Meeting approved that the terms of reference of the Working Group should be as follows:

Exchange of information on the use of radar and other sensors in the surveillance, identification and the risk assessment of bird presence and movements.
The following recommendations were adopted by the Meeting:

a) BSCE members should urge national authorities to encourage the appropriate military and civil personnel to evaluate the capability of radar and other remote sensors to monitor bird presence and bird movements.

b) BSCE members should join attempts to further develop the electronic assessment and calibration of remote sensor output with respect to the bird hazard.

c) BSCE members should continue to cooperate with industry in the development of small, dedicated, commercially available bird-observation radars in accordance with the principles described in the BSCE radar booklet.

d) BSCE members should encourage the use of Geographical

Information Systems (GIS) when quantifying the density, identity and potential hazard of bird movements, particularly at the lowest flight levels.

The Chairman of BSCE paid tribute to the work done by the Working Group and especially the chairman indicating that the Radar Booklet would be of utmost interest to people engaged in bird strike work.

16. Cooperation with ICAO

The Chairman referred to his report on Monday, 21 May.

J. Thorpe, UK, gave the following information on the ICAO regional meeting in June 1989: The meeting was well organized by the local office of ICAO in Nairobi. Nairobi/ Jomo Kenyatta is a real bird strike problem airport for European airlines, in fact the worst airport for damage in the British Airways network. On the parking area you could observe black kites collecting garbage. There is a game park just on the edge of the airport attracting birds of prey circling over carcasses in the park. There were attendance from Ethiopia, Kenya, Malawi, Rwanda, Swaziland, Tanzania, Zimbabwe together with representatives from the African states or aerodrome organizations, Canada, Italy, the UK, IATA and the Airport Associations Coordinating Council (AACC). A number of papers were presented by local states and he got the impression that the states in that part of the world, such as Kenya and Ethiopia, are doing something about birdstrike problems. At the Addis Ababa airport a number of European airlines and aircraft engaged on famin relief have had birdstrikes. The Meeting received a description of the fatal accident at Bahar Dar Airport, Ethiopia, involving a Boeing 737. In Zimbabwe they have also a problem consisting in the presence of elephants knocking down the fences around the ILS installations when leaning against them.

J. Thorpe, UK, continued to report on the ICAO IBIS system

and informed the Meeting of the data is sent out from ICAO to all states containing world analysis, and added that if they did not have access to them, they should find where they were held in their country.

17. **Cooperation with ECAC**

The Chairman informed the Meeting that at the Steering Committee meeting last year it was decided that he should act as rapporteur to ECAC succeeding Vital Ferry and Elisabeth Dallo.A working paper had been made and presented to the annual ECAC meeting in the Technical Committee last week.

18. **Cooperation with the EEC**

The Chairman drew the attention of the Meeting to the recommendation from the Aerodrome Working Group regarding reforesting of farm lands. He had no information on the EEC Council Directive of 2 April 1979 on the conservation of wild birds, cf. Proceedings from the Copenhagen Meeting, page 452, and the Madrid Meeting, page 663.

19. **Cooperation with IATA**

S. Kirjonen, Finland, informed the Meeting that he was a member of IATA Safety Advisary Committee and as such would liaise between IATA and BSCE. At last meeting in that Committee he was informed that many countries and many companies, especially in Africa, indicated major bird problems, and he had informed his colleagues that if possible they could use BSCE expertise.

The Chairman was very pleased that BSCE could rely on S. Kirjonen as a sort of liaison officer between IATA and BSCE.

20. **Other Work Done Since the Last Meeting**

On behalf of R. Merritt, USA, J. Thorpe, UK, informed the meeting on the Canadian Bird Strike Committee meeting in Montréal June last year. It was run in cooperation with ICAO and there were approximately 40 representatives from Transport Canada, Canadian Air Force, Air Canada, Canadian Airline Pilots' Association, United States Air Force and the US Department of Agriculture. At the 3 day meeting the main items were: Aspects of contracting airfield bird control, the use of strobe lights mounted on aircraft for bird avoidance, electrophoresis for feather identification, general recording and statistics and demonstration of radio-controlled aircraft at Rockville Airport, and problems associated with landfields near airfields. The contact person is Paul McDonnald of Transport Canada. The meeting resulted in recommendations, among others: Research data and literature on the use of strobe lights should be collected. The possibility of the creation of a Bird Strike Committee North America should be investigated.

B. Bivings, USA, informed the Meeting on the 4th US Navy/US Air Force BASH workshop in Little Rock, Arkansas, in April 1990 being the first workshop in 4 years. The workshop was oriented towards teaching the flight safety and airfield management people and operations people how to do the things, and it was a hands-on and interactively oriented programme. Lectures were given by Dr. Ron Larkin on NEXRAD radar and by Roxie Laybourne. There were two basic working groups, one on military low level applications, and one on aerodrome applications being attended by about 130 delegates.

L.S. Buurma, The Netherlands, informed the Meeting on the approaching conference in the second week of December this year from 2 to 9 December in New Zealand arranged by the International Council for Bird Protection and the International Ornithological Congress. Together with T. Brom, The

Netherlands, he would represent BSCE at the meeting and he had promised to organize a round-table discussion, the theme being how to have mutual interests between aviation and flight safety people and ornithologists, i.e. the identification aspect and the bird movement aspect.

21. **The Mike Kuhring Award**

Having explained the background for the Mike Kuhring Award, the Chairman informed the Meeting that the Steering Committee at the November 1989 meeting in Copenhagen had decided to confer the 8th Mike Kuhring Award to John Thorpe in recognition of his work for almost two decades for the benefit of flight safety in collecting, analyzing and presenting data and case stories on bird strikes. He indicated that the work of John Thorpe was of vital importance for the work within BSCE as the data help decision-makers to understand that even costly measures to reduce the bird strike risk are worthwhile.

J. Thorpe, UK, was most honoured to receive the Award and accepted it on behalf of the work done by his Working Group.

22. **Planning of future meetings of BSCE**

The Chairman announced that the 21st BSCE meeting will be held in Jerusalem, Israel, starting on 23 March 1992 and ending on 27 March 1992.

He had also been in touch with delegates from other countries in order to make arrangements for future meetings in the 1990'ies.

On behalf of the Israeli delegation, Eyal Shy invited the meeting to Israel indicating that the time was chosen because of the weather and because of the possibility to watch migration of birds.

23. **Other Matters**

J.E. Jansen, Norway, considered the meeting as very successful and an eye-opener to newcomers like him. He suggested, however, an arrangement of the papers in another way than done at the meeting, for example to indicate with a mark on the paper what kind of paper it is and to which working group it belongs.

The Chairman answered that the idea brought forward by Jansen would be considered in a Steering Committee meeting. He further indicated that the Invitation Letter asked for a summary of the paper on the 3rd page, the aim being to facilitate the aquisition of the contents of the papers.

J. Thorpe, UK, informed the meeting of the existence in the UK of a video on the subject of bird strike. As the video was now about 20 years old and is a mixture of military and civil, there had been discussions in the UK about the production of a new video aimed at civil airports, the reason being that this is a man/management problem and that there is a need to make the people who work on airports to keep birds away enthusiastic. In the UK a video is considered a good means of communications and is used for all forms of life, from advertising and so on. He put the question if anybody had any opinion about the usefulness or advisability of trying to produce a BSCE video aimed at civil pilots.

Y. Leshem, Israel, suggested that the Steering Committee not only discussed a video film, but a marketing film of the BSCE issuing the coming decade. He indicated that the Israeli Raptor Centre would be happy to produce a video from all the material shown at this meeting provided free of charge for anyone who wanted it.

The Chairman replied that the suggestion of Y. Leshem would be discussed at the Steering Committee meeting.

J. Thorpe, UK, informed the meeting on the working papers as follows:

WP 5 is really only an abstract of WP 3. WP 6 is also only an abstract, but if anybody requires further information, they should approach the author, R. Speelman. WP 47 and WP 48 have not been issued, but will appear in the final Proceedings.

Finally, the Chairman announced that a revised Index for the BSCE working papers issued during the period 1966 - 1990 would appear in the Proceedings as WP 53.

24. **Israeli video**

Y. Leshem, Israel, presented the video, Flying With The Birds.

25. **Termination of the Meeting**

The Chairman expressed the gratitude of all the participants of the meeting to the National Board of Aviation in Helsinki indicating that the meeting will be remembered for the very efficient way in which it has been performed and for all the arrangements of a social character the participants had enjoyed. He mentioned the get-together party hosted by FINNAIR, the visit to the Sinebrychoff Art Gallery, the cocktail party in the City Hall of Helsinki and the cruise in the afternoon on Thursday as well as the dinner hosted by the National Board of Aviation.

On behalf of the spouses, he thanked the hosts indicating that the spouses had enjoyed the visits to the Arabia Factory, the Kalevala Koru Jewel Factory, the Brunberg Confectionary Factory and the visit to the Sibelius House and the FINNAIR Catering and Service Training Center.

He thanked every person from the host country who had performed all sorts of work, and a special thank went to the person in charge of the project.

He thanked all participants of the meeting for their work and for their patience towards him.

His special thanks went to the members of the Steering Committee and to his secretary who as usual had been of invaluable help to him. Like the elephants in Zimbabwe leaning against the fences of the airports, he had leaned against the Steering Committee for help, but on this occasion there was no damage.

He indicated that BSCE was happy to see new faces at the meeting, but also missed familiar faces. At the beginning of the meeting he had been informed that Dr. Schabram from the German delegation had passed away immediately after the last meeting. He had had telephone calls from Colonel Schneider, Denmark, and from Lars-Olof Turesson, Sweden, that they were sorry not to be able to attend the meeting, and he knew that Roxie Laybourne, John Seubert, USA, and Tim Brom, The Netherlands, likewise deplored that for different reasons they had not been able to attend the meeting.

In declaring the meeting closed, he finally indicated that in his opinion the 20th meeting had been a very successful meeting.